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Effectiveness of provincial health information systems in northern Thailand

Buasai, Supakorn, Dr.P.H.

University of Hawaii, 1992
EFFECTIVENESS OF
PROVINCIAL HEALTH INFORMATION SYSTEMS
IN NORTHERN THAILAND

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PUBLIC HEALTH
MAY 1992

By
Supakorn Buasai

Dissertation Committee:
D. William Wood, Chairman
Kiyoshi Ikeda
Satoru Izutsu
Jerrold M. Michael
F. Ross Woolley
This dissertation is dedicated to Dr. D. William Wood, my most supporting professor and friend.
ACKNOWLEDGMENTS

This dissertation is a follow-through from my participation in the health information system improvement project in Palau during the summer of 1989. I have worked closely with Professor D. William Wood, who has been my adviser since I attended the School of Public Health. I would prefer to consider him as a mentor who has assisted me with utmost understanding, and provided support well-suited to this student's weak and strong points.

I am grateful to my committee members for their support and encouragement. Professor Michael's respectful requests made it possible to acquire assistance from the involved organizations. Professors Izutsu and Woolley provided critical comments with respect to research methodology. Professor Ikeda kindly spent a great amount of time giving assignment, advice and guidance, during the writing of this dissertation.

For four years, the East-West Center has provided me financial support. Specifically, Mr. Yamashita, the Open Grants program officer, has facilitated my study at the University of Hawaii.

I gratefully acknowledge Dr. Paijitra Pavabutra, Dr. Vitoon Saengsinghkaew, and the Ministry of Public Health for their official patronage. A gratitude is especially paid to Dr.
Uthen Charanasri, who gave me advice and shared practical viewpoint for starting this study. I would like to thank Penkae, Nongnuj, and Pinthong for their hospitality, when I did the field work.

Special thanks must go to my friends, Boonyong, Supriya, Wiladlak, and Penny. Without their encouragement and cordial support, I could not have finished this dissertation. Finally, the drive for completing this four-and-a-half-year mission is my parents and sisters, who have been longing for my return home.
ABSTRACT

Health information system is considered a managerial tool that is needed for the planning and management of health service deliveries in developing countries. The health reporting system is its predominant component. A cross-sectional study was conducted in 17 provinces of northern Thailand from June to December, 1990. Movements by Thailand's Ministry of Public Health (MOPH) and its self-contained peripheral units (provinces) suggested that the current health reporting system was inadequate. The effectiveness of provincial health reporting systems was assessed by means of a user satisfaction survey and case study of two selected provinces, across a sample of four critical user groups.

The user satisfaction survey disclosed that the northern regional system was ineffective. Cluster analysis revealed three different user perspectives and three respective user clusters. Discriminant function analyses indicated that meaningful cluster-membership predictors included age, education, past experience, membership of two groups (provincial health officers and community hospital directors) and gender. Personal attributes exhibited as strong a prediction accuracy as locational experiences did, implying that local policies and interventions could have a strong influence on satisfaction outcomes.
Case study results concurred with the survey findings. Further, it suggested that effective system exhibited some plausible features, including; leadership of top management, participation of staff personnel, instrumental properties of the system, stringent quality control, and interinstitutional communication. Adjustment towards more decentralized management at the provincial level was also considered a positive enhancement to the local system improving project. The dissertation also provides recommendations for policy consideration.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF PLATES</td>
<td>xv</td>
</tr>
<tr>
<td>CHAPTER I</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION TO THE STUDY</td>
<td>1</td>
</tr>
<tr>
<td>General Overview</td>
<td>1</td>
</tr>
<tr>
<td>Thailand Situation</td>
<td>4</td>
</tr>
<tr>
<td>MOPH Health Reporting System</td>
<td>8</td>
</tr>
<tr>
<td>Problem Statements</td>
<td>10</td>
</tr>
<tr>
<td>Information System Evaluation</td>
<td>13</td>
</tr>
<tr>
<td>This Study and Its Context</td>
<td>14</td>
</tr>
<tr>
<td>Plan of Analysis</td>
<td>17</td>
</tr>
<tr>
<td>Purpose</td>
<td>19</td>
</tr>
<tr>
<td>Significance</td>
<td>20</td>
</tr>
<tr>
<td>Framework</td>
<td>21</td>
</tr>
<tr>
<td>Research Questions</td>
<td>28</td>
</tr>
<tr>
<td>Limitation</td>
<td>29</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>31</td>
</tr>
<tr>
<td>CHAPTER II</td>
<td></td>
</tr>
<tr>
<td>REVIEW OF THE LITERATURE</td>
<td>35</td>
</tr>
<tr>
<td>Section I: Global Issues</td>
<td>36</td>
</tr>
<tr>
<td>HIS for District (Local) Health Systems</td>
<td>38</td>
</tr>
<tr>
<td>HIS for Decision Making</td>
<td>41</td>
</tr>
<tr>
<td>Community-based HIS</td>
<td>49</td>
</tr>
<tr>
<td>HIS for Cost Analysis</td>
<td>49</td>
</tr>
<tr>
<td>Microcomputers in HIS</td>
<td>50</td>
</tr>
<tr>
<td>Section II: International Experiences</td>
<td>51</td>
</tr>
<tr>
<td>Section III: HIS and HIS Studies in Thailand</td>
<td>56</td>
</tr>
<tr>
<td>Section IV: Information System Assessments</td>
<td>64</td>
</tr>
<tr>
<td>Section V: MIS Success Factors</td>
<td>76</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>80</td>
</tr>
</tbody>
</table>
CHAPTER III

METHODOLOGY OF THE STUDY ............... 82

Section I: Individual System

Users ......................... 83
Research Design:
Population and Sample ........ 83
Variables ................. 90
Preliminary Interview ....... 91
Instrumentation ........... 92
Questionnaire Administration .... 97
Data Analysis ............... 99
Operational Definitions ...... 103

Section II: Provincial Assessment .. 105
Quantitative Assessment ........ 106
Case Study .................... 108
Data Collection ............. 109
Data Analysis ............... 114
Chapter Summary ............. 115

CHAPTER IV

RESEARCH FINDINGS I:
INDIVIDUAL USER SATISFACTION ....... 117

Section I: Profiles of Respondents ................. 117
Group I .................. 119
Group II .................. 119
Group III .................. 120
Group IV .................. 120

Section II: Main Findings ................. 121
Achieved Effectiveness .... 122
Weaknesses of Regional System ........ 123
User Perspectives ........... 125
Satisfaction Predictors ... 127
Locational Variables as Satisfaction Predictors ... 132

Section III: Instrumentation ............ 134
Content and Construct Validity ........ 135
Reliability ................. 143

Chapter Summary ..................... 144
CHAPTER V
RESEARCH FINDINGS II: PROVINCIAL ASSESSMENTS

Section I: Quantitative Provincial Findings

Section II: Case Study of Two Provinces (PR4 and PR15)

PR4 - The Conventional Province

PR15 - The Innovative Province

Chapter Summary

CHAPTER VI
DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Summary of the Study
Discussion of Findings
Policy Recommendations
Major Deficiencies of Current Systems
Methodological Problems and Future Study

Final Conclusion

APPENDICES

Appendix I. Characteristics of Northern Provinces
Appendix II. Questionnaires
Appendix III. Outline of Interview Questions and Discussion In Case Study
Appendix IV. Simplified Templates of PR15's File
Nos. 1 and 7 ........ 282

REFERENCES .................. 284
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Number of Innovative Provinces in the Four Regions</td>
<td>34</td>
</tr>
<tr>
<td>4.1.1</td>
<td>Characteristics of Respondents</td>
<td>146</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Scores of Satisfaction Domains, Domain Groups, and Overall Satisfaction with Domain Ranks</td>
<td>148</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Agglomeration Schedule of Cluster Analysis Performing on A 10 Percent Subsample</td>
<td>150</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Final Cluster Centers</td>
<td>152</td>
</tr>
<tr>
<td>4.2.4</td>
<td>ANOVA for Classification Variables Between the Three Cluster Profiles of the Three Clusters</td>
<td>152</td>
</tr>
<tr>
<td>4.2.5</td>
<td>Profiles of the Three Clusters</td>
<td>153</td>
</tr>
<tr>
<td>4.2.6</td>
<td>Summary of Steps Determining the Model by Discriminant Analysis</td>
<td>154</td>
</tr>
<tr>
<td>4.2.7</td>
<td>Canonical Discriminant Functions of the Full Model</td>
<td>154</td>
</tr>
<tr>
<td>4.2.8</td>
<td>F Tests of Difference and Significance Between Pairs of Clusters</td>
<td>155</td>
</tr>
<tr>
<td>4.2.9</td>
<td>Canonical Discriminant Functions Evaluated at Group Means (Centroids)</td>
<td>155</td>
</tr>
<tr>
<td>4.2.10</td>
<td>Standardized Discriminant Function Coefficients</td>
<td>156</td>
</tr>
<tr>
<td>4.2.11</td>
<td>Pooled-within-groups Correlations Between Discriminant Variables and Discriminant Functions</td>
<td>157</td>
</tr>
<tr>
<td>4.2.12</td>
<td>Canonical Discriminant Functions (Model 2)</td>
<td>157</td>
</tr>
<tr>
<td>4.2.13</td>
<td>F Tests of Difference and Significance Between Pairs of Groups (Model 2)</td>
<td>158</td>
</tr>
<tr>
<td>4.2.14</td>
<td>Standardized Canonical Discriminant Function Coefficients (Model 2)</td>
<td>158</td>
</tr>
</tbody>
</table>
4.2.15 Pooled-within-groups Correlations Between Discriminant Variables and Discriminant Functions (Model 2) .... 159
4.2.16 Canonical Discriminant Functions Evaluated at Group Means (Model 2) .... 159
4.2.17 Classification Results - Model 1 .... 160
4.2.18 Classification Results - Model 2 .... 160
4.2.19 Canonical Discriminant Functions (Model 3 - Locational variables only) .... 161
4.2.20 Classification Results - Model 3 .... 161
4.2.21 Summary of Results of 7 Models .... 162
4.3.1 Domains Rating by Personnel Levels .... 163
4.3.2 Correlations between Overall Score and Domains ......................... 165
4.3.3 Final Statistics of the Second-round Factor Analysis ..................... 166
4.3.4 Factor Loadings Using Varimax Rotation ................................. 167
4.3.5 Factor Loadings Using Oblimin (Oblique) Rotation ........................ 168
4.3.6 Reliability Estimates of Multiple-item Variables .......................... 169
5.1.1 Profiles of the 17 Northern Provinces Grouped by Quartiles of Overall Satisfaction Scores ...................... 223
5.1.2 Provincial Satisfaction and Quartiles by Groups and Components .......... 225
5.1.3 User Satisfaction Profile by Groups ... 226
5.2.1 PR4's Satisfaction Matrix .......... 227
5.2.2 Satisfaction of System Management (PR4) ............................. 227
5.2.3 Satisfaction of Utility Enhancements (PR4) ............................ 228
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.4 Satisfaction of Input Procedure (PR4)</td>
<td>228</td>
</tr>
<tr>
<td>5.2.5 Differences between the two Major Population Data Figures</td>
<td>229</td>
</tr>
<tr>
<td>5.2.6 Satisfaction of Output Quality (PR4)</td>
<td>229</td>
</tr>
<tr>
<td>5.2.7 PR15's Satisfaction Matrix</td>
<td>230</td>
</tr>
<tr>
<td>5.2.8 Satisfaction of System Management (PR15)</td>
<td>230</td>
</tr>
<tr>
<td>5.2.9 Satisfaction of Utility Enhancements (PR15)</td>
<td>231</td>
</tr>
<tr>
<td>5.2.10 Satisfaction of Input Procedure (PR15)</td>
<td>231</td>
</tr>
<tr>
<td>5.2.11 Satisfaction of Output Quality (PR15)</td>
<td>231</td>
</tr>
<tr>
<td>Plate</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>MOPH Data Reporting System</td>
</tr>
</tbody>
</table>

