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THE PERFORMANCE MEASUREMENT IN PUBLIC SECTORS: FOCUSING IN THE PERFORMANCE MEASUREMENT IN A THAI PUBLIC ORGANIZATION

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ABBREVIATIONS AND ACRONYMS

BIOTEC	National Center for Genetic Engineering and Biotechnology Center
CSIRO	The Commonwealth Scientific and Industrial Research Organization (Australia)
GAO	The General Accounting Office (United States)
GPRA	Government Performance and Results Act
ISS	Institutes of Social Studies
MOSTE	Ministry of Science, Technology and Environment
MTEC	National Metal and Materials Technology Center
NECTEC	National Electronics and Computer Technology Center
NSF	The National Science Foundation (United Sates)
NSTDA	The National Science and Technology Development Agency (Thailand)
NUFFIC	Netherlands organization for international cooperation in higher education
OMB	Office of Management and Budget
PBB	Performance-Based Budgeting
PBM SIG	Performance-Based Management Special Interest Group
PPA	Public Policy and Administration (Master Course)
R&D	Research and Development
S&T	Science and Technology

Chapter 1

Introduction

1.1) Introduction and General Background

The world today is facing the problem of scarcity of resources. Due to the scarcity of resources together with the trend of good governance, accountability, and new public management, there is increasing demand to restructure and reform public sectors. The governments around the world try to find ways to improve their public sectors' performances through meaningful reforms (i.e. administrative reform, decentralization). Performance measurement is perceived as one important strategy to improve government productivity because it can show how well the public sectors can perform and whether or not they still need to improve their capacities. Performance measurement is a broad concept covering many concepts and frameworks. A lot of effort has been spent in order to find the best methodologies which can give the precise measurement of public sectors' performance.

1.2) Background of Performance Measurement for Thailand Case

Thailand, due to increasing financial problems from economic crisis, also emphasizes in its public sectors' performance improvement as one of the criteria for allocating the budget. Thai public sectors have to find the way to improve their performance. Many of them agree that performance measurement is a crucial way to achieve that goal.

The National Science and Technology Development Agency (NSTDA) is an autonomous government agency in Thailand working under the Ministry of Science, Technology and Environment (MOSTE). It missions range from raising the technological capabilities of Thai productive sectors, helping to solve socioeconomic problems through science and technology, promoting the development of science and technology human resources, to initiating and strengthening science and technology infrastructure and knowledge.

NSTDA is an autonomous agency which has a management system different from the usual Thai bureaucratic system. Every year, it has to report how well it performs in order to request for a new budget. Therefore, the organization's executives pay high attention to development of effective performance measurement.

The performance measurement in NSTDA is divided into monitoring and evaluation stages. There are a lot of performance indicators which are designed to cover all aspects of its activities in different phases from input, output, outcome and impact. Some examples of

performance indicators being used to measure the performance of NSTDA are: 1) number of scientist and technical staffs in NSTDA, 2) amount of funding in research and development (R&D) projects, 3) number of R&D projects getting patented, 4) number of companies using NSTDA's consulting services, number of students getting scholarships from NSTDA, etc.

1.3) Statement of Research Problems

In theory, there is no doubt among experts about the usefulness of performance measurement in improving a public organization's performance. In reality, the result hardly lives up to expectations. The problems are mostly found when an organization has to design its performance measurement system and develop its performance indicators.

There are various models of performance measurement in the public sector. There are many studies and much research aimed toward finding a model which can give the best answer of 'how well the public sectors perform'. However, there are increasing questions about the standardization of performance measurement in the public sector as well as the best model of performance measurement which will eventually improve productivity of the organization.

Performance measurement is a broad concept and apparently tricky. It depends on an organization's perception and interpretation of its missions and performance. Sometimes the performance measurement is nothing more than the 'looking good' information with a lot of nice figures without any contribution towards the performance improvement of the organization. So it is very interesting to further explore the field of effective performance measurement in public organization as well as the discussions on effective performance indicators.

Other problems which are commonly found in the area of performance measurement in public sectors are difficulties to find satisfactory measurement criteria which reflect the relationships among inputs, outputs, and outcomes; more requirements for a wide variety of measures because performance in the public sector has many dimensions; performance measurement has a cost, takes time, efforts and resources.

In the case of NSTDA in Thailand, the trend of increasing accountability in the Thai public sector has led the development of its performance measurement. However, there are some problems found in its performance measurement system which are not far from problems generally found in performance measurement elsewhere. The problems in NSTDA's

performance measurement are the complexity of its performance indicators, the difficulties to design good performance indicators, as well as the difficulties of getting reliable information. The effectiveness and usefulness of the presented performance measurement is widely discussed.

1.4) Research Questions

This paper aims to study performance measurement in public sectors focusing on the case study of a Thai public organization, NSTDA, on its performance measurement and its performance indicators. In this study, I will also draw some lessons learned from the experiences in performance measurement of public organizations in other countries. Hence, the paper aims to find the answers for these questions:

1) Is the performance measurement of NSTDA effective? To what extent does it conform to theories and frameworks? How relevant are the performance indicators of NSTDA to its mission?
2) What are the limitations and problems found in NSTDA's performance measurement?
3) To what extent are the performance measurement and performance indicators in NSTDA different or similar to other organizations? What are the lessons arising from studies about performance measurement and performance indicators in such organizations?

1.5) Conceptual and Analytical Framework

Performance measurement concept was originally used among private sectors as a way to improve their productivity. Due to the increasing demand for public sectors to improve their performance, this concept was widely applied to more and more public organizations. However, because of the different characteristics of private and public sectors, there are some differences in their performance measurement. This study is focus mainly on the performance measurement within the public sector.

There are various models of performance measurement in public sectors. The three models that are widely used among many public organizations are input-output model, the traditional 3Es model which refers to efficiency etc, and balanced scorecard model. They are different in terms of criteria of measurement. These various models will conform the analysis of this paper. Another concept which will be used as a framework for this study is the performance indicator. It is the indication data which will tell how well and at which degree the organization can perform. To develop the performance indicators is related to the model of

performance measurement an organization selects to use. It is accepted among organizations that good performance indicators are difficult to design, especially for public organizations.

Finally, there is an interesting concept mentioned that organizations differ in some characteristics. These different characteristics effect designing, shaping, and implementing performance measurement in the organizations. This study will also explore this concept in order to understand the factors effecting an organization's performance measurement.

1.6) Research Objectives

As mentioned above, this paper aims to study performance measurement in public sectors focusing on the case study of a Thai public organization, NSTDA, its performance measurement and its performance indicators. The objectives of this study are:

1) Finding out the criteria for effective performance measurement for a specific public organization (NSTDA).
2) Analyzing the organization's performance indicators and finding out the effective ones which are relevant to the organization's mission and have significance in showing how well the organization performs.
3) Finding out the limitations and constraints of performance measurement in a public organization and justifying recommendations to improve its performance measurement.
4) Learning from some similar organizations in order to find some good models which can be adjusted to NSTDA's performance measurement system.

Above all, as illustrated by Peter Drucker that "If you continue to measure your performance in the same old ways, you will continue to perform in the same old ways"[1]. This paper is expected to contribute some improvements to NSTDA's performance measurement which will eventually move toward the goal of improving the organization's performance.

1.7) Research Methodology

This research is an exploratory study of a Thai public organization (NSTDA). I will further explore a few cases of some other countries' experiences in performance measurement of public organizations. Due to the fact that the researcher has direct experience and a special interest in science and technology organizations, the targeted organizations for this study are

[1] www.cmps.gov.uk/excellence/Kpool/Crit00/00-01.doc

mainly science and technology public organizations. The research will be descriptive and analytical based on the secondary data which were mainly gained from observation of the organizations data (documents published by various organizations and websites).

1.8) Sources of Data

The research paper will rely on the collection and analysis of secondary data and literature available from these sources such as libraries and the organization's websites and documents published by various organizations (annual reports, monthly report, etc). Websites about performance measurement and performance indicators as well as the researcher's own experience as the policy and planning officer in NSTDA (having direct responsibility for organizations performance measurement and performance indicators) will be useful to deepen the insights in this study.

1.9) Limitations of Study

There are some limitations for this research paper. First, there are not adequate time and financial resources to do field visits in the case study organizations. Second, this study is mainly based on observation of secondary data which may not be adequate for in-depth analysis.

1.10) Organization of the study:

This study is structured into five chapters:

Chapter One is basically introductory containing statement of the problem, objectives of the study, as well as the methodology of the research.

Chapter Two presents the conceptual framework about performance measurement.

Chapter Three shows two case studies of the performance measurement in similar organization in other countries.

Chapter Four gives an in-depth analysis about performance measurement in a Thai public sector.

Chapter five sums up various conclusions of the study besides making suggestions and recommendations.

Chapter 2

Conceptual Framework for Performance Measurement in Public Sectors

The emphasis in this chapter is mostly on theories and conceptual frameworks of performance measurement. It will bring out the various points of view on definitions, concepts, methods, benefits and practical problems of performance measurement in order to select the appropriate ones for assessing the case studies in the next chapter.

2.1 The Definition of Performance Measurement

There are various definitions of performance measurement such as: The ongoing monitoring and reporting of program accomplishments, particularly progress towards target goals which is conducted by program or agency management (GAO, 1998). Parker (1993) defines it as a systematic attempt to learn how responsive a government's service is to the need of the state and the state's ability to pay; and the public sector's way of determining whether it is providing a quality product at a reasonable cost. Holzer & Callahan (1998) define it as a set of tools that are developed for making better decisions within public organization.

2.2 The Differences of Performance Measurement in Public and Private Sector

There are some differences in performance measurement between the public and private sectors. Blank (2000) points out that it is according to some special characteristics of the public sector such as: it is large and growing; its entities are owned by public; it seeks to maximize service provision from given resource; the resource (budget) constraints and limitations lead the public sector to be utility-seeking, budget maximizing and satisfying self-serving objectives.

Carter *et al.* (1992) mentions some differences in public and private sector's performance measurement as:

1. Because private sectors possess the bottom-line profit, their performance measurement is straightforward.
2. Public sector organizations normally operate under particular social and political pressures which means that public sector organizations pursue political and social goals rather than simple commercial objective. Many of them do not trade in the market.

Apart from that, the public sector is constrained to work within their authorized missions and aim to fulfilling their charter of mission, some of them are even prohibited from direct

competition with the private sector in providing products and services (Arveson, 1999). Rosen (1993) points out further that measuring the productivity of private sectors is much easier than in the public sectors because in private sector, outputs are often the goods that can be counted. Even private sector services, which by themselves are difficult to quantify, can be measured because those services are for sale and can be counted by the value of money they trade with. Smith (in Hollaway *et al.*, 1995) mentions that public sector and not-for-profit agencies have always posed particular problems of organization control not found in the private sector as:

- The difficulty of securing a consensus as to what output and objectives of such organization should be.
- The difficulty of measuring such output and the eventual outcome of public sector intervention.
- The difficulty of interpreting any output and outcome measures that can be developed.
- The difficulty of persuading citizens to take any interest in performance measures or their interpretation.

Due to these differences, complexities, and difficulties in performance measurement which emerge from some special characteristic of public sectors, there is increasing interest to find efficient ways to measure the performance of the public sector.

2.3 The Rationale for Performance Measurement in Public Sectors

Due to the trend of democracy and accountability, governments around the world are facing increasing pressure from society to answer regarding their performances and productivity. Greiner[2] mentioned that the economic and social change and increasing international competition are intensifying demands for eliminating the 'fat' in government budgets and accounting for those revenues that are provided. A great consciousness of tax burdens and policy has resulted in a desire to not only prioritize service based on need and demand, but also to assure that the resources put into services are used to the best advantage (Parker, 1993). Citizens demand greater accountability for the resources they commit to government. These types of accountability issues are the major forces behind the movement toward measuring performance. The implication is that for better decision-making, accountable management, and motivation of managers, performance must be measured.

[2] in Halachmi & Bouchaert 1996.

Because of the growing emphasis on controlling cost, maintaining accountability, and reducing the size of government, performance measurement has become a priority in many state and local agencies (Holzer & Callahan, 1998). Rosen (1993) points out that without performance measurement, it is impossible to ascertain to know how an agency is doing. Performance measurement is essential in targeting productivity problems, identifying models of good performance, spotting trends, and judging the success of initiatives to improve productivity (ibid.)

Osborne & Gaebler (1993:147) describe the rationale for performance measurement in the government as simply as:

> *"what gets measured gets done.....if you don't measure result, you can't tell success from failure; if you can't see success, you can't reward it ; if you can't reward success, you are probably rewarding failure; if you can't see success, you can't learn from it; if you can't recognize failure, you can't correct it; if you can demonstrate results, you can win public support...."*

2.4 The Benefits of Performance Measurement for Public Sectors

Parker (1993) mentioned some benefits of performance measurement for the public sector. It enhances decision making, improves internal accountability, enhances public accountability, supports strategic planning and goal settings, and allows entities to determine effective resource use. It allows policy makers, agency directors, program managers, legislators and the general public to evaluate the effectiveness of government programs.