XV
CHAPTER I
INTRODUCTION TO THE STUDY

This dissertation consists of six chapters. Chapter I will introduce the study which was conducted in Thailand during June to December, 1990. The main subject of this study is the provincial health reporting system under Thailand's Ministry of Public Health (MOPH). This chapter will describe global trends in the health information system (HIS) and specific problems in the Thailand case, as well as the existing structure of the MOPH reporting system. The Thailand case is based on information present in recent researches and that acquired from a preliminary study conducted between June and July of 1990. Then, the main problems under study will be stated. Finally, Chapter I will describe the context of the study, purpose, significance, theoretical framework, methodological plan, specific research questions, and the study's limitation. Related theories and study methods given in this chapter will be only an introduction, of which the details will be provided in Chapters II and III, respectively.

General Overview
In the Alma-Ata Declaration (1978), the World Health Organization (WHO) considers health comprehensively. It is not just a matter of lack of disease but rather the social outcome of national development and progress expressed in terms of improved quality of life. The goal of "Health for
All" demands a full list of health and multisectoral improvements. The World Bank's World Development Report (1986) indicated that although in the several decades great strides have been made in ameliorating poor socioeconomic conditions in the developing world, prospects for 'Health for All' by the year 2000 remain remote. Average annual growth rates for low and middle income countries have remained around 5% for the last 20 years and distribution of income continues to be severely skewed. This rate of change implies that hundreds of millions of people will persist in absolute, dire poverty after the end of this century (World Bank, 1986).

The resources available for the efforts to improve health are small relative to the sums spent in other sectors of the economy. Governments apportion, on average, significantly less than five percent of their budgets to health; individuals and households probably spend one to four times as much. Furthermore, there is indication that per capita resources available for these activities are declining at the international level (deFerranti, 1985; Stinson, 1982). Therefore, improving the efficiency of management of available resources is one way of adding effectively to the relative impacts of health services. A primary constraint is inadequate information support for the managerial process (WHO Report, 1987). This becomes the rationale for using a
management information system (MIS), which may be called health information system (HIS) in the health context.

The health information system helps the manager to evaluate the magnitude and distribution of health problems, to determine whether the goals and objectives of a program or service are being realized, and to assist rationalizing the decision-making process when allocating limited resources (White, 1984).

Perhaps a way to summarize the current problems of health management information systems is Finagles' Law: The information you have is not what you want; the information you want is not what you need; the information you need is not what you can obtain (Opit, 1987). The collection of too much data, much of which is not pertinent, and with no priorities leads to inadequate and inappropriate analyses. Kadt (1989) concludes that major inadequacies of HIS are: (1) the overload imposed on health workers; (2) the over-centralization of information systems; (3) the failure to analyze the available information adequately or to use it for planning or feedback; (4) the aggregation of data at higher levels that masks action which should be taken; and, (5) the failure to build a bridge to other sectors. In developing countries, use of information is rare especially at the local level (Reynolds, 1988).
The WHO Program on Appropriate Health Care Technology selected information technology as its first key issue (WHO, 1988). However, one cannot expect success by simply placing the technology at the disposal of health care providers. An investment in information technology is relatively expensive. It may also produce adverse effects if the technology is used improperly. The Aga Khan Foundation (1988) concludes that the appropriate implementation of an information system is a key to system effectiveness.

**Thailand Situation**

Thailand, a developing country, features a public-assistant health delivery system. The country spends approximately five percent of its GNP on health activities annually.¹ Public delivery systems provide health care to the majority of people. The Ministry of Public Health (MOPH) is the governmental institution responsible for directing and coordinating national health development. A few health-related units under other ministries also play supplementary roles in providing health care to the population (MOPH, 1987). The private sector has been growing and currently provides medical services primarily in Bangkok and

---

¹The average annual per capita expenditure for health from 1983 to 1987 was 44.78 dollars or 5.38 percent of GNP per capita (exchange rate 1 dollar=25 bahts). An estimate for 1991 is 71 dollars or 6.3 percent of GNP per capita. (Division of Health Statistics, 1991 - Original source: The National Board of Economic and Social Development)
other major urban areas. The Royal Thai Government apportions approximately five percent of the annual budget to health care.²

Improvement of the health information system first appeared as a national policy in the Fourth National Plan (1977 - 1981). Emphasis was placed on managerial information and disease surveillance, as well as, on establishing responsible structures. During this period central and peripheral "health information centers" emerged. The information development policy remained in the two subsequent five-year National Plans. The Fifth National Plan (1982 - 1986) stressed data quality. Most recently, besides the emphasis on the utilization for planning, management, and disease surveillance, the Sixth National Plan (1987 - 1991) also mentioned intersectoral information exchange and the introduction of computers.

At present time, only a limited number of studies on health information systems in Thailand exist (see Chapter II for a review of the literature). Reportedly, data are often inaccurate and incomplete, and suffer from a lack of standard

²The Ministry of Public Health (MOPH) obtained a budget of approximately 649 million dollars or 4.84 percent of the government budget in the 1990 fiscal year. The average MOPH budget from 1987 to 1991 was 4.54 and 0.82 percent of the government budget and GNP, respectively. (Division of Health Statistics, 1991).
definitions. Utilization of information is not prevalent for planning and administration (WHO, 1989; Vuttipong, 1988). Imbalanced workload of health personnel, redundancy of reporting forms, irrelevant report contents, and inadequate training and supervision also appear as the most cited problems (Vuttipong, 1988; Temchavala, 1986; Deeswasdi, 1986). Nonetheless, health-related data from outside the Ministry’s structure are seldom obtained (Boonthai, 1984).

The Ministry of Public Health (MOPH), in collaboration with the Primary Health Care Operations Research project (PRICOR) and the United States Agency for International Development (USAID), conducted a study in 1986 which showed that the country’s information system for primary health care management had five major problem areas. These included: (1) centralized planning; (2) uniform project implementations despite local differences; (3) lack of intersectoral cooperation; (4) inadequate emphases on health promotion and disease prevention; and, (5) the targeting and reporting system responded primarily to the central budgetary system and less to local management.

MOPH launched two operational research projects in 1989. They concluded that the imbalanced workload, reporting redundancy and inadequate understanding of data processing were most pronounced at the subdistrict (the lowest) level. Reports
were incomplete and out-dated. Too much emphasis was placed on undefined activities rather than epidemiologically precise data. But project outcomes and health status were inadequately addressed. Little use of the data was common, which was attributed to the doubtful quality of data, deficient analyses, and the lack of usable contents in reports (MOPH, 1989).

Alongside the above two studies, MOPH and PRICOR initiated the "Thailand Primary Health Care Information for Management: Macro and Micro Approaches to A Model System" project. This project suggested a revision of reporting forms, especially the one linking the Ministry and provinces (Form 402). This revision would result in a reduced number of reported items and an alleviation of redundancy. Occasional special surveys were recommended for less frequently requested data. The project also proposed a revision of the health indicator set (and reporting forms) for the use at the local level. By 1990, the "new (data set) model" would be reviewed for validity (MOPH, 1989; see also Chapter II for a review of the literature).

Automation of the system is still embryonic among units under MOPH. By April 1988, twenty five of the 72 provincial health offices had at least one microcomputer installed (Health Statistics Division, 1989). Only a few provinces had as many
as three machines. They were mostly used at provincial health offices. The MOPH's policy was still obscure despite the fact that official statements encouraged automating those departments and offices which considered themselves "ready" (Central Health Information Center, 1989).

MOPH Health Reporting System

Health-related data is collected at the village level and passed upwards through the Ministry of Public Health (MOPH)'s hierarchical structure to the health information center in Bangkok (See Plate I). The Permanent Secretary is the top permanent officer. Locally, provincial health offices function as the primary administrative unit (MOPH, 1987). The structural hierarchy of the information network is as follows (see also Plate I):³

**Village level:** Data is compiled by village health volunteers in their log books. Subdistrict health officers meet with volunteers, collect the information, then integrate it with data recorded on their office monthly reports (PHC MIS Project Study Team, 1986).

**Sub-district level:** Subdistrict health officers at local health centers compile a subdistrict aggregate data

³Although other non-MOPH and private agencies are shown in the diagram, the Ministry does not have official authority to have them send reports. Thus, the reporting system is largely composed of those produced by the MOPH's agencies.
report and submit this to the respective district health office (DHO) on a monthly basis. The raw data comes from various diverse sources and are reportedly processed by an inadequate number of personnel (PHC MIS Project Study Team, 1986; Vuttipong et al., 1988).