Performance measurement helps the public sector to formalize its process of tracking progress toward established goals and provides objective justifications for organizational and management decisions; helps the organization to set its goals and standards, detects and corrects the problems, manages and improves processes; helps to improve the quality and cost of government activities[3]. Roger (2001) mentions that performance measurement helps the organization to diagnose how to get the optimum value of a set of activities and decisions and that it drives the continuous improvement in the organization. Performance measurement provides government and public sectors with the information about how well they can perform, with a means of keeping score on how well their various departments and operations are doing (Holzer & Callahan, 1997)

[3] www.orau.gov/pbm/links/npr2.html

PBM SIG (2001) mentions the benefit of performance measurement as it provides a structured approach for focusing on a program's strategic plan, goals, and performances. It also provides a mechanism for reporting on program performance to upper management. It helps the organization to focus its attention on what is to be accomplished and concentrated in order to achieve objectives. Moreover, it improves the management and delivery of products and services of the public organization. It helps improving communication internally among employees as well as externally between organization and its customers and stakeholders. It also helps the organization to justify their activities and costs. At the same time, it also helps the public sectors show their accountability to society and taxpayers. It helps the organizations to set their goals and standards, detect and correct their problems, manage and improve their processes, determine whether they are fulfilling their vision and meeting their customer-focused strategic goals.

2.5 The Methodology of Performance Measurement in Public Sector

It was already mentioned that the performance measurement methods being promoted for public sector use have been primarily developed in private sector contexts. However, the methods require adaptation for use in assessing the performance of governments, administrative components of governments and government programs (Nakamura, and Warburton, 1998). This refers to what was already mentioned above about the different bottom-line of public sectors and private sectors. The bottom line of public sector is not straightforward to maximize profit like the private sector and mostly deal with the tasks of service delivery to the public. Thus, it is rather more complicated to measure the performance in public sector than the private sector.

The aim to measure the performance of any organization is to find the answer for the question "how well is the organization in achieving its missions?", and to find the way to measure the performance of the organization is to answer the question "how do we know how well the organization is doing?"(Arveson, 1999). From exploring various sources about performance measurement, it can be summarized that there are two frameworks that are widely accepted and used among government agencies elsewhere. One is the fundamental concept framework which aims to measure performance from its beginning to the ends or as being known as "Input-Output Model"(Carter *et al.* 1992). There are many alternatives for this model given by various authors as can be shown in the table below:

Table 2.1: Alternative model of "Input-Output" Model

Input Process Output	Input Output Impact	Input Activity Throughput Consequence	Input Intermediate Output Throughput Output Outcome	Input Process Output Outcome Impact
Butt & Palmer (1985) CIPFA (1984) HM Treasury (1986a,1987)	Audit Commission (1986)	Levitt and Joyce (1987)	Flynn (1986)	PBM SIG (2001)

Source: Adjust from table in Carter et al., 1992:36

The difference between each alternative above is the definition given for each stage of performance which, however, does not make one model much different from the other. The difference in definition depends on an author's perception and interpretation for the stages of performance. An example of a clear definition for these terms of measurement is given by PBM SIG (2001). It defines 'input' as the measurement which aims to measure the human and capital resources used to produce the outputs and outcomes. For 'process', it aims to measure the intermediate steps in producing a product or service. 'Output' aims to measure the product or service provided by the system or organization and delivered to customers. 'Outcome' aims to measure the expected, desired, or actual results to which the outputs of the activities of a service or organization have an intended effect. Finally, 'impact' measures direct or indirect effects or consequences resulting from achieving program goals.

Another famous concept to measure the performance of the public sector is the traditional 3Es (Mayne & Zapico, 1999) which are 'economy, efficiency, and effectiveness'. This concept has gained wide interest from all levels of government during 1980 in England. In some sources, there is also the reference to the additional "E"s as the equity and efficacy (Carter *et al.*, 1992). The definitions for each measurement can be summarized according to some definition givens by a few authors (Flynn, 1997; Carter *et al.*, 1992; Osborne & Gaebler, 1993). 'Economy' is the performance measurement which looks at how much the resource is used up by the public organization over a period (Flynn, 1997). In term of 'efficiency', Carter *et al.* (1992) defined it as the ratio of inputs to outputs or the rate at which inputs are converted into outputs. Flynn (1997) described and defined it a little bit further as productive efficiency and allocative efficiency. 'Productive efficiency' can be measured by the average cost of producing goods and services and is commonly measured by volume of services or products received. 'Allocative efficiency' is measured by looking at whether the organization produces the range of services which reflects the preferences of the citizens that they

represent. It reflects the distribution of resources. It can be seen as the two-sided coin as to get maximum output from the given input, or do you get a given output from a maximum input (Middleton, in Carter *et al.*, 1992). 'Effectiveness' is a measure of the quality of that output, or to find how well it achieves the desired outcome (Osborne & Gaebler, 1993). There must be the agreement on what a desired outcome is. For the additional Es, Flynn (in Carter et al., 1997) gives the definition of 'equity' as the performance measurement which focuses at the extent to which services are allocated equitably, and 'efficacy' as the impact of organization's performance to the society. This concept of performance measurement can be shown as the figure below:

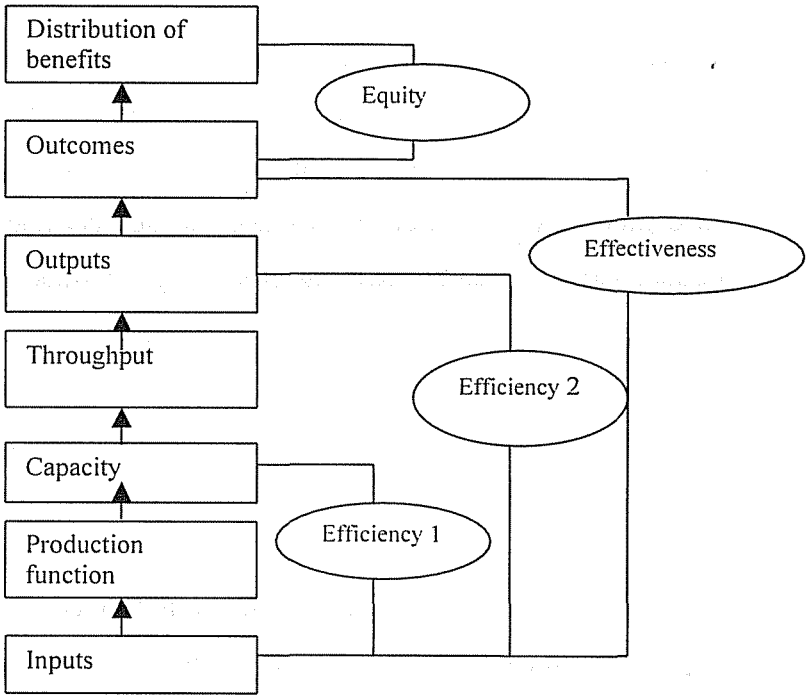


Figure 2.1: Elements of performance measurement (Flynn, 1997)

For the aspects or dimensions to measure, there is also a concept borrowed from the private sector which is known as "a Balanced Scorecard". It refers to a combination of the different types of measures that set out in the performance measure in order to ensure a rounded picture of the service[4]. This Balanced Scorecard concept was developed by Kaplan and Norton in the early of 1990s and was broadly used in many international private sector companies (ibid.). This concept suggest that any service may be measured in terms of a number of dimensions a typical private sector organization might wish to consider such as the Customer Perspective, the Internal Business Process Perspective, the Financial Perspective, and the Continuous Improvement Perspective (figure 2.2).

[4] www.audit.scotland.gov.uk/publications/pdf/ms99_01.pdf

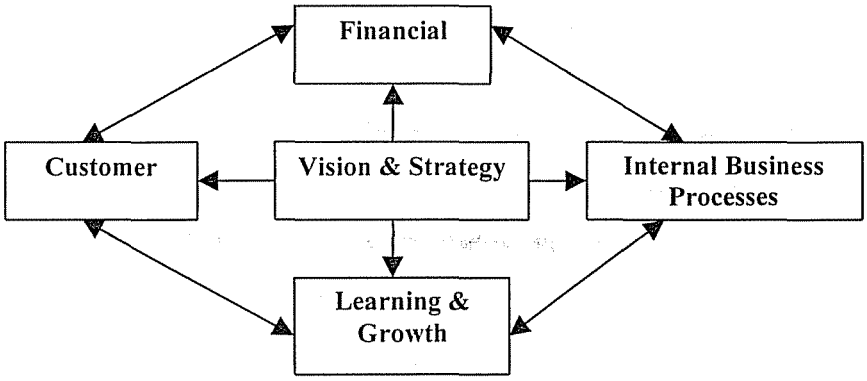


Figure 2.2: Balanced Scorecard Performance Measurement framework
(Source: http://www.audit.scotland.gov.uk)

When this approach is applied in the public sector organization, each of its perspectives can be described as:[5]

1) The customer perspective: because the public sector organizations exist to provide services which meet the needs of their customers (they can refer to citizen, consumer, or clients or service users). For this perspective, the performance measures would be able to assess customer or stakeholder expectations, perceptions and level of their satisfaction.
2) The internal business process: to provide quality and cost-effective services, public organizations must be able to identify the key business they need to be good at and then measure its performance in undertaking those processes. This perspective encourages managers to identify what the key business processes are, in the context of overall strategy, to assess current performance and establish targets for improving performance.
3) The learning and growth perspective: to achieve continuous improvement in delivering quality and cost-effective services, a public organization needs to ensure that it is able to learn and improve from both an individual and organizational perspective. It is important to measure the organization's ability to learn, to cope with chance and to improve through its people, its systems and infrastructure.
4) The financial perspective: The public organizations will continue to require key measures of its financial performance but these need to be linked with overall goals of the organization.

[5] www.audit.scotland.gov.uk/publications/pdf/ms99_01.pdf

In this concept, Kaplan and Norton stressed that the Balanced Scorecard needs to be developed and derived from the organization's vision and priorities[6]. It is a supplement to traditional financial measures of performance with measures that assess performance from these additional perspectives. It helps the organizations monitor their overall strategic performances. The additional or alternative perspectives may be required when apply this concept to measure the performance in particular organization in order to achieve their specific goals of performance.

Because organizations are all different, there is no universal standard for measuring the performance of organizations, especially for the public sector (Mayne & Zapico-Goni, 1999). There are many efforts and studies that aim to find the most effective ways to measure the performance measurement in public sectors. Therefore, there are various concepts about how to measure the performance in the public sectors. The important point is that the organizations or the agencies have to decide on the most appropriate which fits into their own contexts and purposes. Halachmi & Bouckaert (1996) mention that a proper performance measurement requires a thorough understanding of the end user and the intended use of the data which means a good performance measurement should match the perspective for taking the measurements with the purpose for which the measurements are taken. The good performance measurements should be geared to meet specific needs of specific users (ibid.).

Performance Indicators

When studying performance measurement, one also has to consider performance indicators. The Performance indicator helps us to define a clear measurement concept that we are trying to find. A performance indicator is a policy relevant statistic, representing a number of qualitative descriptions which provide an indication that the organization is performing as it should[7]. It can be indicative, suggestive, or diagnostic (Carter *et al.,* 1992). Flynn, (1997) mentions that performance indicators can have two managerial uses as a part of the control system (punish bad performance and reward good performance); and a part of the process of finding out better ways of managing.

Developing performance indicators depends on the framework of performance measurement that the organization chooses. If an organization chooses to follow the traditional 3Es model, its performance indicators will be selected to show each category of measurement criteria

[6] ibid.
[7] www.orau.gov/pbm/links/npr2.html

(economy, efficiency and effectiveness). It is difficult to set the universal standard for developing performance indicators for every public sector. We have to search through the mission and vision of each organization and define what is the product or service of that organization, what are the desired outcomes, and which processes deliver those outcomes. They cannot be straightforward. The manager of each public organization would have to design measurement, set up the data source and implement it.

For the input-output model, the performance indicators can be categorized as Macpherson (2001) who also clarified the performance indicators for a generic process as shown in figure 2.3.

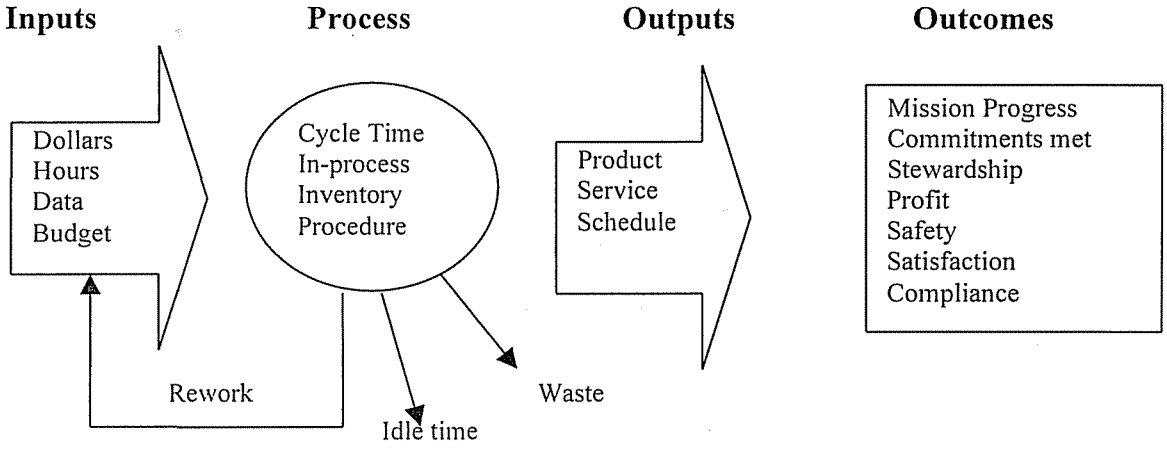


Figure 2.3: performance indicators (Source: Macpherson, 2001)

For the performance indicators which are according to the 3Es models, it can be clarified as: *(*Carter *et al., 1992)*

- Economy: The performance indicators that measure how actual input costs compare with planned or expected costs. Generally, this performance indicator focuses at the budget process, as the purchase and provision of services at the lowest possible cost with a specified quality which should be an objective of any public sector service.
- Efficiency: The performance indicators that measure the ratio of inputs to outputs, or the rate at which inputs are converted into outputs.
- Effectiveness: The performance indicators which measure the ratio of output with planned output or measure how far the output achieves organization's objective.

Traditionally, most performance indicators in public sectors are designed in quantity aspects of measurement and ignore the quality aspect. There is a criticism especially for performance indicators generated by the 3Es model that they tend to ignore the quality aspect of service delivery because of difficulties in defining and constructing the quality indicators. (Carter *et al.*, ibid.) . There have been considerable efforts that try to find ways on how to measure the quality of public sector's performance. One of them is by Rosen (1993) who mentions the way to measure quality in public sector by asking the group of people (customers) to give their opinion of what the good quality of that service should be and then select the best and most important indicators. Each kind of output and service is qualified by its own particular, customized set of indicators. The quality of performance indicators may be reflected in figures such as the number of customer complaints, and the number of activities that have to be redone because of error. Quality data can be also obtained from user surveys (ibid.).

Good performance indicators are very difficult to develop and it is not an instant process that can be finished in a short time. There are some essential characteristics of good performance indicators which are mentioned by Rosen (1993) as:

1) Validity means it really measures what it ought to measure.
2) Reliable means it is consistent, giving the same readings at different times or by different measures.
3) Clarity means it is clear and understandable.
4) Relevance means it can provide information needed to make decision about the performance of the agency.
5) Controllability means the person or group being measured should have control over all aspects of performance that make up the measure.
6) Accurate means the indicator has no built-in bias or distortion.
7) Sensitivity means the indicator can capture the variation that occurs in the object, event, or situation being measured.
8) Affordable means the indicator is not prohibitive in cost or effort.

2.6 The Problems and Limitations of Performance Measurement in Public Sector

The performance measurement in the public sector has some limitations and problems. Mintzberg (Blank, 2000:10) points out "the myth of measurement":

"...many activities are in the public sector precisely because of measurement problems; if everything was so crystal clear and every benefits so easily attributable, those activities would have been in the private sector long ago..."

PBM SIG (2001) mentioned some limitations and problems mostly found in the performance measurement are indicated as:

1) Limitations in performance measurement:

- The cause and effect of outcome are not easily established.
- Poor results do not necessarily point to poor execution.
- Numerical quotas do not fix detective process.
- Measurements only approximate the actual system.
- Performance Measures do not ensure compliance with laws and regulations.

2) Problems mostly found in performance measurement in the organization:

- Amassing too much data which make the manager and employees either ignore the data or use it ineffectively.
- Focusing only on short-term performance indicators and ignore the long-term measures.
- Failing to base decision-making on the data.
- Collecting inconsistent, conflicting, and unnecessary data.
- Establishing unrealistic and/or unreasonable measures.
- Failing to link measures.
- Measuring process too often or not often enough and sometimes, measuring too little.
- Ignoring the customer or important stakeholders.
- Confusing the purpose of the performance measurement system.

Roger (2001) also mentioned in his work some limitations such as the fact that it is often not easy to sell the idea of performance measurement to the public sector. Performance measurement does not guarantee that the public sector managers will use the result to improve their performance. They may continue with their old, comfortable, preferred, wasteful practices.

Rosen (1993) pointed out some limitations which can occur in the performance measurement that uses a single criterion as such may motivate the workers to complete that single criterion but spend less time on completing their whole job. Multiple measures, on the other hand, can also create confusion.

2.7 The Factors effecting public sector performance measurement

There are some factors that effect and influence the performance measurement of the organization. Carter *et al.* (1992) points out some factors where organizations differ and how they effect and shape performance measurement of the organizations. These factors are ownership, trading status, competition, accountability, heterogeneity, complexity and uncertainty. Ownership is the way to observe the location of organization whether it is purely public or mix hybrid or jointly owned enterprises. Trading status is looking at whether they are located in the tradable or non-tradable sector of economy which from this point will shape different performance indicators for the organization. Next is the degree of competition, the number of organizations providing similar products of services and their share of the market that will shape the organization's performance indicators to concentrate on the effectiveness of the services provided to customers. The accountability concerns the extent to which an organization is politically accountable which lately, obviously, takes the form of the various requirements to account for performance measurement in most public sectors. The degree of 'heterogeneity' within the organization is another factor that shapes the design of performance measurement in the organization. The degree of 'complexity' means the extent to which an organization has to mobilize a number of different skills in order to deliver its service or produce its goods. Apart from that, the organization may also vary in the degree of 'uncertainty' of the relationship between means and ends or the relationship between the input of resources and the achievement of stated objectives.

Moreover, Carter *et al.* (1992) also refers to two other dimensions of the organization that may influence to the effectiveness of performance measurement. First is the structure of authority - the institutional relationship between the center and periphery – which may vary in the extent to which the organization's institutional structure allows the center to exercise direct control over the periphery. Second is the autonomy of the actors within an organization which may vary in the degree of autonomy enjoyed by actors within them.

2.8 The Science and Technology (S&T) Public Organizations and their Performance Measurements

In the present world, we cannot deny the importance of S&T to our society. It is perceived as one factor enabling a country to compete in the world market. It is accepted as the factor linked to economic growth development of the country. More and more, both in developed countries and in developing countries, there are increasing numbers of S&T public

organizations. Some of them, especially in technology advanced countries, are conducted by the private sector. Some of them, especially in developing countries, are still run under the supervision of the government and receive most of their budget from the government. The amount of budget the government spends for this institution is counted as the indicator which is significant for the country's development capability. Therefore, there is an increasing budget amount that the government spends in these S&T public organizations each year which raise questions from the public about their performance and their impact of them toward the society.

The same as other public organizations, the S&T public organization has to focus on its output, outcome and impact in term of performance measurement. Moreover, it also has to find the standpoint of its performance as the organization which aims to promote the development of S&T in the country. Teather & Montague (2000) mention that "for major S&T organizations and at the national level, there is a clear requirement to link program impacts to government S&T policy objectives". Therefore, the performance framework of the S&T organization is relevant to many levels of management and S&T decision making. Generally, the focus is primarily on resource management and delivery with some reference to immediate impacts (ibid).

Teather & Montague (2000) developed the performance framework for S&T public organization. This framework leads analysis beyond the natural tendency to focus on immediate direct impacts of each innovation to an examination of a broad range of benefit and long-term impact. This performance framework approach requires the collection and analysis of performance based information in terms of resources, reach and results which can be shown as table 2.1 below.

Table 2.2: S&T Performance Framework (Source: Teather & Montague, 2000)

How?	Who? Where?	What do we want?	Why?
Fundamental research	Science Community	Advance knowledge	Wealth creation, public health, security, and environment protection
Applied research, development, and technology transfer support	Specific public and private users	Technology adaptation, adoption, development, and exploitation (In support of public missions as well as private benefit)	
Innovation system support	Industry groups sectors and consumers	Improved innovation speed and efficiency and reduced market transaction costs	

Science and Technology Performance Indicators

Because of the S&T organization is complicated in terms of its products and services, there are also many efforts to develop common performance indicators for S&T public organization. The common indicators that were used by many science and technology organizations are as follows:

Table 2.3: S&T Performance Indicators

Type of Indicators	Quantitative Measurement	Qualitative Measurement
1) Input	1) Funding (percentage or amount of government funding, Percentage or amount of mutual funds from industrial sectors, Percentage or amount of mutual funds from other cooperative organization or academic institutions, foreign fundings 2) Manpower (number of scientific manpower, number of technical staff, number of administrative or support staff) 3) Instruments (infrastructure, instrument, etc.)	
2) Output	1) Patents (number of patents) 2) Literature (paper published) 3) Human resource development (number of training, number of funds giving to students)	
3) Outcome	Patent used, citation, number of scientist in industry,	Management capacity
4) Impact	urbanization, energy saving , capital saving	Public attitude toward science and technology, national science and technology strength and weakness

Source: adapted from Morita-Lou, 1985:18

In my opinion, these S&T indicators are by no means different from other conceptual frameworks of performance measurement that I mentioned at the beginning of this chapter. The most important point is that these indicators should link with organization's objectives and missions. In each organization, the objectives, missions, contexts and factors are all different.

The organization needs to design its performance measurement in a way which relates and fits for the particular circumstances. These S&T performance indicators will not contribute to performance achievement of S&T organization if they are just being put there without any relevance to the organization's objectives and missions. Perhaps, they are useful for

comparing with other international S&T organization or as a guideline to design performance indicators for other similar organizations.

However, measuring the performance in the S&T organization also has some limitations because most of the activities in S&T organization are in the area of R&D. PBM SIG (2001) pointed out some limitations to measure R&D activities which are the main product of S&T organization: outcomes could not be quantified in advance; knowledge gained or results from the research are not always of immediate value or application; research projects mostly take time and results are unpredictable; there is high percentage of negative determinations or findings; there are a lot of unknown factors which cannot be measured.

2.9 Conclusion

Scarcity of resources as well as emerging trends of good governance and accountability have led to the increasing demand for performance improvement in public sectors. Performance measurement is perceived as one of the important strategies to improve performance and accountability in the public sector. There are various concepts for performance measurement and performance indicators. However, there is no universal one which can apply with all public organization because organizations are different. Every organization has its own objectives and factors which effect and shape its performance measurement and performance indicators. The frameworks which are widely used among public sectors are input-output model, 3Es mode, and a Balanced Scorecard model.

To design and select a performance measurement framework which fits an organization, one should consider the intended uses and end users of performance measurement information. There are some organizational characteristics which effect the design and implementation of performance measurement in the organization. These are ownership, trading status, competition, accountability, heterogeneity, complexity and uncertainty.

Lately, in the era of S&T development, there is an increasing number of S&T public organizations around the world. These S&T public organization are also facing questions from society and the government about their performance and their accountability and are trying to find the performance measurement and performance indicators which can best reflect their performance. There are ongoing efforts in trying to find the performance indicator specifically for these S&T organizations.

Chapter 3

Lessons Learned from Performance Measurement in Public Sectors in Other Countries

Performance Measurement is not new. It has existed a long time in the private sector since organizations and firms adopted the mechanism to monitor their own performances for internal and external uses. Later, the public sector adopted this concept to use it as a tool for improving their productivity. In this chapter, two case studies of performance measurement in S&T public organizations in other countries (Australia and U.S.) will be observed. The reason for choosing S&T public organizations because the analysis of this study will be done in a Thai S&T public organization. The lessons learned from this chapter are expected to be relevant for the analytical section in the following chapter.

3.1 The Commonwealth Scientific and Industrial Research Organization (CSIRO) and its Performance Measurement

3.1.1 Overview of CSIRO[8]

CSIRO is Australia's Commonwealth Scientific and Industrial Research Organization. It is perceived as one of the world's largest and most diverse research institutions. It is an independent agency operating under the Science and Industry Research Act 1949. It aims to produce the works that touch every aspect of Australian life. Its work varies from the molecules of life to the molecules in the outer space. It aims to find ways to improve quality of life and economic performance of Australia by S&T.

CSIRO's primary functions (according to the Science and Industry Research Act 1949, Section 9) are:

1) To carry out scientific research for the purpose of assisting Australian industry, furthering the interests of the Australian community, contributing to the achievement of national objectives or the performance of national and international responsibilities.
2) To encourage or facilitate the application or utilization of the results of scientific research.
3) To carry out services, and make available facilities, in relation to science.

The secondary functions of CSIRO which are specified in the Act include international scientific liaisons, training of research workers, publication of research results, and dissemination of information about science and technology.