District level: DHOs compile district monthly reports. Community hospitals regularly report about curative activities and community-based activities within the district central community. \(^4\)

Provincial level: The provincial health information center of the provincial health office (PHO) collects all health data gathered by public and private health units within the province. Data is generally sent from DHOs, provincial and community hospitals, municipalities, and the private sector. Then statistical data processing and information analysis is conducted for the purpose of planning. A summary of the information is then forwarded to the Central Information Center in Bangkok. In 1988 twenty-five PHOs reportedly used computers in data processing (Department of Health Statistics, 1988).

\(^4\)These hospitals are normally small-sized ranging from ten to ninety beds and provide primary and secondary medical care. They are also responsible for community-based health programs within district community centers.
Central level: The Central Information Center collects reports from all provinces as well as those generated by organizations outside of the Ministry. The Center reports to the Permanent Secretary. Currently, some MOPH's central units also demand direct reports from PHOs. Quarterly reports are generated and distributed to respective offices in the MOPH. The central system is now partly automated.

The Problem Statements

Besides the MOPH's initiation, several provinces have currently developed their own provincial system improvement projects. Dr. Somsak Choonharasmi, the director of the Health Statistics Department, named eight notable provinces in 1990. He reported that these "provincial innovations" exhibited some variation. A researcher working on the MOPH/PRICOR project elaborated with two contrasting cases: while Lampang's approach stuck to manual form design, Phuket

5 The preliminary interview indicated that the Center could not process and provide adequate, timely data to other central units, thus it often bypassed.

6 This interview was conducted in July 1990.

7 He reported some of the innovative provinces; including, Lampang, Phuket, Nakhon-rajasa (Korat), Maha-sarakham, Srisakhet, Singhaburi, Angthong and Ayuthya. He, nonetheless, admitted that not all of the provinces improving their provincial systems reported to the MOPH of their implementations. The extent of change also varied across the provinces.

8 This interview was conducted in August 1990.
accentuated automation. However, each of the innovative provinces was implementing its model in parallel with the MOPH conventional system.

Dr. Chunharasmi contended that the trend will be greater reliance on provincial health offices (PHOs). He raised an example. The MOPH has established a new centrally required data set which amounts to only sixty percent of items in the existing set. This new central periodic form (Form 402) will be in use starting in the 1991 fiscal year. A role of the PHO will be to justify data items to remain and to be discarded in the new form. Dr. Uthen Charanasri, another significant MOPH's expert, pointed out two practical inadequacies of existing systems that appear as the main rationale for current changes: (1) the lack of instrumental features aiding field operations and project monitoring; and, (2) questionable target population data (see Chapter Five for details).

Recent movements by both MOPH and the provinces illustrate a recognition of the inadequacy and dissatisfaction with the current system. Dr. Charanasri's assertion and Dr. Chunharasmi's contention concur with the above MOPH-PRICOR conclusions suggesting that a greater degree of

---

9This interview was conducted in May 1990. Dr. Charanasri is currently the Chairman of General Communicable Disease Control Division. He was the former provincial chief medical officer in Korat who initiated the province's information system improvement project in 1985.
decentralization will be incorporated in the MOPH information system. This implies that emphasis should be placed more on peripheries than the center, or at least, no less than on the center. Since changes have been initiated by, happened in, and will likely expand in the peripheries, concerns of local users are critical to success or failure of the implementation. A systems evaluation based on local users' viewpoints would make sense.

The first major problem in the current process is that the aforementioned evidences suggest that local systems are performing inadequately. Study is thus needed to disclose specifically what system facets are considered problematic, and what factors underlay the outcomes of system performance as viewed by the users. A second fundamental problem is that what local users want might be different from central endeavors and that these differences might lead to negative consequences. Thus, a proactive understanding becomes sensible. While current movements have been taking place sporadically and often go unreported, such experiences should be explored to examine the potentials of the altered systems. Specific questions include: why such changes occurred; whether system outcomes depended on existing organizational structures, environments, individuals or were internal to system management; and, what features potentially contributed
to more and to less successful results. Such case studies can become guidelines for future contingent implementation.

**Information System Evaluation**

Information systems assessment can be thought of as a continuum which ranges from the highly objective to the very subjective or political approaches (Hirschheim and Smithson, 1988). Assessment of system effectiveness is an approach which falls somewhere in the middle of the above continuum, as described in the management information system (MIS) literature (Hirschheim and Smithson, 1988). One questions whether (and the degree to which) the system is performing what it sets out to accomplish. To measure effectiveness of the information system, "user satisfaction" has received research supports and serves as a primary construct by which information systems are evaluated and behavioral issues examined (Ives, Olson and Baroudi, 1983; Nolan and Seward, 1974). This measure defines effectiveness as "the extent to which the system satisfies the users." Mellone (1990) points out that user satisfaction assessment is indeed one form of attitude measurement.

Nonetheless, though user satisfaction seems to be the best established and most practical measure, Mellone (1990) remarks that it alone is not sufficient to capture adequately the full meaning of effectiveness. She advises researchers to
consider, in addition, user behavior in the transformation of inputs to outputs. This study used user satisfaction assessment and supplementary case studies for the evaluation of system effectiveness. Chapter II will describe research approaches and related theories of information system assessments in more details.

This Study and Its Context

Under the constraint of limited resources, health care planning and administration demands meaningful information to enhance the quality of decision-making and implementation. Although MOPH has a policy to improve the current health information systems, which are found to be inadequate, the strategy to achieve this goal is still unclear, especially with respect to provincial systems. Inadequacies of the existing systems are reflected by the emergence of reported movements in several provinces and within the MOPH central units. Further, the investment in information technology is usually high, so a thorough system design is required. This study is intended to examine the health information system, specifically the MOPH reporting system.

\[10\] Such as those incidents reported by Dr. Chunharasmi, Dr. Charanasri and the MOPH researcher above. The preliminary study also obtained congruent opinions from other interviewees.
Under the MOPH's structure, provinces are considered a self-contained governmental unit of the national health system. They mediate between national plans and local needs through their operations. Hence, the focus of the study was on provinces. The primary question was whether the provincial information systems responded to demands of the various organizational constituencies. In other words, how effective were the current provincial health information systems as reflected by user satisfaction?

The study also investigated different facets of satisfaction and factors determining their fulfillment. By breaking down the satisfaction construct into four interpretable components and by disaggregating the organization (province) into four meaningful segments, assessment of the system users' evaluation with respect to provincial accomplishments become more specific. This study further examined factors potentially associated with specific satisfaction patterns and system effectiveness. The patterns of satisfaction breakdowns were examined in comparison to the qualitative findings of field study. Case study was aimed at: (1) verifying satisfaction survey results; and, (2) adding information to the user satisfaction survey. Since this study was considered exploratory research (this research paradigm has never been applied in the context of Thailand's public health delivery system), it was expected that the survey might not explain
emerging satisfaction patterns fully, and that pertinent factors needed to be sought out via field investigation of the underlying process and situation.

This cross-sectional study employed a self-administered questionnaire survey as the principal method. The surveyed population was composed of government health officers (information system users) in all seventeen provinces of the northern region. Supplemental field study, conducted in two selected provinces, included interviewing predetermined personnel (system users), nonparticipatory observation and an examination of existing reports. Chapter III will describe the study methods in detail.

Selection of the northern region as the study site rested on the evidence that the region was composed of a good mix of innovative and conventional provincial systems. Innovativeness was indirectly estimated by two features: implementation of health information system improvement project and early acquisition of computers at the provincial health office. Table 1 shows that the northern region appeared as the most innovative region and composed of a good mix between innovative and conventional provincial systems.
Plan of Analysis

The study is composed of two levels of assessment: individual users and provinces. The survey provided user opinions on various aspects of the provincial systems they interacted with. Data analysis started with calculating the overall satisfaction score provided by individual users. The aggregate average score became the crude estimate of regional system effectiveness. Disaggregation of the overall score illustrated a clearer picture as to specific strengths and weaknesses of the regional system and suggested problem areas within the regional system.

The study presumed that satisfaction patterns would provide more specific information on how users felt about their respective systems than overall scores would. Based on patterns of satisfaction components, the study used cluster analysis to identify distinct groupings of users. Once user groups were identified, the study employed discriminant function analysis to determine which attributes characterized each of the groups. The study posits that both personal attributes and collective (locational) variables were meaningful predictors of group membership. The former referred to individual characteristics, whereas the latter, including province and group, captured the experience to which users had been exposed as members of respective organizational segments. The meaningfulness of collective factors pointed to
the significance of effects that local policies exerted on organizations (see Chapter III).

The second part of the analysis was an investigation at the provincial level. The study first examined whether certain provincial profiles were associated with provincial satisfaction scores. Then, the pattern of satisfaction scores exhibited by the four provincial segments were inspected. By comparing the scores and their patterns, one can identify provincial systems that may work well or less well. The study anticipated that pertinent factors associated with system outcomes were inherent to the process and might not be included in the survey models. The field study in the two provinces could disclose the underlying processes. Qualitative arguments are aimed at attesting to whether the survey scores concur with what was found in the field, and explaining why they appear as such. Looking closer at the underlying mechanism, one expects to identify possible "process factors." This refers to specific situations, as

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Baroudi and Orlikowski (1988) affirm that the survey scores are useful for comparisons across different user groups of the same information system (to pinpoint the problems particular users may be experiencing), as well as for comparisons across the various information systems (to highlight specific information systems that may be problematic). They advise that the survey should not be seen as definitive evaluation. It does, however, provide a starting point to identifying possible areas of conflict and dissatisfaction. In enabling the further investigation, it can be a powerful tool.
well as, provincial policy and interventions affecting system effectiveness.