[8]Source: www.csiro.com.au/index.asp?type=aboutCSIROIndex

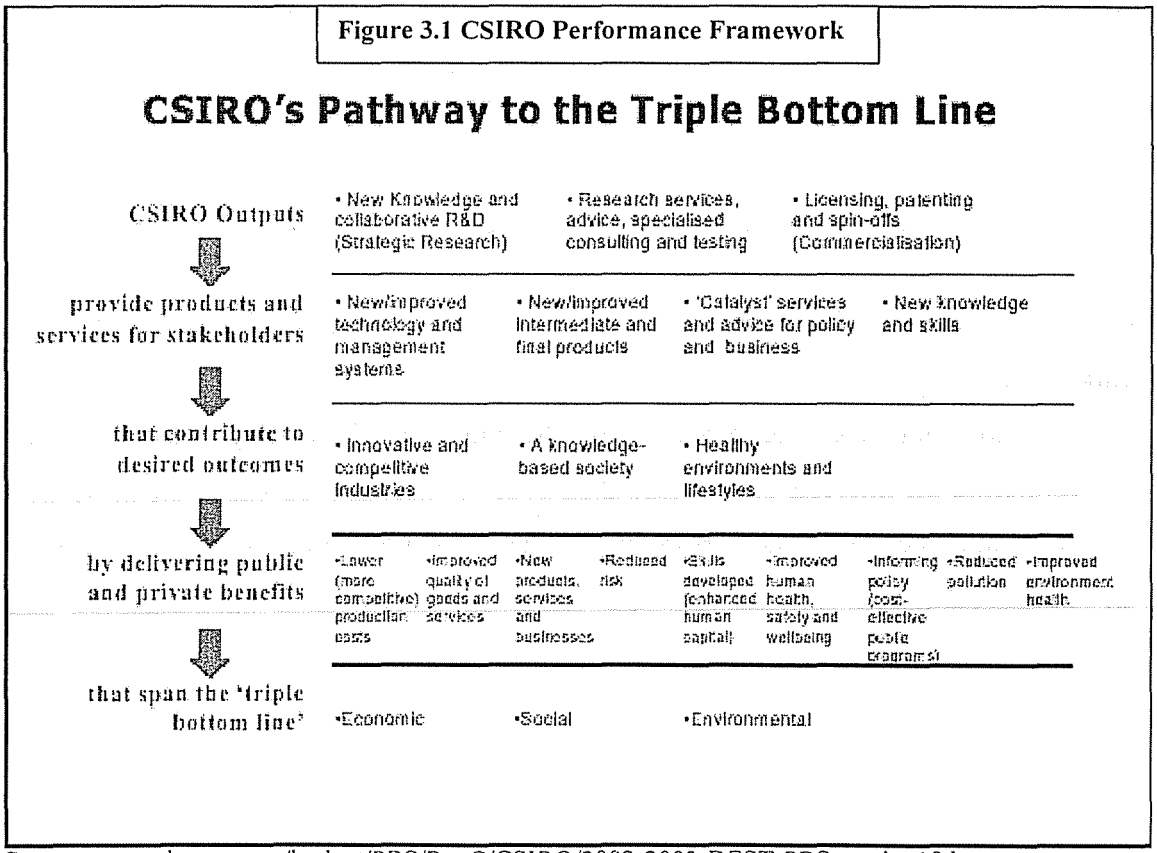
Vision: to be a world class research organization vital to Australia's future

The organization has 6,500 staff members performing R&D activities over a broad range of economic and social issues including agriculture, minerals and energy, manufacturing, communication, construction, health, and the environment. The purpose of CSIRO is to deliver the science and innovative solutions for industry, society and the environment. The organization is composed of 22 sectors covering the area of research already mentioned above. CSIRO's research is performed by the divisions which are the business units of CSIRO. Many of them are involved in more than one sector. By assembling the teams with the most appropriate expertise and resources across the organization, the organization is able to solve industrial and environmental problems with a multidisciplinary approach. In terms of budget, the total appropriation for CSIRO in the 2002-2003 budget is $656.829 million[9].

3.1.2 CSIRO Performance Measurement and Performance Indicators[10]

The Performance Measurement framework of CSIRO was developed to measure its performance and it is named as "outcome-and-output framework" as in figure 3.1

Figure 3.1 CSIRO Performance Framework



Source: www.dest.gov.au/budget/PBS/PartC/CSIRO/2002-2003-DEST-PBS-section18.htm

[9] 1.78 Australian Dollars = 1 Euro (November 2002)

[10] Source: www.dest.gov.au/budget/PBS/PartC/CSIRO/2002-2003-DEST-PBS-section18.htm

CSIRO's Key Performance Indicators

There are six corporate performance indicators which are shown in Table 3.1. This performance information is presented annually in the CSIRO Annual Report. It is mentioned that in most cases CSIRO's performance measurement emphasizes at its output level[11].

Table 3.1 Performance Indicators of CSIRO

Input Indicators	Sector Profile External Earnings
Output Indicators	Publications, Reports and Patents Trained Students
Outcome Indicators	Customer Satisfaction Adoption and Impact of Research and Advice

Source: www.dest.gov.au/budget/PBS/PartC/CSIRO/2002-2003-DEST-PBS-section18.htm

Descriptions of CSIRO performance indicators:

1) Sector Profile: It is the information about the shift of resources in accordance with priority decisions for three years (the change in total resourcing of research directed to each of the output groups and component Sectors). This indicator measures CSIRO's shift of resources in line with changing priorities as determined in consultation with Government, Sector Advisory Committees and CSIRO customers in the public and private sectors.
2) External earnings: The amounts and sources of external earnings for research and related services. This indicator reflects the demand for CSIRO's research and services consistent with its mission.
3) Publications: The number of patents, reports and other publications annually; quality assessment through citation analysis on a five-yearly basis. This indicator is used to assess CSIRO's ability to access the world's knowledge base.
4) Training: The number of research students supervised or co-supervised by CSIRO staff. This indicator reflects CSIRO's contribution to the development of the skills base of Australia and its own staff.
5) Customer satisfaction: This is measured by customer feedback and repeated business. This indicator relates to CSIRO's responsiveness to the needs of customers with whom the Organization has a contractual arrangement.
6) Adoption and impact of CSIRO outputs: The evidence of the utilization of research results and advice together with estimates of the consequent economic, social, environmental or policy impacts. This indicator assesses the significant impact of CSIRO's work. The indicator looks at examples within each output group – of practices, instruments, products

[11] ibid.

and processes developed by CSIRO and adopted by users in industry, government and the community, or changes in user practice in response to policy advice provided by CSIRO.

In its annual report (CSIRO, 2000)[12], CSIRO claims that its performance indicators can provide information on CSIRO's 'effectiveness' in contributing to the achievement of the government outcome, and on performance in relation to the 'price, quantity and quality' of outputs as shown in table 3.2.

Table 3.2: CSIRO Performance Indicators Categories

	Performance Indicators					
	Shift of Resources	External Earnings	Publications, Patents etc.	Research Training	Customer Satisfaction	Adoption and Impact
Effectiveness					x	x
Price	x	x				
Quantity			x	x		
Quality			x		x	

Source: www.dest.gov.au/budget/PBS/PartC/CSIRO/2002-2003-DEST-PBS-section18.htm

Effectiveness (Achievement of Outcome)

CSIRO's contribution to the outcome will be shown with evidence of economic, social and environmental benefits achieved through the adoption and impact of CSIRO research and advice. The information is gathered from project evaluations, stakeholder feedback and commissioned benefit-cost studies which include: lower (more competitive) production costs; improved quality of goods and services; new products, services and businesses; reduced risk; development of skills (enhanced human capital); improved human health, safety and well-being; informing policy (cost-effective public programs); reduced pollution; improved environmental health

Output Quantity, Quality and Price

The indicators set out below are specific indicators of output quantity, quality and price that are drawn from a larger information set developed for internal management purposes to assist in monitoring and managing performance.

[12] www.csiro.com.au/proprietaryDocuments/CSIROAnnualReport2001to2002.pdf

Output 1: New Knowledge and Collaborative R&D (Strategic Research)

Indicators	Type
Investment in strategic research business domains	Price
Publications: number by type	Quantity
Citation analysis	Quality
Post-graduate supervision	Quantity
Peer assessments/reviews	Quality

Output 2: Research Services, Advice, Specialized Consulting and Testing

Indicators	Type
Total investment in research services business domain	Price
Number of projects completed	Quantity
Proportion of projects fulfilled on time	Quality
Proportion of projects fulfilled on budget	Quality

Output 3: Licensing, Patenting and Spin-offs (Commercialization)

Indicators	Type
Total investment in commercialization business domain	Price
Licensing activity	Quantity
Revenue per license/option/assignment	Quality
Patents: - number of applications; total number of patents getting	Quantity
Patent impact index	Quality
New startup companies	Quantity
Startup company performance	Quality

Cross-Output Indicators

Indicators	Type
Customer Satisfaction – Comparative Value Rating	Quality
Customer Satisfaction with CSIRO's products/services and with CSIRO's	Quality
Awards/prizes etc	Quality

Source: www.dest.gov.au/budget/PBS/PartC/CSIRO/2002-2003-DEST-PBS-section18.htm

3.1.3 Some Observations about CSIRO's Performance Measurement:

Actually, in order to analyze performance measurement, there are many factors which have to be considered such as organizational characteristics (as mentioned by Carter *et al.*, 1992), and some internal and external factors which effect the design and implementation of performance measurement. However, due to the limitation to access all dimensions of CSIRO's performance measurement, this analysis will focus and interpret solely from the information available from the Internet source and CSIRO annual report. There are some observations that can be drawn from this information such as:

1) From generally observing CSIRO's performance measurement, in my opinion,it shows a good effort toward finding the performance measurement which best fits the

organization's missions. It is composed of various criteria of measurement (input, output, outcome, effectiveness, and quality). The indicators in each criteria of performance measurement are clearly clarified. Nevertheless, due to a lack of information from CSIRO about its intended use and end users of performance measurement (according to Halachmi & Bouckaert, 1996), we cannot summarize whether this model is fit for the purpose of performance measurement. However, due to the dimension of performance measurement, according to the concept of 'Balanced Scorecard' which suggests that the organization consider various dimensions of its service[13]. CSIRO's performance measurement indicators fall into three perspectives: financial, customer, internal business process. However, the perspective of 'learning and growth' is still unemphasized, considering its essential for internal management in order to know how effective its staff and system are.

2) In terms of the relevance of its performance measurement and organization's functions and vision, most of CSIRO's performance indicators are relevant to its primary and secondary functions. The performance indicators are designed to cover all its functions and are clearly clarified into each specific criteria such as input, output, outcome, effectiveness, and quality.
3) It is not clearly stated in the information about the criteria used to measure the adoption and impact of CSIRO. When CSIRO mentions its claimed impact, such as reducing pollution or improving environmental health, it might happen to be a result of mutual efforts by many actors or various organizations. Literally, impact measurement is very difficult especially in this S&T area where the result and impact may go beyond the scope of an organization. Thus, it is very interesting to learn about the methodology this organization uses for measuring its impact on society.
4) In my opinion, some traditional concepts of performance measurement are not in compliance with S&T public organizations which may have their own specific kind of services and products. While CSIRO mentioned its indicators as "the proportion of projects fulfilled on time" or "the proportion of projects fulfilled on budget", actually, this concept is widely used as a way to measure efficiency of performance measurement according to the 3Es model. However, for CSIRO's R&D projects, this concept does not work well. The R&D projects have many uncontrolled factors and the expected results are

[13] www.audit.scotland.gov.uk/publications/pdf/ms99_01.pdf

not easy to estimate (PBM SIG, 2000). When the projects could not be completed on time or within the budget, this doesn't mean that those research projects are not good in quality. On the other hand, even projects which are finished in time and do remain within the budget, it cannot be always said that they are good in quality.

5) The observation of CSIRO's performance measurement also can be done through the concept of characteristic of good performance indicators as mentioned by Rosen (1993) as validity, reliability, clarity, relevance, controllability, accuracy, sensitivity, and affordability[14]. From available data, I assume that most of CSIRO's performance indicators are reasonably good according to the concept. Nevertheless, there can be som doubts raised regarding some indicators, such as citation analysis in terms of its validity and controllability. In my opinion, citation cannot be a good indicator of performance achievement. It does not prove whether the project is success or to what degree the project has had an impact. It can be shown by good-manner writers but questions of controllability still remain. Doubts can also be raised as to the accuracy of peer assessments and review indicators which may have a bias in the process. However, due to the limitations in data, I could not confirm or dispel these doubts.

3.2 The National Science Foundation (NSF) and its performance measurement

3.2.1 Overview of NSF[15]

The National Science Foundation (NSF) is the leading American science and engineering enterprise. It was established under the special law, the National Science Foundation Act of 1950. It accounts for one-fifth of all federal support for basic research and 40 percent of support for basic research at academic institutions, excluding the life science. Despite its small size, NSF has a strong impact on scientific and engineering knowledge and capacity. From its five decade leading performance, NSF has shaped society and enabled the United States to become the most productive nation in history.

The Mission: To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.

Vision: Enabling the Nation's future through discovery, learning, and innovation. Realizing the promise of the 21st century depends in large measure of today's investments in science, engineering, and mathematics research and education. NFS's investment-in people, in their

[14] Meanings are clarified in chapter two.

[15] Source: www.nsf.gov,www.nsf.gov/pubs/2001/nsf0186/nsf0186.pdf, www.nsf.gov/pubs/2002/nsf02105/nsf02105.pdf

ideas, and in the tools they use – will catalyze the strong progress in science and engineering needed to secure the Nation's future.

To promote the progress of science, NSF invests in three strategic areas : People, Ideas, and Tools.[16]

1) People: by facilitating the creation of a diverse internationally competitive, and globally engaged workforce of scientists and engineers and well-prepared citizens is NSF's first priority. To achieve this goal, NSF supports improvement efforts in formal and informal science, mathematics, engineering, and technology education. NSF works to enhance the diversity of science and engineering workforce.
2) Ideas: Investments in ideas support cutting edge research and education that yield new and important discoveries and promote the development of new knowledge and techniques within and across traditional boundaries. These investments help maintaining America's academic institutions at the forefront of science and engineering. The results of NSF-funded projects provide a rich foundation for broad and useful applications of knowledge and development of new technologies. Support for ideas also promotes the education and training of the next generation of scientists and engineers.
3) Tools: NSF investments provide the tools for research and education, including instruments and equipment, multi-user facilities, digital libraries, research resources, accelerators, telescopes, research vessels and aircraft, and earthquake simulators. These tools include large surveys and databases as well as computation and computing infrastructure for all fields of science, engineering and education. Support for these unique national facilities is essential to advancing U.S. research and education.

However, NSF does not conduct research or operate laboratories by itself. Instead, the foundation is a catalyst for seeking out and funding the best ideas and most capable people, making it possible for researchers to pursue new knowledge, discoveries, and innovation. Nearly 90 percent of NSF funding is allocated through a rigorous competitive process that is critical to fostering the highest standard of excellence and accountability. NSF has been recognized as a model of administrative efficiency for low overhead costs, and the proposal

[16] www.nsf.gov/pubs/2002/nsf02105/nsf02105.pdf

review system. However, growing demands from the society to NSF requires that the organization improve its management and administrative performance in the years to come. The foundation adheres to the highest standards of management efficiency and integrity.
For its management, NSF has a strategic plan set for the organization for 5 fiscal years. NSF's strategic plan emphasizes three focal areas – people, ideas, and tools and describes three core strategies – developing intellectual capital, integrating research and education, and promoting partnerships- which together guide NSF in achieving its mission.

3.2.2 NSF Performance Measurement and Performance Indicators

For the performance management, all federal agency in U.S. have to emphasize on their performance measurement according the Act called "Government Performance and Results Act of 1993 (GPRA)[17]. For NSF, it has used the model of performance measurement developed by the Office of Management and Budget (OMB) called "performance scorecard model" which has specific indicators to reflect the agency's performance. For developing this scorecard, NSF also related the indicators to its core area and its mission and vision.

NSF's performance includes three sets of performance goals and measures: for strategic outcome, for management, and for investment process. NSF focuses its goals on long-term outcomes because they ultimately convey the value and demonstrate the impact of what NSF does for the American public. NSF's performance scorecard can be described as shown in the table below:

[17] Under the Government Performance and Results Act (GPRA) of 1993, every major federal agency must shift their focuses away from traditional concerns as staffing and activity levels and toward a single overriding issue: results. The act requires agencies to set goals, measure performance, and report on their accomplishments *(http://www.house.gov/science/gao.html)*

Table 3.3: NSF's Performance Goal Indicators

Performance Goals	Performance Goal Indicators
1) Strategic Outcome	
1.1 People – developing a diverse, internationally competitive, and globally engaged workforce of scientists, engineers and well-prepared citizens through :	The demographic data on participants in NSF-funded activities and in the science and technological workforce; quality and nature of experiences in NSF-funded activities aimed at educating the next generation of the workforce; model and practices to strengthen teacher training and classroom instruction; and student achievement; the annual and final progress reports for awards, press releases and scientific publications which show significant achievement in one or more of the following indicators :
- Workforce Development and an Informed Citizen	- The mathematics, science, and technology skills of US.students at the K-12 level and for citizens of all ages were improved - A science and technology instructional workforce which reflects American's diversity - Globally engaged science and engineering professionals who are among the best in the world - A public that is provided access to the benefits of science and engineering research and education
- K-12 Education Reform	- Over 80 percent of school participating in systemic initiative programs will (i) implement a standard-based curriculum in science and mathematics (ii) further professional development of the instructional workforce and (iii) improve student achievement on a selected battery of tests after three years of NSF support
-Teacher Development and Enhancement	- 65,000 pre-college teachers with intensive professional development experiences were provided through systemic initiative and related teacher enhancement programs
1.2 Ideas – Enable discovery across the frontier of science and engineering , connected to learning , innovation and service to society	The information on quality of outputs and outcomes, importance and impact of discoveries, introduction of new ideas, interplay of disciplinary and interdisciplinary research and balance of the portfolio; and the annual and final progress reports of awards, press releases, and scientific publications which can show significant achievement for these following indicators : - a robust and growing fundamental knowledge base that enhances progress in all science and engineering areas including the science of learning - discoveries that advance the frontiers of science, engineering and technology - partnerships connecting discovery to innovation, learning and societal advancement - research and education processes that are synergistic

Performance Goals	Performance Goal Indicators
1.3 Tools – Provide broadly accessible, state-of-the art, and shared research and education tools	The reports that demonstrate the development of new tools and technologies; multidisciplinary database; new instrumentation; shared-use facilities; development/deposition of data, research materials and other relevant products of awards in public databases, museums, or other shared repositories; and annual and final progress reports for awards, press releases and scientific publications which can demonstrate significant progress in achieving one or more these indicators: - shared use platforms, facilities, instruments, and databases that enable discovery and enhance the productivity and effectiveness of the science and engineering workforce - networking and connectivity that take advantage of internet and make information available to all citizens - information and policy analyses that contribute to the effective use of science and engineering resources
2)Management Goals **2.1 Business Practices** - Electronic Proposals Submission - Electronic Proposals Processing - Videoconferencing/Long Distance Communications **2.2 Staff** - Diversity - Work Environment	 - Percent of full proposal submission received electronically through fast lane - Number of competitions where the review process is conducted in a totally - Number of videoconference complete at NSF - Number of new-hired women staff and number of underrepresented minority groups - Development of an employee attitude survey
3) Investment Process Goals **3.1 Proposal and Award Process** - Merit Review - Implementation of Merit Review (Reviewers) - Implementation of Merit Review (Program Officers) - Customer Service (Time to prepare Proposals) - Customer Service (Time to decision) - Award Size - Award Duration - Maintaining Openness in the System	 - Percent of basis and applied research funds allocated to projects reviewed by appropriate peers external to NSF and selected through a merit-based competitive process - Use of merit review criteria by reviewers - Development of a measurement system to determine extent of program officer attention to both merit review criteria and establishment of baseline against which to measure future performance - Percent of program announcements and solicitations available at least three months prior to proposal deadlines or target dates - Percent of proposals processed within 6 months of receipt - Average annualized award size for research projects - Average duration of awards for research projects - Percent of competitive research grants going to new investigators
3.2 Broadening Participation (Reviewers)	Accomplishment of the aforementioned actions during fiscal year indicates successful achievement of this performance goal
3.3 Facilities Oversight - Construction and Upgrade - Operations and Management of Facilities	 - comparison with planned annual cost, planned annual schedule, planned total cost - comparison with schedule operating time

Source: adapted from the table in www.nsf.gov/pubs/2001/nsf0186/nsf0186.pdf

3.2.3 Some observations about NSF's performance measurement:

As with the previous case study, in order to analyze performance measurement, there are many factors which have to be brought out for consideration such as organizational structure, organizational culture, external and internal factors which all can affect the performance measurement system. However, due to the limited available acess to NSF's performance measurement, this analysis will focus on and interpret solely from the information available. Some observations about its performance measurement are:

1) For the United States, there are performance measurement models developed by the GPRA Act and OMB which have the guidelines and frameworks to help organizations within this country to develop the performance measurement. So for this case, one of other success factors in the organization's performance measurement has come from the frameworks and guidelines on the national scale.
2) According to performance measurement conceptual framework, NSF's performance measurement model is the combination of every model. It measures its input, process, output and impact according to 'input-output' model such as number of staff (input), percent of research grants (output), development of employee attitude survey (outcome), and the mathematics of US students and citizen improvement (impact). It also measure in terms of its economy (comparison with planned annual cost), efficiency (percent of proposals processed within timeframe), effectiveness (eighty percent of participants in the programs can improve student achievement after three years). In terms of its measurement dimension or according to the "Balanced Scorecard concept", NSF's performance measurement also has various dimensions such as internal business (people, ideas and tools), customer (customer service survey), learning and growth (business practices, staff, facilities), and financial (planned annual cost, planned total cost). This is also according to Halachmi & Bouckaert (1996:3) that "depending on the desired performance information, agencies may have to use more than one kind of measurement".
3) NSF designed its performance indicators according to its goals which relate to the organization's missions. In my opinion, this model is interesting and effective because it will push the organization to accomplish its goals. This is also according to Halachmi & Bouckaert concept (1996) about intended use of performance measurement. For this case, the intended use of the organization's performance measurement is to achieve the specific goals. However, this model will work well only when the organization can specify its goals which only a few organizations can do. To be able to specify the goals and develop the indicators according to the goals as in this model will help the manager of the

organization to make a sound decision to achieve the goals. The organization's manager can concentrate on less focus areas and save time for collecting data. According to PBM SIG (2001), one factor to the success in developing good performance measurement is that the organization must have the clear vision, mission and objectives for its performance. Because NSF has been established for a long time and has gained a good reputation for its performance achievement, this organization has clear vision, mission and strategic goals which are factors to help developing the good performance measurement..

4) This performance measurement case is a good example of developing the indicators that are important but generally are ignored because of their difficulties or sensitivity, for example, the indicators to measure intangible performance (knowledge, idea), number of women on staff, number of underrepresented minority group.
5) When observing the characteristics of good performance indicators according to Rosen (1993), due to the data available, most of the indicators are good in terms of validity, reliability, clarity, relevancy, controllability, accuracy, sensitivity, and affordability. However, in my opinion, some of NSF's performance indicators are not clear about the criteria of measurement. For example, when NSF mentioned "the mathematics, science, and technology skills of US. students and the K-12 level and for citizens of all ages were improved" , it does not clearly indicate the criteria used to measure indicators. Also, some doubts about validity of indicators may also arise from some quantitative measurement indicators such as number of videoconferences in NSF, average award size for research projects, etc. Nevertheless, the deeper analysis for these indicators could not be done due to the restrictions to assess this organization's performance measurement.

3.3 Conclusion

In this chapter, case studies of two S&T public organizations were carried out in order to learn about performance measurement in the similar organizations in other countries. CSIRO in Australia and NSF in U.S. are selected because of their sound experiences in their organization's performance measurement.

Observed through these two organizations, we found that they are good cases which are different in terms of measurement that they select to use. CSIRO is a good example of various criteria of measurement that varies from input, output, outcome, economy, efficiency and effectiveness. It can also give a multi-dimensional view of its performance through its customers, internal business, and financial measurements. This case is a good example in term

of clarifying the indicators according to criteria of performance (input, output, outcome, and effectiveness) which is in accordance with the organization's missions. NSF is a good example of an organization that has clearly specified goals and has developed the indicators related to them. This model is useful for strategic management in order to achieve the goal.

Moreover, in terms of S&T performance indicators, these two organizations show good examples of efforts to determine how to measure the outcome and impact of an S&T organization which are actually difficult due to the nature of their products such as the utilization of R&D project and impact to the society. However, due to limited data for analysis, the observation is done mostly through the performance measurement model and little on the characteristic of good performance. It was found that most of the performance indicators can be defined as good performance indicators although there are some doubts in the validity, accuracy, and controllability in some of them which need to be observed deeper with more information.

From these two case studies, it seems to me that for performance measurement, every organization is in a learning process that will never end. No models or indicators can be judged as wrong. The proper model of one organization may improper for another organization due to many factors both inside and outside the organization. Learning from another organizations can give us the idea of how to design the performance measurement model but cannot give us the perfect model to adjust to our own organization. Each organization needs to clarify the purpose of its performance measurement and design its performance measurement to meet that purpose.

Chapter 4

Performance Measurement and Performance Indicators in a Thai Public Organization

From the previous chapters, the theories about performance measurement and the lessons learned from some organizations in other countries were shown in order to understand performance measurement in public sectors. It will be useful to look more deeply into one organization to see its performance measurement and performance indicators. For this chapter, a Thai public organization, which was known as "NSTDA", is selected to observe.

4.1 Overview of NSTDA

NSTDA is an autonomous organization under the ministry of Science, Technology and Environment. It was established under the special law "the Science and Technology Development Act" in December 1991. It is operating under the policy guidance of its board chaired by the Ministry of Science, Technology and Environment.

Under one roof, NSTDA effectively composes of a central office and three national research centers namely National Center for Genetic Engineering and Biotechnology Center (BIOTEC), National Metal and Materials Technology Center (MTEC), and National Electronics and Computer Technology Center (NECTEC). It is established to be a major driving force for rapid science and technology development in support of national economic and social policies.

Objective: For its objective which was stated in section 11 in the act, NSTDA aims to achieve these objectives:

1. To manage its endowment fund in accordance with laws, regulations and resolutions of the board.
2. To conduct surveys, studies and assessment for supporting the formulation of policies, plans, programs and measures that facilitate the national science and technology development, for submission to the Minister.
3. To conduct research, development and engineering activities, and support research, development and engineering activities of the public sector, the private sector, and the educational institutions, as well as promote cooperation in such activities among the private and public sectors and the educational institutions, including

international cooperation, for the development of commercial benefits from these activities.

4. To provide and support services in the areas of product standard testing, quality assurance, instrument calibration, technological information and consulting, and other scientific and technological services.
5. To support the enhancement of the capabilities in assessing and acquiring imported technology as well as in management of investment and development projects related to the acquisition and assimilation of foreign technology so that the technologies acquired are efficient and appropriate and the activities implemented and help strengthen the technological capacity of the country.
6. To implement and promote the development of the scientific and technological infrastructure of the country, inclusive of science and technology human resources development in both the public and private sectors.
7. To undertake other activities designated by law as duties of the agency and assigned by the board.