**Purpose of the Study**

The aim of this study is to examine the relationship between health personnel attitudes (called "user satisfaction") and their behaviors, which provided the basis of assessing the health information systems in the northern region of Thailand. The elementary purpose is to estimate the effectiveness of the regional health information system as reflected by user satisfaction given the set of satisfaction domains. More specifically, the study further attempts to:

1. Identify specific areas of weakness with regard to the four disaggregated components of satisfaction;
2. Based on these patterns of satisfaction, classify users into distinct groups so one can see the main perspectives that users expressed about the system;
3. Determine those factors that were associated with user satisfaction as well as assess their relative contributions;
4. Examine whether personal and locational (collective) variables were comparable predictors of user satisfaction;
5. Examine satisfaction scores and their patterns by provinces to distinguish outcomes of the system at the provincial level;
(6) Compare the survey results with field study findings and explain the patterns exhibited by the two selected provinces based on qualitative findings;

(7) Postulate the main "process factors" found in the field that affected system effectiveness.

Significance of the Study
There has been a global and country need for an effective health information system. MOPH has implemented research and projects to improve the government health information system. MOPH has sponsored and facilitated transformation of provincial systems on an assumption that effective models would emerge.

MOPH has advocated a policy to improve national health information system but the strategies are still ambiguous, especially for provinces. Among the recognized obstacles are lack of HIS expertise, an over-centralized system, the risk of high cost of investment, and lack of adequate assessment. This dissertation was endorsed by the MOPH's top-management. They participated from the beginning in designing the study. Because of such sponsorship, it becomes more likely that MOPH would consider the findings. The study presents a picture of the provincial systems in the northern region and recommends critical points for policy consideration.
The study demonstrates the use of a practical assessment tool for this relatively new research area (under the study context). Qualitative findings also provide information not available in the current literature, and so contributes to new knowledge to the field of HIS.

MIS (or HIS in the health context) is accepted as a powerful managerial tool. However, it will not work unless it produces what the organization and users require. This study provides an insight into local middle management of the factors that contributed to the effectiveness of HIS in supporting organizational operations.

The results will be presented to the Society of Rural Doctors, to which most physician-administrators in rural areas belong. This should help draw attention to the issues and research findings leading to more interest in unproving HIS and future actions. Finally, this study is the author's dissertation for the fulfillment of the Doctor of Public Health degree.

**Framework of the Study**

This evaluation framework adopts the position that success is a subjective notion which is best measured in terms of user satisfaction. The choice of user satisfaction in measuring effectiveness implies a particular view of organization and its operations (Mellone, 1990). Scott (1987) suggests that it
is often associated with the "natural system" view of an organization. This paradigm asserts that human activities and attitudes have impacts on the organization and that satisfaction be a tenable indicator of effectiveness (see Chapter II: Section 4).

The above framework\textsuperscript{12} counts on the expectancy-value approach, especially the "theory of reasoned action" (see Ajzen and Fishbein, 1980) in psychology. The theory states that attitudes towards behavioral action and social norms are assumed to influence behavior through "behavioral intention," and behavioral intention is assumed to be highly correlated\textsuperscript{13} with "actual behavior." Simply phrased, if one feels good about the system, one would intend to perform well, and, in actuality, will tend to act favorably with it.

\textsuperscript{12}An excellent review of the theoretical grounds applied to information system is given by Mellone (1990).

\textsuperscript{13}Ajzen and Fishbein (1980) suggests that such a correlation can be enhanced by two modifications. They recommend: (1) specific measurement items as to context, action, target and time, and (2) assessment under a situation in which behavior is under volitional control. The extended operationalization of satisfaction, using the four major components covering 24 domains (see Chapter III), fulfilled the former condition. However, since reporting was one of daily tasks of the studied health officers, the latter was partially met.
This study adopts the assumptions described by Davis and Hamann (1988) and Davis and Srinivasan (1988). These assumptions and those of this study are as follows:

(1) The purpose of an information system (IS) and its functions are to support the other functions of an organization. Information systems do not have an independent purpose; there is always a "host organization" to be served;

(2) The organization and management of the information system should "fit" the organization and management of the host organization;

(3) The effectiveness of the information system is reflected by its performance in response to organizational needs and priorities;

(4) The perception of the user with regard to the system being used (i.e., its performance) is an accurate indicator of system effectiveness;

(5) The perceptions of several users of a system can be aggregated to arrive at an overall assessment of the system under study; and,

(6) User satisfaction with an information system can be measured accurately.

Assessment for this study includes primarily the functional, and, to a lesser extent, technical characteristics of the provincial health information system. The study leaves the
area of economics untouched since it requires a technically different approach (see Chapter II). Typically, financial data is either inaccessible, incomplete, dispersed or unavailable. The time frame investigates mainly the then present situation and recent past (i.e., the past three years).

The research presented here is intended to be a formative assessment. The study provides diagnostic information which helps explain why the health information system performed as it did. The overall satisfaction score is presented with its four meaningful facets: System Management, Utility Enhancements, Input Procedure and Output Quality.\(^\text{14}\) By examining these four main components, one can expand the discrimination of user perception beyond a single "satisfied-dissatisfied" dimension. Thus, system problems can be diagnosed more precisely and more specifically.

The study considers the users of the three utilization modes described by Davis and Srinivasan (1988). They include "direct users" (those engaged in sending and receiving data to and from the information department), "automatic users" (data

\(^{14}\)These components and their domains were adapted from well-established scales, notably those by Jenkins and Ricketts (1985), Bailey and Pearson (1983), Baroudi and Orlikowski (1988), and Ives, Olson and Baroudi (1983) and reclassified by a factor analysis of survey responses. See Chapters III and IV.
processing staff), and "indirect users" (administrators who acquire information from the reports). Given such classification, authoritative and administrative positions would play a critical role in determining the utilization mode. In this study context, high-ranking personnel amounted to far fewer in number than low-ranking officers. Yet some users exhibited mixed modes. This study divided each PHO into four segments based on organizational distance from the provincial health office. They included: provincial officers, community (district) hospital directors, district health chief officers, and subdistrict health chief officers. The two middle groups are largely indirect users whereas the last group represent direct users. The provincial group included both indirect and automatic users. However, this delineation is not precise. By comparing the disaggregated scores across these four organizational segments, the survey may identify problem areas as well as locate where they occurred within the provincial organization.

This study proposes two classes of factors influencing the outcome of satisfaction. The first, called "individual attributes," include age, gender, education, past experience, decisional authority, status (administrative and medical), position, time in the position, and perceived development of
the locality where the person worked. The MIS literature\textsuperscript{15} describes past experience (Goldhaber, 1985), autonomy, and intrinsic meaningfulness of task (Blauner, 1960; Sheppard and Herrick, 1972). It was expected that the task attributes be captured by personal status and position-related variables in this study. The perception of local development level was assumed associated with the complexity of community structure, even though this was an over-simplification. The second class of variables was those characterizing people in the same organization or organizational segment in the same manner. Termed "locational (or collective) attributes", they include: province and group (referring to membership of the four basic segments in each province). They reflected effects of local policies or interventions.

The study posited that both classes of factors influence the satisfaction outcome. The outcome refers to the picture (pattern) of satisfaction components, not just the overall satisfaction. The implication is that intervention policy can be customized to suit meaningful targets revealed by the significant individual attributes. Alternately, the greater locational factors exhibited their significance, the more variation of events would occur among provinces and groups.

\textsuperscript{15}Blauner (1960) and Sheppard and Herrick (1972) also describe level of pay and economic security, and opportunity of social interaction as significant factors. Since they are less IS-related, the model does not include them. Porter and Lawler (1968) state that productivity produces satisfaction.
One would have to be meticulous about such policy that affects significant organizational segments.

Baroudi and Orlikowski (1988) suggest that a user satisfaction survey be coupled with further field investigation.\textsuperscript{16} Hirchheim and Smithson (1988) call this most subjective and political end of evaluation "understanding-zone" studies. Land (1976) and Mendelow (1984) note the conflicting information system evaluation criteria of the various groups of users. Carnall (1982) states that introduction of an information system poses problems because of conflicting interests and differing views. This study included a field study in two selected provinces to address this issue. One was regarded as an innovator\textsuperscript{17} and the other was less innovative but was of comparable characteristics. The field study adopts the two-dimensional framework - satisfaction components and provincial segments - for the analysis of observed situations. The aim is to distinguish provincial interventions and specific situations that affected system effectiveness. Case study also provides an evaluation based

\textsuperscript{16}User satisfaction survey could be considered assessment of outcomes. Scott (1987) points out that using outcome criteria for determining organizational effectiveness is subject to certain biases. Outcomes can be affected by differences in inputs, technology, and output environments. He suggests that process and structure criteria should also be considered.

\textsuperscript{17}The selection was based on the information from the preliminary interview, conducted during June-July, 1989, with several of MOPH's distinguished officers.
on field observation to be compared with the picture of the sixteen-cell satisfaction matrices reported by the satisfaction survey. This latter endeavor would help verify the use of a satisfaction survey for information system assessment in the study context. Finally, study implications will be on the grounds of association between the findings of the two approaches.

Research Questions

Specifically, the study tries answer to the following questions:

(1) How much did the provincial health information systems accomplish, based on how the users felt about it? How many of the users considered themselves satisfied?

(2) Given the four facets of user satisfaction, was there any particular area where the system exhibited major weakness?

(3) How did users view the information system with regard to the expressed patterns of satisfaction? Were there any distinct patterns? If so, how did the users cluster themselves based on those patterns?

(4) Which attributes were good predictors of emerging satisfaction patterns? Did locational attributes exhibit
comparable significance as personal attributes?

(5) How much did each of the 17 provinces accomplish? Did satisfaction patterns show any distinct clustering? Did provincial satisfaction scores exhibit any association with organizational structure and environmental variables?

(6) For the two selected provinces, to what degree did survey satisfaction patterns agree with observed findings? What kinds of changes took place? What induced those changes? What did provincial policy and management do with the system? What were the prevalent ways of utilizing health data? What part of the input procedure was likely source of error? Did the two systems differ in terms of output quality? How did these differences affect stakeholders in each of the four segments?

Limitation of the Study

Generalization: As the target population was the information system users in all seventeen of the northern provinces, generalization to other parts of the country would be cautioned. Some of the characteristics worth considering included regional subculture, economic development of the area, resource, and coinciding program management. Furthermore, because the information system is a supporting system without its own products or discrete services, any
health officer in the organization can be regarded a user even though one seldom interacted with the system. This study did not employ random-type sampling of users across the whole organization. The selection of samples adopted a position criterion which chose from only the positions closest to the systems. Thus, though responses may reflect more accurately how the system was performing, it should be noted that they did not represent all health officers (see Chapter III).

Scope of Study: This study paid attention primarily to functional and somewhat to technical domains. It neglected other relevant criteria, especially economic impacts. Regarding the time-frame, it assessed only the current system which operationally covered only the past three years.

The "System" under Evaluation: By the time of the survey, some provinces had introduced changes within their provincial systems. It was assumed that they were implementing their innovations alongside with the MOPH conventional system. In one instance the provincial system may have been well-identified, whereas, in another it may have been only a small annex to the conventional system. Practically, the user did not see the "system picture," but considered information-related tasks as a part of one's daily activities. Thus, users responded based on the situation each faced
individually, not on any well-delineated system model. This notion should be kept in mind when interpreting the findings.

The Field Study: The field study relied much on conditions within the organization. In a government agency, interviewees often adopt a policy not to disclose some information. Or they may just prefer to do so, either for one’s own or the agency’s sake. Investigation of materials usually required permission so the researcher would not come across any meaningful materials which the organization preferred to keep untouched by outsiders.

Chapter Summary

Resource scarcity demands efficient and effective management of the health delivery system. The health information system is believed to be appropriate managerial tool. The Thai Ministry of Public Health (MOPH) adopted this position and had implemented research attempts and information system improvement projects. Reportedly, several provinces had introduced such projects at the local level. These phenomena indicate the inadequacy and dissatisfaction with the current MOPH’s system. However, nobody has arrived at well-accepted model.

This study investigated the situation in the northern region, particularly the effectiveness of the regional health
information system. The region was selected primarily because it included a good mix of innovative and conventional provincial systems. The study conducted the assessments at two levels: individual users and provincial systems. By coupling a user satisfaction survey with field investigation, the study presents the user perspectives as well as the observed significant process factors influencing the systems outcomes. This formative study aims to provide recommendations at the policy level as to how provincial health information systems may be effectively improved.
Plate I
The MOPH's Data Reporting System

PERMANENT SECRETARY

Other Ministries, Privates

Central Health INFO. Center

MOPH's Central Units

Municipalities
MOI
Others

PHO

Hospitals:
general community
private

District Dist. Centers

DHO

Private

Health Centers

Community Health Workers
Community leaders, villagers

Main channel
Secondary channel
### Table 1
Number of Innovative Provinces in the Four Regions

<table>
<thead>
<tr>
<th></th>
<th>North</th>
<th>North-east</th>
<th>Central</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIS Projects*</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Computerization**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1990</td>
<td>11&quot;</td>
<td>15</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Total Provinces</td>
<td>17</td>
<td>17</td>
<td>24</td>
<td>14</td>
</tr>
</tbody>
</table>

**Notes:**
* Excluding Bangkok.

** The provinces include: North - Chiangrai, Lampang, Prae, Nakhonsawan, and Pitsanuloke; Northeast - Srisaket, Korat, and Maha-sarakham; Central - Ayuthya, Singhaburi, and Angthong; and, South - Phuket and Surat-thani. The information were reported by the preliminary informants during May to July 1990.

/ Source: Health Statistics Division, MOPH. The figures were as of April 1988 and April 1990, respectively.

// The figures across the two rows of computerization were those reported to the MOPH. It was also possible that some provinces had machines but failed to report. The researcher called the seventeen northern provincial health offices in July 1990, and sixteen PHOs reported having at least one computer.
CHAPTER II

REVIEW OF THE LITERATURE

The subject examined in this dissertation brings together primarily two areas of the literature: local-level health information systems (HIS) in developing countries and evaluation of management information systems. The study thus becomes interdisciplinary. The related literature includes the essence of health service management (especially local-level health management systems), organizational paradigms (primarily the "natural system" paradigm), psychological theories (especially the theory of reasoned action), as well as management information system evaluation research (emphasizing here the measure of user satisfaction).

Specifically, this review of the literature features the following points:

(1) With regard to health information systems, what kinds of issues is the world mainly concerned with? What elements of those issues are closely related to the study context?

(2) What is the international position of the Thai HIS situation?

(3) Considering HIS as a supporting feature of an organization, how can it contribute to organizational management and operation? What are some concrete examples of information utilization?
(4) What do organizational and psychological theories teach us about the relationship between information and people in the organization? To what extent does the user's perception imply the effectiveness of the HIS?

(5) What elements contribute to successful implementation of management information system (despite the fact that the literature has been mainly founded in Western high-tech context)?

The review of the literature is arranged in five sections covering five main areas from general to specific: (1) global issues concerning health information system (HIS); (2) international experiences in the improvements of HIS stressing those of Asian developing countries; (3) HIS in Thailand and existing research on HIS in the country; (4) assessments of information systems; and, (5) information system success factors.

SECTION I: GLOBAL ISSUES

Most nations acquire health information by means of national reporting systems. All countries have institution-based systems for the collection of routine information about health-service delivery. But these account for only a fraction of the population suffering from health problems, and often only a fraction attending institutions, since figures
from non-governmental sectors are frequently not included. Many countries also use surveys to supplement reporting systems and to obtain information about other aspects of their health situation. Two other alternative surveillance systems include: institution- or city-based records of incidence of target diseases and local-level household surveys of mortality and morbidity carried out by trained local personnel. However, the institution-based reporting system generally has been the primary national health information system (Woodall 1988).

Reynolds (1988) reveals that current global issues on the challenges and opportunities for the improvement of health information systems include: (1) HIS for district (local) health systems; (2) HIS and decision making; (3) community-based HIS; (4) HIS and cost analysis; and, (5) microcomputers in HIS.

This section describes each of these issues but the two areas of decision-making and district health systems are presented with greater elaboration than the others owing to their close relation to the provincial health information system examined by this study. They feature concrete examples of how local public health organizations can use HIS for planning and management.
The World Health Organization (1981) defines a district health system based on primary health care as "a more or less self-contained segment of (the) national health system." This definition corresponds with the provincial health system in Thailand. Smith, Hansen and Karim (1988) describe the three common sources of information at the district level: (1) the traditional health facility-based record system; (2) community-based information system; and, (3) special studies and other sources such as census data. Of the three, the facility-based reporting system has been the most dominant.

Recent attention to district health systems has arisen from a growing awareness that better organization and management of health activities at the operational level is critical for effective implementation of national policy. Principal features of a district health system which would respond to the concept of comprehensive primary health care are: (1) equitable allocation of resources in relation to needs; (2) accessibility and coverage for the entire population; (3) emphasis on health promotion and disease prevention; (4) addressing inter-sectoral determinants of health as well as health services; (5) seeking to involve and entrust communities and individuals to assume greater responsibility for their own health; (6) comprehensive and integrated approaches for more efficient use of scarce resources; and,
(7) coordinated action of all health and health-related organizations and groups in the district under the leadership of a district health team (Smith et al, 1988).

Currently, there is a movement, in both developed and developing countries, to decentralize HIS to the local level. Common deficiencies are outlined as follows:

1. Important information is missing, specifically with respect to target populations, coverage implications, relationships between health resources and populations, and distribution of special risks. Information about health outcome and program impact are often lacking. Important items on social and environmental determinants of health (e.g., literacy and school attendance rates, and their differences by sex, occupational groups at high risk) are usually unavailable, as well as that concerning relevant local institutions, such as private organizations which provide health services.

2. Available data is inappropriate in quantity and quality. Analysis and use are inadequate. Available information is often late, incorrect, incomplete or missing.
(3) Health staff have limited skills in information processing and use. These include epidemiological and statistical skills.

(4) Available information is not sufficiently used for decision-making. Because it is usually a centrally determined process, there is limited effort to encourage analysis and use at the local level (Smith et al, 1988).

Looking at national health information systems, Kadt (1989) maintains that the most serious inadequacies of HIS include: (1) the overload imposed on health workers, (2) over-centralization of information systems and their data, (3) failure to analyze the available information adequately or to use it for planning or feedback, (4) aggregation of data at higher levels which masks actions that should be taken; and, (5) failure to build bridges to other sectors. This notion suggests that one of the weakest portions of HIS has been the local managerial process.

Kadt (1989) continues that most information systems are designed as data collection and reporting systems, with little or no attention to analysis and utilization. The traditional emphasis has been placed on selecting indicators and then designing forms to collect data based on those indicators. Smith et al (1988) consider decentralization of resource
management and planning responsibility as a prerequisite condition to ensure that the local health system can play a pivotal role as a mediator between local needs and national policy. Decentralized health management requires that local managers would specify local objectives and that their HIS would collect information to enable those managers to track performance on locally-defined problems and priorities (Reynolds, 1988). Thus, key questions include: How would such a system satisfy both demands at the national level for standardized comparison, and at the district level for local planning and evaluation? How would local managers be trained to use HIS for local decision-making?

**HIS for Decision Making**

The relationship between decision-making and information utilization is intricate. According to Simon (Simon 1960; March and Simon, 1958), decision-makers do not necessarily want to find optimum solutions; these people quite often choose options that are subjectively good enough, i.e. they

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"Mintzberg (1972) argues that the content of information used by managers are of two types: "soft" and "hard". Substantial manager's inputs are soft and speculative - impressions and feelings about other people, hear-say, gossip, and so on. The very analytical inputs - reports, documents, and other hard data seem to be of relatively little importance to some managers. So, a primary cause of ineffective decision-making is that decision-makers tend to underemphasize analytical inputs."
"satisfice" (satisfy+suffice) instead of optimize. An action is chosen because it is both rational, albeit not optimized, and satisfactory (i.e., "good enough") to the decision maker. To the utmost rationality, the manager may obtain a "perfect solution" by means of sophisticated modeling. When one either optimize or satisfices, information becomes an essential input.

The implication to the information system function is to expand the boundary of rationality by effectively providing adequate, relevant, and accurate information in a conceivable way so that the "satisficed" decision approaches the quality of a "perfect solution."