Afterwards, NSTDA developed its vision and missions which are relevant to the objective of the organization:

Vision: A learning organization excelling in Science and Technology critical to the socioeconomic development of Thailand

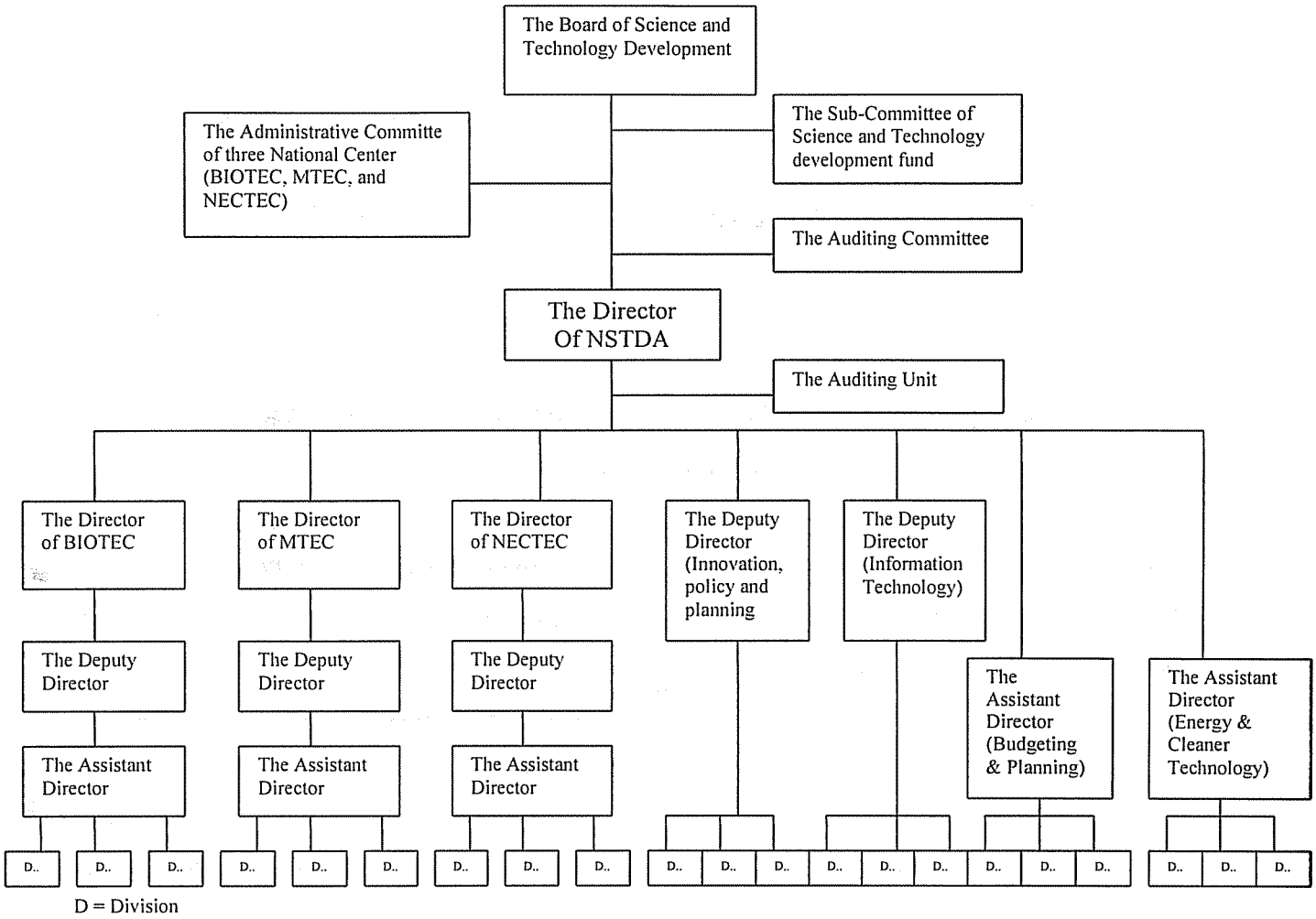
Missions:

1. To raise the technological capabilities of Thai productive sectors
2. To help solve socioeconomic problems with science and technology
3. To promote the development science and technology human resources
4. To initiate and strengthen science and technology infrastructure and knowledge
5. To be a learning organization which embeds trust, flexibility, transparency and accountability into its operation

The structure of NSTDA organization

As mentioned above, the NSTDA is composed of 4 sub offices. It is managed by the supervision of the executive board (namely science and technology development board). The national center committee also assists the board to manage three national centers. The highest executive management officer of NSTDA is the director. The structure of NSTDA can be viewed as figure 4.1:

Figure 4.1: NSTDA's organization structure[18]



NSTDA's Staff

In 2001, the total staff of NSTDA is 1,548 (NSTDA, 2001). They are employed on a contractual basis. The staff of NSTDA can be divided into 3 categories: researcher and academic staff, operation staff, and administrative staff. The proportions within these 3 groups can be shown as in the table below (table 4.1)

Table 4.1: NSTDA Staff categorized by the job[18]

	Analyst and Researcher	Operation Staff	Administrative Staff
NSTDA Staff	930 (60%)	580 (37.5)	38 (2.5%)

[18] source: NSTDA's Annual Report 2001

NSTDA Budget:

About 83 % of NSTDA budget is funded by the government (NSTDA, 2001). Other sources of financing are from donor funds, patent, and service fees. In FY 2001, NSTDA has the operation budget about 2,404 million baht[19]. NSTDA budgets were categorized and operated due to its mission (ibid.):

1) Administration, planning and internal management 366.4 million baht (15.2%)
2) S&T Infrastructure Development 446.4 million baht (18.6%)
3) S&T Research, Development and Engineering (both in-house and funding) 754.6 million baht (31.4%)
4) S&T Human Resource Development 130.8 million baht (5.4%)
5) Technology Transfer 168.1 million baht (7.0%)

4.2 The Performance Measurement and Performance Indicators in NSTDA

In NSTDA, there is still no standard of performance measurement. Originally, NSTDA's performance measurement was initiated by demand from outside the organization. It was donors and funding agencies that requested NSTDA to report its performance progress. Later, NSTDA developed its performance measurement for internal management purpose. NSTDA performance measurement is still in a learning process in an effort to find the best system to fit the organization. A large part of NSTDA's budget was spent in this learning process, by inviting foreign experts to teach the methodology, by adopting the international performance standard namely ISO 9000[20], and arranging the workshops about performance measurement which involve many stakeholders.

In NSTDA, the planning and policy division is the main office which deals with the performance measurement analysis and reporting. The performance measurement information is reported both to external users (the Minister of Science, Technology and Environment; the Budget Bureau, and other government agencies as needed), and internal users (NSTDA Executive Officers, other divisions as needed).

The performance measurement in NSTDA can be categorized into two stages: monitoring and evaluation. In the monitoring stage, the organization performance measurement is focused on

[19] 42.80 Baht = 1 Euro; November 2002

[20] NSTDA adopted and implemented some scopes of ISO 9000(quality of process and service) for only some activities (Research funding, Human Resource Development, some technology transfer services). However, this standard is not implemented for all NSTDA's activities.

the input and output. In the evaluation stage, the performance measurement is focused on the outcome and impact. The system which NSTDA uses to monitor the performance measurement is both through an electronic system and documents. To evaluate, NSTDA has established a committee which is composed of internal and external experts to evaluate their performance. The performance of NSTDA can be divided into five areas:

1) R&D Performance - For this area, NSTDA has the dual role of both implementing and supporting S&T development by carrying out in-house research, and supporting research funding to public and private sectors outside the organization, preferably to meet industrial and social needs.
2) Science and Technology Human Resource Development - NSTDA provides scholarships, together with training and exchanging programs in S&T fields.
3) Technology Transfer Development - NSTDA provides industrial consulting services, provides loans for investment, provides skilled experts, and assists in finding and acquiring appropriate technology.
4) Science and Technology Infrastructure Development – NSTDA develops S&T infrastructure such as incubators, laws, facilities, instruments, networks, etc.
5) Administrative and internal management: to be able to achieve its objectives and missions, NSTDA tries to develop the effective administrative and internal management within organization.

NSTDA has developed its performance indicators related to these five areas of performance. Its performance indicators are both quantitative and qualitative. However, there are difficulties in reporting some performance indicators of NSTDA especially in qualitative performance indicators such as qualitative details of how NSTDA's R&D projects have an impact in the country, qualitative details of how capital and energy are saved through NSTDA's R&D projects, qualitative details of capability improvement of people who attend the training programs from NSTDA. Most of these qualitative performance reports, NSTDA are prepared descriptive detail. However, these details are still obscure and raise more questions from the public about the real distribution NSTDA put into those results claimed by NSTDA.

In order to report this performance measurement information, NSTDA has the system to collect the information of its performance every month by sending performance reporting form distributing to every division. This performance information is collected and analyzed by the planning and policy division every three months. After that, this analyzed information is

sent both to the internal and external users. For external users, it should be noted that most of them would require NSTDA to report its performance according to their specific performance report forms which sometimes have different performance indicators from NSTDA's[21].

4.3 Analytical Part of NSTDA's Performance Measurement

4.3.1 The Effectiveness and Relevance of NSTDA's Performance Measurement

1) In Chapter two, I mentioned that there are some main conceptual frameworks of performance measurement which are widely accepted throughout public organizations such as the input-output model, the traditional 3Es model, and the Balanced Scorecard concept. To analyze the effectiveness of presented NSTDA's performance measurement, I adopt these three frameworks to observe NSTDA's performance indicators. The reason why I adopt these three frameworks together is because in my opinion, each of these frameworks alone cannot give the perfect dimension of performance measurement. Using the input-output model alone will give you the picture of each performance's criteria (input, process, output, outcome and impact) but it still cannot link with other criteria in order to give the whole picture. Using 3Es Model alone may also be not good in NSTDA's situation as it still has to provide the information for external users, since some of them need to know the details of input and process (for example, the Budget Bureau always needs to know how NSTDA has allocated the budget). The Balanced Scorecard concept will give you the dimensions of performance measurement (Financial, Customer, Learning & Growth, Internal Business Process), which in each dimension, still requires a way to find the criteria to measure the performance. The checklist for NSTDA performance indicators which are adopted from these frameworks is shown as table 4.2 below :

[21] The details of NSTDA's performance indicators are shown in table 4.2 _

Table 4.2: NSTDA's Performance Indicators (according to performance measurement framework)

NSTDA's Performance Measurement Indicators	Input	Process	Output	Outcome	Impact	Economy	Efficiency	Effectiveness	Equity	Financial	Customer	Learning &Growth	Internal Business
1) Research and Development													
- Amount of budget using in research and development activities	✓					✓				✓			
- Number of researcher, technical staffs and support staff involved in project	✓					✓						✓	
- Duration of R&D project		✓											✓
- Number of R&D project (in-house, funding, mutual funding)			✓										✓
-Number of NSTDA's R&D project getting patent			✓										✓
- Number of science and technology publications(Books,Journals, Proceeding)			✓										
- Number of R&D projects being used (commercial and public purposes)*				✓									✓
- Quantitative and qualitative details of commercial and social benefit getting from using NSTDA's R&D projects*					✓								✓
- Quantitative and qualitative details of the impact of NSTDA's R&D projects *					✓								✓
2) S&T Human Resource Development													
- Amount of budget using in S&T human resource development activities (scholarship, exchanging program, training, workshop, etc)	✓					✓				✓			
- Number and details of scholarship provided (name, status, area of study, title of thesis or project)			✓										✓
- Number of scholarship students finishing study			✓										✓
- Number and details of training projects (title, date, place, number of participants)			✓										✓
- Number of exchanging programs			✓										✓

NSTDA's Performance Measurement Indicators	Input	Process	Output	Outcome	Impact	Economy	Efficiency	Effectiveness	Equity	Financial	Customer	Learning &Growth	Internal Business
- Number of foreign and Thai experts involving in the programs			✓										✓
- Number of R&D projects done by scientists or students who got scholarship from NSTDA				✓									✓
- Number and detail of workshop (title,time, place, number of participants)			✓										✓
- Quantitative and qualitative details of capability improvement of people who got the training from NSTDA*				✓									✓
- Quantitative and qualitative details of other NSTDA's Human Resource Development program*			✓										✓
3) Technology Transfer Development													
- Amount of Budget using in technology transfer activities	✓					✓				✓			
- Number of experts, technical staffs involved	✓					✓						✓	
- Duration of Technology transfer project		✓											✓
- Number of Technology transfer project			✓										✓
- Number of companies using services of NSTDA's technology transfer			✓										✓
- Amount of fees getting from providing consultations to private companies			✓							✓			
- Level of customer satisfactions in using NSTDA's technology transfer service*			✓								✓		
- Number of products and/or services improved by NSTDA's project*				✓									✓
- Number of private sector's staffs getting skill improvement by NSTDA's technology transfer project*				✓									✓
- Qualitative details of companies' improvement after getting services from NSTDA (productivity improvement, profit increasing, etc)*				✓									✓

NSTDA's Performance Measurement Indicators	Input	Process	Output	Outcome	Impact	Economy	Efficiency	Effectiveness	Equity	Financial	Customer	Learning &Growth	Internal Business
4) S&T Infrastructure Development													
- Amount of budget using in Infrastructure Development	✓					✓				✓			
- Duration of Infrastructure Development Project		✓											✓
- Number of Infrastructure Development project			✓										✓
- Number of customers using NSTDA's S&T Infrastructure projects			✓										✓
- Number of fees getting from using NSTDA's infrastructure			✓							✓			
- Qualitative details of benefit getting from using NSTDA's project*				✓									✓
5) Administrative and Internal Management													
- Amount of budget using in internal management (wages, compensations, incentives, training, etc.)	✓					✓				✓			
- Number of projects aiming to improve administrative and internal management			✓									✓	
- Number of internal staffs getting training (both inside and outside)			✓									✓	
- Number of workshops and seminars about internal management improvement			✓									✓	

Note: The judgement criteria for this table is done by researcher's experiences together with using conceptual frameworks in chapter two.