Even though the decision maker can acquire the information, utilization for making a decision is a complex phenomenon. One may define information utilization as the situation in which the decision maker becomes familiar with a report and applies it in some manner. In the realm of bureaucratic organization, Rich (1975), in his review of the literature, finds utilization theories divided into three general categories: (1) organization interest theories; (2) the two-

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19Simon's term "bounded rationality" has been applied to the view that people are indeed rational only up to a point, as an alternative to many normative decision models requiring a complete cost-benefit analysis for any decision. Managers tend to behave rationally within the parameters of the simple model (March and Simon, 1958; Simon, 1960; Agnew and Brown, 1986).
world's theories; and, (3) the nature of decision maker theories.

The organization interest theories account for utilization or non-utilization in terms of the routines and/or rules of the bureaucracy, the interest to protect staff or budget items, the reliance on more familiar and predictable in-house generated information, and the tendency to process information on the basis of whether it conforms to the position the organization is disposed towards.

The two world's theories point to gaps in communication, common values, and common problem-solving orientations between researchers and decision makers. The two parties differ in their view of practices. For example, the decision maker's main criteria may involve the time element he must deal with (e.g., some partial information now is better than full information, which cannot be used, later), whereas the researcher is often concerned with high quality information.

Finally, the nature of decision-making theories argue that the decision-making process itself is critical in accounting for utilization. The process determines the utilization. For example, when faced with unclear policy problems or those requiring immediate answers, the decision maker becomes less
likely to acquire full information, but tends to rely upon the knowledge of "experts" surrounding him/her.

Opit (1987) contends that HISs are supposed to aid management decision making, but many do not. Most HIS are designed without regard for the analysis and use of data, especially at the local level. Another reason is that health indicators are often undefined counts of events rather than epidemiologically precise population-based statistics, and not actual events compared with planned events (Last, 1987). Most produce descriptive information without eliciting problem areas, leaving managers to their own devices to interpret the information.

Opit (1987) urges that the information system be incorporated into the hierarchy of decision-making and action mechanisms at every level, so information becomes a source or product of action. Further, that devolving power and resources to the grass-roots could improve the usefulness, cost-effectiveness, accuracy, and timeliness of health information at all levels, and would benefit the people.

In the context of local health systems the major concerns for decision-making can be grouped into four categories (Smith, Hansen and Karim, 1988): (1) resource allocation and utilization; (2) use of services, coverage and quality; (3)
policy and strategy; and, (4) assessment of health needs and programma effects and impact.

(1) Resource Allocation and Utilization

Personnel: One major area of resource allocation and utilization is deployment by category of worker, and by area and size of population. This allows comparison of the distribution of health personnel and population distribution, and to the distribution of other resources, or to activity outputs. Another relevant personnel concern is the level of knowledge, attitude and practice of health workers in relation to their work. This information is important as part of monitoring previous training and determining further training.

Pharmaceuticals and Supplies: The rate of usage of essential pharmaceuticals with comparisons among the various units is an important consideration. In more developed areas further comparison with patterns of diagnosis at the various institutions can provide an indication of the quality of prescribing practices. The availability (both shortage and excess) of essential drugs and vaccines, including oral dehydration salts and family planning supplies needs to be properly monitored.
Facilities, Equipment and Transport: Each health facility normally maintains an inventory of equipment to ensure accountability. It is useful to have clear procedures for dealing with breakdowns of equipment. Information about mileage and fuel consumption is simple to obtain and can indicate need for maintenance, or misuse of fuel. It is more complex, but not impossible, to relate vehicle use to specific purposes, such as health center supervision, community support, or hospital logistics, and to monitor use against targets.

Finance: The ability to monitor allocation and use of financial resources depends on the degree of financial decentralization. Fuel for vehicles, travel and daily allowances for field staff, and funds for office supplies and maintenance of buildings and vehicles are among the important items to be properly administrated.

Some data on most of these items is readily available. But it is frequently under-used for the purpose of monitoring the effectiveness of the health system. Furthermore, existing information systems often make it quite difficult to relate resources to particular activities, to geographic areas, or to identified high-risk groups or priority activities. Comparison of performance among different areas may be inferred from
relating defined outputs, activities and inputs (Smith, Hansen and Karim, 1988).

(2) Use of Services, Coverage and Quality
To ensure quality and coverage of services, local health management staff should have current information on priority service activities, including the estimated target population for each activity and the number (and proportion) of this target population actually provided with services. Monitoring changes in these coverage figures over time indicates how well the local health team is succeeding in its efforts. The assessment of quality is probably most useful when the indicators of accessibility and coverage have reached satisfactory levels (WHO, 1986; Smith et al, 1988).

(3) Policy and Strategy
Given the critical role played by the district as a mediator between national plans and local needs, it is obvious that knowledge of both national plan strategies and targets, and local plan priorities and resources, is essential for district health personnel. Policies, objectives, and targets must be translated into operational plans which specify who is responsible for what actions, when, where, and how. The local health team also coordinates its plans with those of other
sectors such as agriculture, education, and community development. In addition, technical supports, usually provided from the upper levels, must be combined with information about local situations in order to develop appropriate plans of actions (WHO, 1981 and 1986; Smith et al, 1988).

(4) Assessment of Health Needs and Program Effects and Impacts

While the terminology "needs" and "impact" suggest two different activities, both are stages in the circular managerial process of planning, implementation, evaluation, and replanning. Information requirements for both are closely related. As most of this information changes over time, changes in key variables over a period of several years, as well as seasonal changes, become important for planning. Information about patterns of diseases and conditions can help to identify when to concentrate various activities and interventions (WHO, 1981; Smith et al, 1988).

Microcomputers and new software may be helpful in circumstances where such resources become available. Several generic microcomputer software models have important implications for PHC management, including simulation, optimization, sensitivity analysis, "what-if" models, linear
programming, project management, scheduling, and resource allocation (Wilson, 1988; Reynolds, 1988; Abrantes and Oliveira, 1988).

Community-Based HIS

Communities are not usually involved in the management information system (MIS), except as respondents to surveys and providers of information for health records. But the health care system, especially within the PHC concept, requires information on community needs and community use of that information. Key questions include the following: Is a community-run HIS feasible? What would an effective, community-based HIS look like? How would it contribute to national and district/provincial needs for information? Would a community-level HIS run by health post staff be more feasible? What would a feasible, community-based HIS look like (Reynolds, 1988)? Currently, community-based HISs are not prevalent. Scott (1988) describes a local surveillance system in Kerala State (India), and points out the problems of data precision, case identification, interpretation, and remedial actions.

HIS for Cost Analysis

One of the anomalies of health information systems is that they rarely measure costs, even though budgeting and resource allocation are among the principle functions of health care.
managers. Private sector programs usually keep better track of costs, but government programs rarely do, often equating budgets with expenditures. This makes planning difficult. A document presented to the WHO Executive Board in 1982 noted the limitation of estimating health expenditure in developing countries and the difficulties arising from lack of data, differing definitions of health expenditures, different systems of classification used by countries and differences between budgetary intentions and real financial outlays (WHO, 1980). Reynolds (1988) points out several key questions including: Can microcomputers be used to provide managers with timely cost information? How can peripheral staff be trained to use software packages that are now available? Mach (1984) suggests that the total cost of health services can be estimated by disaggregating national expenditure data, by aggregating data from local studies, or by use of a combination of the two approaches.

**Microcomputers in HIS**

In developing countries, computers are beginning to be seen in PHC programs, but largely for wordprocessing, some record management, and occasionally, financial management. They are not yet used to provide managers with information they need and can use to make decisions. In some cases automated systems actually reduce rather than increase efficiency, as well as increase paperwork, because they duplicate manual
systems. A primary obstacle to the productive use of microcomputers is human. Key questions include: Why is the technology not used and what can be done about it? Is there a lack of awareness of managers about what microcomputers can produce? Are there too few trained staff? Is there a lack of "user-friendly" programs that are designed for management needs (Reynolds, 1988)?

During the last 25 years, uses of informatics (the integration of information technology and methodology) have changed considerably. The trend in health information systems suggests that automated or partially automated systems will be expectedly implemented with advantages of capacity, enhanced communication, and possible lowering of costs (WHO, 1988a). Health informatics may assist planning and managerial processes, enhancing efficiency and effectiveness. These processes receive varying emphases at different levels of management. They include: policy formation and broad programming, detailed programming and budgeting, monitoring and control of implementation, and evaluation and reprogramming (WHO, 1988a).

SECTION II: INTERNATIONAL EXPERIENCES

With the advent of PHC systems, more integrated information systems based on a multi-purpose or multifunctional approach, are being designed and implemented (WHO, 1988a). In 1988, the
World Health Organization (WHO) conducted an assessment of health situations in major regions of the world. This investigation also revealed the status of regional health information systems (WHO, 1990).

National information systems in the 11 Asian countries including Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Mongolia, Myanmar (Burma), Nepal, Sri Lanka and Thailand were assessed. Six principal regional weaknesses were identified. These included: (1) insufficient importance given to information support; (2) failure in organizing, coordinating; presenting and using information; (3) difficulties in obtaining dispersed information (with particular reference to health expenditures); (4) overemphasis on information at the central level, (5) lack of prospective and disaggregated data; and, (6) lack of necessary equipment and resources (Wysocki et al., 1990).

A statewide management information system (MIS) for the Indian Population Program attempted to establish such a system which would reinforce the bottom-up primary health care planning approach. Preliminary studies in two states showed that health workers were spending up to 60% of their time on activities such as record-keeping (WHO, 1988). Since the late 1970s, a pilot study to test the modalities of community-based
health reporting systems had been implemented in Kerala, yet resulted in questionable success (Scott, 1988).

Bangladesh has been pilot testing a greatly simplified "Integrated Reporting System" that focuses on a limited number of family planning and maternal and child health activities. A simple analysis plan is being developed as part of the system to allow supervisors to assess the performance of field workers (Ho, 1985).

Myanma has been developing a "Minimal Essential Data" system that will drastically reduce the amount of data collected on a routine basis. This will be supplemented with "rapid surveys" when additional data is needed for a special purpose (Aga Khan Foundation, 1988).

Malaysia and Singapore have been implementing a computer-assisted health information recently (WHO, 1988). The Malaysians identified the following problems: (1) Flow - a large quantity of data is collected at the peripheral level with only a little feedback as well as untimely and non-utilizable reports (by the lower levels); (2) Procedures - unclear forms, insufficient instruction, and unretrievable hand-written data; (3) No appreciation of health information - primarily because the collectors cannot use the collected
data (Teoh, 1984). Singapore is in the process of incorporating data from the private sector.

The Philippines' Department of Health has established a major restructuring of its health information system since 1989. The project began with the Field Health Services Information System (FHSIS). This unit was responsible for the collection and dissemination of data, regarding activities in all public-sector health facilities of the country, with the exception of activities taking place on hospitalized patients. Other components of the system will be developed or revised in the following few years (Robey and Lee, 1990).

The South Korean Government initiated compulsory health insurance in 1977. Inclusion of different segments of society (e.g., industrial workers, farmers, urban residents) and increasing coverage has gradually taken place. The government set up two administrative organizations: the Korean Medical Insurance Corporation (KMIC) and the Federation of Korean Medical Insurance Society (FKMIS). They are responsible for data collection, program monitoring, claim processing and payment (Yang, 1991).

The WHO American Regional Office examined the situation in 27 member countries. These included countries in North and South America, which represented nearly 100 percent of the
population of the region. The study revealed that most national information systems dealt only with the public sector. Ministries of health has no real leadership and the data available only partially reflected the health situation. Timeliness was a notable problem. Regarding Health-for-All strategies, only half the participating countries had a functional national monitoring and evaluation process. Important items needing quality improvement were infant mortality, literacy, health expenditure, maternal mortality and percentage of economically active population (Miglionico and Casas, 1990).

The European Regional Office disclosed the situation in 25 European countries: Definitions of health indicators appeared too abstract and differently perceived by countries. Some quantitative indicators were arranged by target, not by subject or area. Comparability among countries was limited. Data on most morbidity indicators except infectious diseases, were provided, on average, by only one-third of the countries. Nearly two-thirds provided data on cervical cancer and some occupational diseases. Data on health services and resources were relatively promising, as they were provided by about two-third of the countries. Many countries conducted surveys at different times (Nossikov, Prokhorskas and Shabanah, 1990). Currently, health survey has been the primary means of acquiring information among African countries (Kalambay, 1990).
SECTION III: HIS AND HIS STUDIES IN THAILAND

In Thailand, not many studies have been conducted in the area of health information systems. However, frequently cited problems are: imbalanced workload of health personnel; redundancy of reporting forms; irrelevant report contents; inadequate training and supervision; and limited utilization of information (Vuttipong, 1988; Temchavala, 1986; Deeswasdi, 1986).

Earkanna et al, in 1983, studied the capability of village volunteers in reporting health data including immunization and sanitation activities, and sickness episodes of villagers. Volunteers in three districts of Samut-songkhram province attended a two-day training session and then reported the data, using the provided forms, to subdistrict officials every month for the entire year. The study showed that the volunteers performed adequately and the data was reported on time and efficiently. The volunteers became recognized by other villagers as knowledgeable persons. However, the study was conducted in only one province (which was a close neighbor of Bangkok), so the results might be challenged on the grounds of generalization.

Vuttipong et al (1986) designed four different sets of disease surveillance forms and tested them in Rajaburi province. The focus of this study was the community-level surveillance
system and practical record forms. The first set of forms was disease specific, i.e., one form for one disease. The second was symptom-oriented. The third was less formatted and stressed the user’s convenience. The last set was the form used in the local drug cooperative. The third set contained the most accurate data but was also more difficult to deal with in the analysis step.

Deeswasdi (1986) studied the workload of subdistrict officials in nine provinces and included every region of the country. He estimated that for all the assigned activities to be properly implemented, a health center needed six personnel instead of two to three, as at present. He found that health center personnel spent 20-27 percent of their working time in creative activities, 14-16 percent in data reporting, 9-11 percent in training and supervising village health volunteers, and 17-18 percent in other activities including local integrated development programs. The study proposed a more flexible job-description and more decentralization so that the information would become more meaningful and realistically utilized.

Since 1970 the National Board of Economic and Social Development (NBESD) has developed a set of Basic Minimum Needs (BMN) and constructed forms for collecting BMN data at the village level. Currently the BMN forms are used in parallel
with pre-existing forms (the National Rural Development Form 2c: NRD-2c). Both contain some overlapping data as well as data used for local development planning.

Temchavala (1986) reported that the Basic Minimum Needs program has been an "exercise" for the development of local human resource and uses the data system as a major tool. This study focused on the village-level and the then-infamous BMN concept. The study showed positive impacts of using BMN indicators. Villagers were involved in data collecting and simple data analysis so that they would realize the "real" problems of the community. Nonetheless, MOPH has placed less emphasis on the BMN policy for the last few years.  

Swetaseranee et al (1987) studied the information system in Nakorn-sawan Project, a joint project of the Ministry of Public Health, Mahidol University and WHO. The project's primary objective was to utilize health data for planning at each level and feed it to the next level based on the Basic Minimum Needs set forth by NBESD. At present the Nakhon-sawan pilot project uses a computerized system for data processing at the village, subdistrict, district and provincial levels.

NBESD and Thammasat University has been in the process of revising the NRD-2c forms which have been the primary data collecting forms at the village level for rural development planning. However, this was a starting point of a multisectoral endeavor and the ministries have yet relied on their own reporting systems.
The study, however, reported ambiguous conclusion, mainly because personnel still have to maintain the conventional manual system along with the automated system. One argument is that the special project might exert influences on the current information system, especially when it is used as a project monitoring system.

MOPH in collaboration with Primary Health Care Operations Research (PRICOR) conducted a study in 1986. The study noted five major problem areas: (1) centralized planning; (2) uniform project implementations despite local differences; (3) lack of intersectoral cooperation; (4) inadequate emphases on health promotion and disease prevention; and (5) targeting and reporting system responding primarily to the central budgetary system and less to management (MOPH, 1989).

Vuttipong et al (1988), supported by MOPH and PRICOR, conducted operational research on the development of a Health Information System for Managerial Applications (at the micro-level) in Srisaket province. The research looked at HIS at the provincial, district and subdistrict levels. This study, well portraying the provincial health information system, provided the following conclusions:

*Workload:* The workload at the subdistrict level was the worst. Every month a health center, which usually was staffed by 1-3 personnel, had to process 70-79 reports.
and forms; the number of official reports processed by the province, district, subdistrict, and subdistrict with the "extended OPD" were 68, 54, 67 and 107, respectively, excluding locally developed operating forms. Late reporting was not uncommon. At the district and provincial levels, the amount of overworkload was relatively less and late reporting usually resulted from the fact that the health center could not complete the process on time.

**Redundancy of Reporting Forms:** This was the most frequently cited problem, especially by health center personnel. Reporting forms usually originated from various divisions at the ministerial level. Additional information was often requested by individual divisions without coordination. Many of the same pieces of data appeared on several forms to be filled out at the lowest level.

**Reporting Problems:** Some forms were too ambiguous and complicated to understand, especially for newly recruited personnel. There was not enough training and consistent supervision. Although the handbook for such forms was available it became out of date because of the frequent changes to the forms.
Reporting Forms: Almost all of the various kinds of reporting forms were centrally produced and distributed. Sometimes the delivery was disrupted and shortages occurred among users at the periphery. Forms often contained too many and/or too few data fields. A number of fields demanded so much technical knowledge that they were never filled out. Adventitious or later-requested data were not in congruence with existing reports. The form design did not enhance simple analysis which might be done locally.

Utilization of Data: At the subdistrict level, utilization of data seldom existed at all. One potential cause was the workload. The data collected might not respond to health center needs. Lack of knowledge and skills to perform data analysis was cited as another important problem.

At the district level, the primary use of data was to monitor planned activities, especially that of the health centers. Indicators on health status, demographics, resources, and environments were seldom used.

At the provincial level, reports were compiled, again, mainly for the sake of reporting. Even though the top-management seemed to have an interest in using
information, utilization had been limited. One reason was the questionable quality of data. Inappropriate data sets, ignorance, and lack of technical-know-how were other potential explanations. Report processing and compiling was time-consuming.

However, this operational research was conducted in only one province in the north-eastern region, Srisaket. The methodology included nominal group process, record review, and testing of "new model." This study did not consider variation across provinces. The strength of this study is that records and reporting forms were objectively examined. However, it ignored the fact that the information system is the supporting instrument to the organization - not a separate entity on its own. Therefore, the management process was not taken into consideration, and users were a secondary issue.

Another MOPH-PRICOR sponsored operational research, studied at the ministerial level, indicated a need for a revision of data collecting forms and health indicator sets (Kanchanasinita, 1989: MOPH, 1989). This operational research suggested a "new model" which would reduce the number of reports from 243 to 115. By 1989, testing of the new model had begun. The study looked mainly at the national level. Since it would result in cutting down the quantity of data reported to the Ministry,
the new model prompted some fundamental questions\textsuperscript{21} as to how provinces would justify what items to keep or to discard (i.e., differences in provincial capabilities to deal with the abruptly changed reporting structure), and whether or not, and how, a more decentralized structure might emerge side by side with the existing reporting system. The study led to a MOPH-initiated implementation project. The revised set of indicators were to be reviewed for validity by 1990 (but the final analysis is not yet available).

Recently, Chongsuvivatvong and Nitimanop (1991) revealed that the proportion of time spent on routine data collection by health centers, in southern Thailand, ranged between five percent (for a five-man center) and 12.5 percent (for a two-man center) of official work-hours. Health officers considered commonly used forms to be of higher utility than sporadically requested reports. The study identified the low utility/time-consumption ratio items. This study mainly paid attention to the lowest-level workers, however, subjective measurement of utility is questionable. "Time spent" was adopted as the only surrogate of "cost", so confounding; such as reporting frequency, sources and value of data items, became surreptitious. However, the researchers contend that

\textsuperscript{21}These were reactions gathered from the preliminary interview during June to August 1990. The interviewees included three middle-level administrators and three staff in the Ministry. Interviewing provincial officers in the case study also covered this policy matter.
community-level health workers should participate in the development of the HIS.

All the existing studies pointed to the same direction. The national and provincial health information system was functioning primarily for the sake of reporting. The operationally weakest point was the subdistrict level. Unusable data sets, redundancy and tedious processing, coupled with the lack of analytic skills, contributed to its non-function, especially at local levels.