* These performance indicators are mostly measured and collected in evaluation stages, done by evaluating committee which composes of internal and external evaluators.

From the table above, it was shown that most of the performance indicators used by NSTDA fit into an 'input-output' model (even it is noticeable from the table that most of the emphasis falls into output more than other stages). There is still a small number of performance indicators which can show a linkage between each criteria or known as '3Es model' by which we can measure the performance in terms of economy, efficiency, effectiveness. For this concept, NSTDA's performance indicators meet only one criteria which is 'economy' by measuring how the organization uses the resources over a period of time. In terms of dimension for performance measurement, as can be referred to the 'Balanced Scorecard' concept, most of the NSTDA performance indicators fall into the criteria of internal business more than another areas of performance.

To find out whether the present performance indicators of NSTDA are effective and relevant according to conceptual frameworks of performance measurement, I use Halachmi & Bouckaert's concept (Halachmi & Bouckaert, 1996) that proper performance measurement requires an understanding of the end user and the intended use of performance measurement information. For the NSTDA case, the end users and the intended uses of performance measurement information can be divided into two groups:

(1) The internal users: which are executive officers, aim to use this performance measurement data for making decisions to improve the organization's performance. For their decision making, these internal users need the data of the whole process of organizational performance from input, process, output and outcome. They also need to know the organization's performance information in terms of efficiency and effectiveness. They also need to know the performance information which can show all dimension of organizational performance in order to know that which dimension need improvement. It can be said that this group of user needs a lot of performance information for their decision making. NSTDA performance indicators which are periodically collected and used are composed of forty performance indicators (table 4.2). Every three months, more than one hundred pages of performance information are sent to executive officers. However, most of NSTDA's performance indicators fall into input-output model type more than other criteria of performance measurement. Thus, for this group of internal end users, the NSTDA performance measurement still could not meet with intended use which would require more criteria of performance information.

(2) The external users: which are the supervisory unit – MOSTE; the funding unit (the Budget Bureau); the auditing unit (the office of the Auditor General); the cooperative agency (other R&D institutions, universities, foreign R&D organizations, other ministries which cooperate or join in some activities); donor agencies (World Bank, etc.); and non-institution actors (politicians, media, the people). These external users need specific information for their own individual use which can described as :

- The supervisory unit: NSTDA is operated under the supervision of MOSTE. MOSTE has the duty to monitor and evaluate NSTDA's performance to see how effective NSTDA performs. The performance report form, designed by MOSTE, is sent to NSTDA every three months. In this performance report, it mostly focuses at NSTDA's output such as the number of R&D projects done, the number of scholarships provided and the amount of service provided. These indicators are not much different from the presented performance indicators that NSTDA collects for its internal management purpose. Thus, for this intend use, NSTDA can use its own practical performance measurement to report to MOSTE.
- The funding unit: it was mentioned in the beginning of this chapter that 83% of NSTDA budget is funded by government. The Budget Bureau is the funding unit that directly deals directly with NSTDA in the budgeting procedure. Before 1999, the performance report which the Budget Bureau required from NSTDA focused on the input and process in budgeting details under the "Line-Item Budgeting system". After 1999, the Budget Bureau changed the budget system to "Performance-Based Budgeting (PBB)". According to Henry (1989), for this budgeting system, it considers both input and output, activity classifications, the description of an agency's program and its performance, and the exploration of various kinds of work/cost measurements. For the Thai context, the Budget Bureau has adopted this concept and applied with Thai bureaucracy agencies since 1999. In the Budget Bureau's document distributed to all agencies about the concept and method of this budgeting system, it is clearly stated that the emphasis of this system is on outputs, outcomes and impact more than on the input of the performance. It also states the necessity of an agency to measure the performance and design performance indicators which are clear and can measure the criteria in terms of quantitative, qualitative, cost and time. It also mentions the 'cost or efficiency indicators. From this end user's requirement, it can be

summarized that it needs performance information in terms of output, outcome, impact, economy and efficiency. Thus, from the requirement of this end user, the performance measurement of NSTDA still cannot well meet the criteria of performance measurement it requires.

- The auditing unit: for Thailand is known as the office of the Auditor General. This unit originally and practically audits Thai government agency in financial matters. Recently, it has tried to increase the role as the government-evaluating unit by which it tried to expand the scope of auditing. In general, it accesses the organization in terms of input and output which as the practical performance measurement of NSTDA can, more or less, meet the requirements. However, this unit also has to follow the concept of the Budget Bureau to place more emphasis on the results of performance which presented performance measurement of NSTDA has to improve in some criteria (impact, efficiency, effectiveness).
- The cooperative agency (other R&D institutions, universities, foreign R&D organization, other ministries which cooperate or join in some activities): these agencies sometimes need the performance information of NSTDA in different criteria and categories to be used for their own specific purposes. So for this intended use, NSTDA does not know whether its performance measurement can cover all the requirements of these intend users or not. Generally, NSTDA only has to gather information for them contemporaneously but it is not too difficult since these groups of users do not require extremely complicated data.
- The donor agencies: there are some donor agencies which donate funding both in kind and in cash to NSTDA to enhance the S&T development. These donor agencies also want to monitor and evaluate output, outcome and impact of their funding. However, these donor agencies limit their attention only to the output, outcome and impact which emerge from their funding. So for intended use of these end-users, present performance measurement of NSTDA can meet the requirement, however, it needs to place more emphasis on outcome and impact measurement and clarify funding projects from normal projects.
- Non-institutional actors[22]: which for this context means politicians, media, NGO and the public. This group of users wants to know NSTDA's performance information in terms of its impact, especially the impact to the society.

[22] After the concept of Cahn, (1995) who identified the actors in policy process as institutional actors and non-institutional actors.

Although, in present performance measurement of NSTDA, although it already has the indicators in terms of impact these are quite descriptive in nature and still could not give exact answers relating to the real impact of NSTDA on the society. NSTDA has often received such responses, especially from politicians, media and NGO. This group of users push NSTDA to be able to provide the real answer of its real impact to the society. However, as mentioned in PBM SIG (2001), there are always difficulties in measuring the impact of performance especially in the area of R&D. So in order to meet this expected intend use and end users, NSTDA needs to develop criteria which can more directly measure its impact to the society.

2) To observe the effectiveness and relevance of NSTDA's performance measurement, it can also be observed through some characteristics of good performance indicators pointed out by Rosen (1993), as follows:

- Validity: NSTDA's performance indicators should measure what it ought to measure, which should be appropriate to the organization's objectives and missions. Observing through presented NSTDA's performance indicators, it was found that they still could not effectively present the achievement of the organization related to organization's missions. NSTDA's missions are related to what will come out as the 'outcome' and 'impact' of its performance more than the 'output' stage. However, as shown in table 4.2, most of NSTDA's performance indicators fall into 'output' measurement more than other criteria of measurement. This is because of the difficulty to measure performance in terms of outcome and impact especially in R&D area as mentioned in chapter two. Thus, to get valid performance indicators, NSTDA has to be able to develop its performance indicators more in terms of outcome and impact.
- Reliability: The indicators are consistent, giving the same readings at different times or by different measures. Observing through NSTDA's performance measurement, it was found that performance indicators which are quantifiable (mostly in input, process, and output criteria) are more reliable. However, there had been a small problem relating to the method of counting the new, on-going, and finished R&D projects[23] but this problem was lately solved by clarifying the standard criteria of projects counting. The problem of reliability in NSTDA's performance indicators is

[23] Practically, R&D projects takes time for more than one year (two to five years) and likely to have a problem to double count the new, on-going, and finished projects.

found in qualitative performance indicators mostly in outcome and impact measurement. NSTDA still does not have the standard criteria for its outcome and impact measurement. Different criteria of measurement often give different result at different time.

- Clarity: Performance indicators should be clear and understandable. From experiences and observation comparing them to the case studies in chapter three, I think NSTDA's performance indicators are clear and understandable. As mentioned above that NSTDA has put emphasis on its performance measurement and spend a lot of effort and resources for this objective. To design the performance indicators, NSTDA involved many stakeholders and tried to make every performance indicator as clear as possible. There is a manual for performance reporting given to every division in the beginning of each fiscal year describing meanings of performance indicators. However, there are some of NSTDA's performance indicators especially those relating to qualitative details which cannot give a clear definition of its criteria of measurement .
- Relevance: The performance indicators should provide information needed to make decisions about the agency's performance. As already mentioned in the first part of this analytical part which is according to Halachmi & Bouckaert (1996) this should reflect needs of end users and intended uses of performance measurement. For this purpose, various criteria of performance measurement are needed in order to make decisions for organizational performance improvement. However, presented NSTDA's performance indicators mostly fall into input-output model type more than other criteria of performance measurement. Thus, NSTDA's performance indicators are still not perfectly relevant to managerial needs and purposes.
- Controllability: The persons or groups being measured should have control over all aspects of performance that go to make up the measure. There are a number of NSTDA's performance indicators that go beyond controllability of persons or groups being measured such as number of R&D projects getting patents (dependant on the authorized agency and its procedures), number of R&D projects being used both for commercial and public purpose (dependant on readiness and understanding of R&D projects by the public).
- Accuracy: The indicators should not have built-in bias or distortion. There are also some of NSTDA's performance indicators that can have built-in bias or distortion such as the level of customer satisfaction in using NSTDA's technology service (where the

questionnaire can be designed to meet the expected result), number of products and services improved by NSTDA project (where the products or services maybe improved by various factors apart from NSTDA's contribution), and the number of private sector's staff members getting skills improvement from NSTDA project (where the staff may actually improve and develop their skills from multiple sources).

- Sensitivity: The indicators should be able to capture the variation that occurs in the object, event, or situation being measured. Some of NSTDA's performance indicators are still not sensitive because it still could not respond to the new demands which emerge from time to time. For example, when the Budget Bureau launched a new budgeting system-PBB, the presented performance measurement of NSTDA still could not meet all performance measurement criteria of this nUew budgeting system.
- Affordability: The indicators should not be prohibitive in cost or effort. For the presented NSTDA's performance indicators, they are affordable, which means they are under the scope of organization's mission and within its management authorities.

3) Then, there are the organization's characteristics which, according to Carter *et al.* (1992), effect and shape organization's performance measurement and indicators. They are ownership, trading status, competition, accountability, heterogeneity, complexity and uncertainty. These characteristics also effect and have influence in designing and shaping NSTDA's performance measurement as follows:

3.1 Ownership means that the location of an organization is linked to its approach to performance assessment. Public sector organizations pursue political and social goals rather than simple commercial objectives. NSTDA is a government agency operating under the supervision of MOSTE. In Thailand, there are increasing demands from both the government and society to improve performance in the public sector. In his declarations, the Thai Prime Minister, Mr. Thaksin Shinnawatra, pledged to the public that "...there will no longer inert Thai bureaucracy and all public agencies need to tell the public how much money they need, what they plan to do it, and how they will use it to produce good results.."[24] This government initiative has increased the demand for administrative reform in Thai public sectors. NSTDA, without any exception, is also facing this political demand as are other Thai public sectors.

3.2 Trading status means the status of the organization in either the tradable or non-tradable sector of the economy will have an effect on the designing of performance

indicators. In the tradable sectors, they will have a wide range of financial indicators. For the NSTDA case, it is a non-profit sector, so its performance indicators are less emphasized as financial indicators. Most of its present financial indicators are based on requirements from other agencies, such as the Budget Bureau, MOSTE, as a way to monitor budget spending. However, when the Budget Bureau launched the new budgeting program to PBB, there are requirements for more financial indicators such as cost effective indicators (unit cost, etc.).

3.3 Competition means the number of organizations providing similar products or services and their share of market may lead to a variety of performance indicators which concentrate more on measuring productive efficiency and effectiveness of the service provided to customers. While the monopoly or non-competition organization may regard non-profit performance indicators as a means of assessing the standard of its performance. For the NSTDA case, it is an organization that has no competition. Even while there are other S&T public institutions in Thailand, they provide different products and services and in different areas. Hence, NSTDA faces no competition threat from other organizations to move towards the efficiency and effectiveness of performance improvement.

3.4 Accountability means the extent to which an organization is politically accountable which is statutory requirements and obligations for most public sector organizations to design at least some performance indicators. Carter *et al.*(ibid.) also refers to the extent to which a service is in the public eyes and subject to media attention. For NSTDA, the political accountability is one of the important factors that pushes NSTDA to improve its performance measurement in order to answer questions from politicians. Every fiscal year when NSTDA proposes its budget for the next fiscal year, it always receives many questions from politicians about its performance. Apart from that, NSTDA is one of the public organizations whose budget has traditionally been large because the government realizes the importance of S&T development. Because of political pressure, budget issue, together with its autonomous management authorities, NSTDA needs to find the way to show accountability to the society. Performance measurement is selected as a strategy to show its accountability to the society.

[24] Bangkokpost, October 6,2002.

3.5 Heterogeneity means the number of different products or services provided. He assumed that assessing the performance of a single-product organization is less difficult than assessing that of a multi-product organization, where there may be trade-offs between various objectives. For NSTDA, it is a multi-product organization. Its expected products range from R&D projects, S&T human resource, consulting services, and S&T infrastructure. Its products and services are also varied from biotechnology, material technology, to electronic and computer technology. According to Carter *et al.*(ibid.), to assess this multi-product organization is likely to be difficult. The performance measurement of this multi-product organization is quite complicated in order to have the ablility to cover all products and services provided. For NSTDA, its heterogeneity leads to the situation that the performance indicators of NSTDA is measured by more than forty indicators.

3.6 Complexity means that organizations may also vary in the degree of complexity which means the extent to which an organization has to mobilize a number of different skills in order to deliver its services or produce its goods. It may also be related to the variety of products and services mentioned before. For NSTDA and the two organizations discussed in chapter four, all are S&T public organizations. For each of their products and services, they require primarily different staff skills, varying from technicians, researchers, operation staff, and administrative staff. It was found from their performance indicators that these S&T organizations have tried to cover their efforts to mobilize different skills within their organization such as number of researchers, technical staff, and experts involved.

3.7 Uncertainty means that the organization's performance measurement may also vary due to the degree of uncertainty of the relationship between means and ends, or the relationship between the input of resources and the achievement of stated objectives. Objectives in many organizations are often absent, ambiguous, and sometimes conflicting within their multiple objectives. Search through NSTDA objectives, they are massive and require various tasks and skills in order to achieve these objectives. Some of them are unclear and it is difficult to clarify the way they may be reached such as 'to undertake activities designated by law as duties of the agency and assigned by the board'. This results in a situation where NSTDA cannot clearly clarify its performance indicators in order to achieve some of its stated objectives.

3.8 Carter *et al.*(ibid.) also points out two other dimensions of organization which may result in the effectiveness of performance measurement which are the authority

structure and the degree of autonomy within the organization[25]. The assumption is that the greater the standardization of work tasks, the more effectively the center can measure and control performance; while the standardization of work is minimal then the individual worker or group of workers may exercise considerable autonomy and discretion. NSTDA is an autonomous agency which is composed of four sub units. All of these sub centers are autonomous units which means that they have management authorities over their own organization. These three organizations are specialized in terms of skills, products and services (in biotechnology, material, and electronic and computer). Although NSTDA sets the standards for its performance measurement, it still does not have full control over the details and criteria of measurement. The situation that arises most often is that the national center has its own definition and judgement for each criteria of performance measurement. For example, the definition and criteria of measurement in terms of output and outcome for BIOTEC may not be the same as what MTEC or NECTEC defines. This is also true according to Macpherson (2001) mentioned that "there may also be a perceived loss of control over how performance is portrayed – when there is an indicator everyone can see, there will be a variety of opinions about what it means".

4) Observing through NSTDA performance indicators, there are some indicators that are based on S&T performance indicators such as number of NSTDA's research projects getting patents, number of science and technology publications, amount and quality of technology diffusion of information and research results. The most important point regarding these S&T performance indicators is they have to link with the organization's objective and mission. For NSTDA case, the S&T performance indicators are still within the scope of its objectives and missions. However, they need to be re-designed and shaped to fit with the intended used. For example, instead of counting the number of projects getting patents, the emphasis should be on the number of projects being used by private sector and the benefit which arises from that project usage.

5) As mentioned before, NSTDA's performance indicators are separated and divided into two stages: monitoring and evaluation. This is actually good and proper due to the amount and nature of NSTDA's performance indicators. First, it will not overload the burden of NSTDA staff to gather the information for all indicators. Second, due to the nature of

[25] Definitions in chapter two

R&D projects, most of them cannot provide the expected results and outcomes during the time allocated to do so. However, attention should be paid to the selection of performance indicators for each stage and selected time frame. This can also be designed by considering the intended uses and end users of performance measurement information such as considering who is the end user for the monitoring stages of performance measurement and which kind of information it needs.

4.3.2 Limitations and Problems in NSTDA's Performance Measurement

From the analysis of NSTDA's performance measurement, it was found that there is a serious problem in designing effective performance indicators to meet the intended uses and end users of its performance information. Moreover, there are still other limitations and problems in NSTDA's performance measurement which are not far from the problems generally found in performance measurement elsewhere. The problems which were mostly found in NSTDA's performance measurement are according to PBM SIG (2001) mentions such as that:

1) The cause and effect of outcome are not easily established. For NSTDA, the outcome of R&D project is sometimes beyond the authorities of NSTDA. For example, in order to make use of R&D projects, the readiness of people and society is important as well as the supporting from other institutions.
2) Amassing too much data has the effect that the manager and employee either will ignore the data or use it ineffectively. NSTDA's performance measurements are composed of 40 performance indicators. Every three months, the performance report which contains more than one hundred pages of information is produced. Actually, the executive officer who needs to use this information does not have enough time to pay attention to all performance indicators and all the details in the performance report. The employee who needs to report the performance indicators find NSTDA performance measurement too much and too complicated. It seems like a vast amount of information from NSTDA's performance measurement is just a waste of time and being used ineffectively.
3) There are also other problems found in NSTDA's performance measurement apart from what PBM SIG points out. First is the problem of reporting system. Although there are electronic systems providing for reporting the performance, the problems about reporting system still remains. The employees do not feel like they are obliged to report what they do. It can be analyzed that there is a lack of incentives for reporting systems. Second is the problem of getting the information according to all performance indicators of NSTDA, some of them are too difficult or too complicated to find the information to report. Third is

the problems of various dimensions and objectives of NSTDA. As already described, NSTDA was established as an institution to promote S&T development in three main areas: biotechnology, material, and electronic and computer technology. These missions are varied from doing in-house research, funding research, enhance S&T human resource development, promote technology transfer, and establish S&T infrastructure. Because of this, it makes performance measurement of NSTDA so complicated that as many as forty performance indicators are used.

4.4 Conclusion:

NSTDA is a Thai public organization which has a mission to promote S&T development of Thailand. It is an autonomous agency operated under the supervision of MOSTE. Its missions are various from in-house research, providing research funding, enhancing S&T human resource development, promoting technology transfer, and establishing S&T infrastructure. For its performance measurement, NSTDA has has put forth great effort in trying to find the performance measurement for using both for internal management and response to external demand. However, questions can be asked about the effectiveness and relevance of its performance indicators.

By using the conceptual frameworks about performance measurement (performance measurement methodologies; performance measurement for intended uses by end users; characteristic of good performance indicators; organization characteristics) to observe NSTDA's performance indicators, it was found that there is a serious problem for designing its performance measurement to meet its intended uses and end users. Although there are forty performance indicators which are designed to cover all aspects of its missions, some important dimensions are still missing. Another problem that was found is some presented performance indicators are not effective or relevant to the organizational missions which is related to the problem of designing performance indicators to meet intended uses. Also, it was found that there are organizational characteristics that influence and shape performance measurement of NSTDA. Finally, it was found that NSTDA, the same as other public organizations elsewhere, is facing some limitations and difficulties of performance measurement which need to be considered when trying to find effective performance measurement.

Chapter 5
Conclusion and Recommendations

5.1 Main Findings

This paper has sought to find the degree of effectiveness and relevance of performance measurement of a Thai public organization-NSTDA, as well as finding out the limitation and problems in its performance measurement. The cases of similar organization in other countries have been observed in order to draw some useful concepts to apply and suggest the improvement for performance measurement in a Thai case.

The study starts from exploring through concepts of performance measurement in order to use as a tool to observe a Thai public organization for the degree of effectiveness and relevance of its performance measurement. It is found that the concept of performance measurement is enormous and diverse. Its increasing interests are emerged from the trends of good governance and accountability that call for public sector around the world to concentrate more on their performance improvement. Performance measurement is considered as a crucial strategy to improve performance of public sector. There are many methodologies to measure performance measurement. Generally, there are several models that are used in public organizations. First concept is called "input-output model" which aims to measure the stages of performance from input, process, output, outcome, to impact. Second, "the 3Es model" which measures the performance in terms of economy, efficiency, and effectiveness. Third, there is the "Balanced Scorecard concept" that emphasizes on the dimension of measurement from customer perspective, internal business process perspective, learning and growth perspective, to financial perspective. However, there is no universal model to measure performance in public sectors. An organization needs to find a model which fits to its context and objective. As Halachmi & Bouckaert (1996) mentions, performance measurement should be designed to meet intended uses and end users of performance information. After selecting the model to measurement performance, one also needs to consider how to design relatively good performance indicators which have some characteristics as validity, reliability, clarity, relevancy, controllability, accuracy, sensitivity, and affordability.

In this study, two similar S&T public organizations in another countries (CSIRO in Australia and NSF in U.S.) are selected to observe about its performance measurement. It is found from the observations that these organizations do not strict with any sole model of performance

measurement. Within their measurement frameworks, they contain more than one model of framework such as 'input-output model', 3Es model, and Balanced Scorecard model. The main lesson learned from these two organizations is that an organization can use more than one model of measurement due to its missions and purposes of performance measurement. In my viewpoint, CSIRO is a good example of how to clearly clarify the indicators to each stages of measurement (input, output, outcome, impact, efficiency, and effectiveness), while NSF is a good example of clarifying the organization's goals and set the indicators to achieve those goals. These two organizations show a good effort of how to measure the outcome and impact of S&T organization which are actually difficult due to the nature of their products and services. Observing through these two organizations, we can draw a good guideline for designing a good performance measurement for an organization, but we could not imitate the exact model to apply with any organization due to the difference missions and purposes of performance measurement in the organizations.

The main focus of the study is on a Thai public organization namely NSTDA. The performance measurement concepts are adapted to be a checklist to find the categories of presented performance measurement framework of NSTDA. It is argued that most of NSTDA's performance indicators come under the 'input-output model'. To find whether it is effective and relevance, Halachmi & Bouckaert's concept about intended uses and end users of performance information is selected to use as analytical tool. From the intended uses and end users of NSTDA's performance information, it requires more than the presented performance measurement of NSTDA can provide. To understand more about NSTDA's performance measurement, Rosen's concept of characteristics of good performance indicators is also used. The analysis shows that NSTDA's performance indicators do not comply with some characteristics of good performance indicator which are validity, reliability, relevancy, and controllability.

There are organization characteristics which have effect and influence in designing and shaping organization's performance measurement such as ownership, trading status, competition, accountability, heterogeneity, complexity, and uncertainty. For NSTDA, because of operating within government body, it faces political demand within the country to improve its performance. It is operated within the non-trading status which makes NSTDA does not have much financial indicators. There is no competitive organization for NSTDA which leads to not much demand for efficiency and effectiveness performance indicators.

However, NSTDA is facing increasing demands from the public to show its accountability. NSTDA requires the performance measurement which can answer the society about its outcome and impact. Due to high degrees of heterogeneity, complexity, and uncertainty of NSTDA, make it comes with a massive amount of indicators which some of them are still vague.

Based on the analysis, it is found that there are also some problems and limitations found in implementing NSTDA's performance measurement which should be bear in mind for any efforts to improve NSTDA's performance measurement. These problems are difficulties to established cause and effect of organization's outcome, too much data, lacking of incentive for performance report, difficulties to find information to report, too much objectives.

In summary, the presented NSTDA's performance measurement still requires improvement to be able to meet requirements in relation to its intended uses and end users. It is still not sufficiently relevant to precisely capture organization's missions. However, in my opinion, every organization is in a learning process to find a proper performance measurement model which fit to its organization. The experiences and concepts from other organizations can be learned and using as a guideline but cannot be instantly applied because the organization's missions and contexts are all different as Lindenburg and Ramirez (1989:5) points out that "no recipes for development can be passed blindly from one to another.

5.2 Recommendations

To improve NSTDA's performance measurement, the lesson drawn from two case studies shows me that we can apply more than one framework of measurement depend on the intended uses of performance information. This is conform the statement by Halachmi & Bouckaert (1996:3) that "depending on the desired performance information, agencies may have to use more than one kind of measurement". From analytical part, it is obviously shown that, for NSTDA, it needs to emphasize more to outcome and impact measurement. Also, NSTDA needs to move its criteria of measurement more to "3Es model" and "Balanced Scorecard model".

As Rosen (1993:65) points that "..no measurement system captures everything". Due to NSTDA's various objectives and missions which make NSTDA's performance indicators too complicated and contained too much data, it require to prioritize its objectives and select

focused area to measure. Within the organization, it should be agreed upon the strategic goals and the prioritization of its activities. Together, the indicators which are designed should reflect the achievement of the goals. This is also referred by Halachmi & Bouckaert (1996:3) that the performance objectives of an agency at a given point of time represent the priorities the organization gives-or is expected to give to various aspects of its performance.

NSTDA's performance measurement also should be more relevant to its missions. I suggest that the performance framework developed by Teather & Montague(2000), described in chapter two, may be useful for NSTDA to clarify its mission. It needs to look through its missions and ask itself about its expected results and targeted customers. In designing performance indicators of NSTDA, it should be involved by stakeholders as much as possible in order to make mutual understanding of what is the expected result for each group of stakeholders.

While developing the performance indicators, the characteristics of good performance indicators by Rosen (1993) should be used as the checklist in order to get a set of good performance indicators which can definitely contribute to NSTDA's performance improvement. However, S&T activities are diversified and mostly are results from mutual efforts with other organizations or sectors. Therefore, an emphasis should be given to the reliability and accuracy of the indicators.

Above all, every stage of improvement in NSTDA's performance measurement should be done according to the concept of intended uses by end users. All the performance information will be wasteful if they do not meet the requirements of end users.

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