SECTION IV: INFORMATION SYSTEM ASSESSMENTS

Hirschheim and Smithson (1988) describe that information system (IS) assessment can be thought of as a continuum ranging from the highly objective or rational approaches at one end (i.e., efficiency study) to those which regard evaluation as very subjective or political at the other (i.e., understanding the system). This dissertation is confined to system effectiveness assessment. This kind of evaluation falls into the middle of the objective-political continuum\(^22\).

When one asks about effectiveness, (s)he is concerned with whether the system is doing what it is supposed to do. System effectiveness assessments have been done using various measures. The two most widely applied measures are system

\(^{22}\)Other measures are discussed later in the chapter.
usage and user satisfaction (Srinivasan, 1985; Mellone, 1990). The choice of usage as a measure generally rests on the notion that the more the system is used the more effective it is (Ein-Dor and Segev, 1978). However, Ginzberg (1978) and Srinivasan (1985) argue that frequency of use may not always be the indicator of system worth. Further, in the context of how well the system supports decision-making, more frequent use may reflect the inadequacy of information generated.

Other studies have adopted user satisfaction as an effectiveness indicator (Zmud, 1979; Srinivason, 1985). This means that the system is effective to the extent that it satisfies the users. Lucas (1975) generally finds a positive association between system use and user satisfaction, but Schewe (1976) reports no significant relationship. Robey (1979) discerns a strong relationship, but Srinivason (1985) argues that the relationship is not always positive. However, between the two most established measures - system use and user satisfaction - the latter has received greater support and serves as the principal construct by which information systems are evaluated and behavioral issues examined (Ives, Olson and Baroudi, 1983; Nolan and Seward, 1974, Mellone, 1990).

In the MIS literature, users have become more and more involved with system development and its success, especially
in the setting of computerized information systems (Ives and Olson, 1984). A user is a person who needs the outputs produced by the system to perform his or her job. This includes executives, managers, professional staff, secretaries, office workers, field workers, and others. The present trend of information system development is to have users more involved. This should result in increased individual performance and fewer implementation problems because the system can be tailored to meet user's expectations, needs and behaviors.

Cyert and March (1963) suggest that an information system which meets the needs of its users will reinforce satisfaction. As such, satisfaction\(^{23}\) of users is a potentially measurable, and generally acceptable, surrogate for utility.

Notably, researchers have argued over the theoretical controversy (Mellone, 1990; Doll and Torkzadeh, 1991) that user satisfaction hinges on an organizational model and the psychological constructs regarding attitude-behavior. The

\(^{23}\)In some studies, other terms have been used to refer to essentially the same concept: "felt need," "system acceptance," "perceived usefulness," "feelings about information system," and "MIS appreciation" (Ives, Olson, and Baroudi, 1983) and, more generally, "attitudes and perceptions" (Lucas 1975).
former is the "natural system model" and the latter involves the "theory of reasoned action."

The choice of the user satisfaction construct in measuring effectiveness implies a particular view of the organization and its operation. Scott (1987) describes three categories of organizational models: rational, natural, and open systems. The first model defines the organization as a "collectivity oriented to the pursuit of relatively specific goals and exhibiting a relatively formalized social structure." This model includes the classical, traditional, scientific management, and Weberian approaches. Criteria for effectiveness generated by this model emphasize the number and quality of outputs and the economy (Scott, 1987).

The natural system model is the one with which the satisfaction construct is most associated. This model looks more closely at the interaction and interest of people in the organization. The model definition considers the organization as a "collectivity whose participants are little affected by formal structure or official goals but who share a common interest in the survival of the system and who engage in collective activities, informally structured, to secure this end." These organizational collectivities not only pursue specified goals but are also engaged in other activities required to maintain themselves as a social unit. The model
contends that when conflict arises between the simultaneous achievement of "support" and output goals, support goals tend to dominate. Among the support goals, the primary one is survivability. Effectiveness is determined by the perceptions of the organizational constituencies rather than by objective measures of organizational features. The human relation school, Barnard's cooperative system, Selznick's institutional approach and Parson's social system constitute this model (Scott, 1987).

The open-system model emphasizes the interrelationship between the organization and its environment. Here, an organization is a "coalition of shifting interest groups that develop goals by negotiation; the structure of the coalition, its activities, and its outcomes are strongly influenced by environmental factors." Thus, the bargaining position of the organization becomes the main criterion of effectiveness. This model includes the general systems, systems design, and environmental approaches (Scott, 1987).

Past operationalizations of the user satisfaction construct have been based on the evaluation of product-service attributes, including content (accuracy and relevance), presentation (format and mode), and service quality (support for development and maintenance). The theoretical framework adopted in these studies is the expectancy-value framework.
(Bailey and Pearson, 1983; Melone, 1990). Such a framework represents the user's attitude as a multi-attribute belief structure. This structure is typically expressed mathematically as a linear-additive equation.

One of the more popular of these expectancy-value approaches is the "theory of reasoned action" (Ajzen and Fishbein, 1980). The theory postulates that a person's behavior can be predicted from an expectancy-value influenced by: (1) behavioral action; and, (2) social norms, resulting in a person's attitude formation. Both (1) and (2) are assumed to influence behavior through behavioral intention, and behavioral intention is assumed to be highly correlated with actual behavior. Past research relating user's attitudes (e.g., satisfaction) to success (e.g., intention to use the system) adopts this model in both the assumed direction of influence (attitudes lead to behavior) and expectancy-value formulation (e.g., Ives, Olson, and Baroudi 1983; Bailey and Pearson 1983).

While the theory of reasoned action continues to generate a large number of studies, the empirical evidence has forced some caution and reconsideration (Chaiken and Stangor, 1987). Largely in response to a number of empirical studies yielding relatively low correlations between attitude and behavior, Ajzen and Fishbein (1977) made two modifications. The first
modification advises researchers to construct measurement items that are more specific as to context, action, target and time. The second modification recommends that the theory should be applied only to situations in which behavior is under volitional control. Another limitation of these approaches is when individuals are asked to fill out an attitude questionnaire on a subject for which they have no attitude stored in memory, the act of measurement may prompt attitude formation, rather than assess a pre-existing attitude (Fazio, Lenn, and Effrein 1984).

The most prominent rival of expectancy-value approaches has been the family of cognitive approaches. These approaches focus on the mental processes that influence attitude-behavior relationship (e.g., Fazio 1986, 1988). These approaches rest on the assumption that attitudes must be accessible to influence perception, judgment, and behavior. Attitudes (e.g., user satisfaction) are likely predictors of behavior when they are stored in memory rather than "computed on the spot" in response to a question (Fazio, Lenn, and Effrein, 1984). A relevant implication is the assertion that not all attitudes (or expectancy-values) are equal in influencing behavior. Therefore, the predicting power will be boosted if the measuring instrument taps the relative accessibility (e.g., elapsed time of response) of different attitude dimensions.
Davis (1986) explains the attitude-behavior relationship by his "technology acceptance model." This model focuses on the acceptance of computer technology. The model states that the intention to use is determined by perceived usefulness and perceived ease of use (Davis, 1986; Davis, Bagozzi and Warshaw, 1989).

Melone (1990) points out that although user satisfaction has been the most widely used measure, it might not adequately capture the full meaning of effectiveness. In addition to affect-oriented measures (e.g., user satisfaction), other criteria (e.g., output-oriented ones) should be employed, she contends.

A last pertinent point to be made about satisfaction is the consequence of dissatisfaction. Job satisfaction does not necessarily lead to better performance. In fact, the cause-and-effect direction of the relationship is rather reversed. However, the link between dissatisfaction and performance is conceivably distinguished. Equity theory\textsuperscript{24} suggests that workers who are frustrated in attempts to attain some desired outcome will either aim for alternative goals (e.g., give up on the idea of being promoted to supervisor aiming instead at

\textsuperscript{24}This motivation theory assumes that people want to be treated fairly and that people within an organization tend to compare their own contributions and rewards with those of others. When they perceive that inequity exists, they will try to do something to correct it.
becoming elected union steward) or exercise some kind of defensive behaviors in an attempt to reduce the tension (e.g., complain to coworkers). Other consequences include absenteeism, turnover and sabotage (French, 1990).

The alternative measure, system use, as the effectiveness indicator is more prone to methodological flaws. These weaknesses are confined mainly to operationalization, and characteristics of decisions and jobs (Ginzberg, 1978; Ives, Olson and Baroudi, 1983). Nonetheless, although user satisfaction seems to be the best established and most practical measure, Mellone (1990) remarks that it alone is not sufficient to capture adequately the full meaning of effectiveness. She advises researchers to consider, in addition, user behavior in the transformation of inputs to outputs.

Information systems effectiveness assessment is sometimes performed on other bases: (1) pure economic evaluation, (2) comparison to standards, (3) financial risk assessment, (4) managerial risk assessment, (5) IS managerial assessment, and (6) organizational IS assessment (Hirschheim and Smithson, 1988; Ginzberg and Zmud, 1988). The following are concise descriptions for each of these measures:
(1) **Pure Economic Evaluation.** Ideally, an assessment of the IS function would result in a determination of the total economic impact of the IS functions on the organization, but this is rarely, if ever, possible. While determination of the costs of the enterprise's IS function is relatively straightforward, determination of the benefits is difficult and sometimes impossible. This difficulty stems from the fact that many changes are taking place in the organization and sorting out the IS expenditures from the effects of all the other changes is an imposing task. Also, the time lags between investment and the resulting benefits further complicate the process of determining the contribution.

(2) **Comparison to Standards.** One alternative is to compare the IS expenditures of an organization with standards. These standards may be based on overall industry averages, spending of competitors, or allocation of costs into specific IS expenditure categories. Each type of "standard" has its own problems. Using overall industry averages, one might face problems of small sample size, different categorizations, and errors in reporting data. Competitor's information is often hard to obtain.
and the role of IS may be different. Allocation policy depends considerably on potential advantage or disadvantage.

(3) **Financial Risk Assessment.** IS assessment is sometimes performed by internal or external auditors. A financial risk or financial control assessment seeks to identify and control or minimize risk to the organization from failure or inferior performance by the IS function. The Institute of Internal Auditors (1978) has identified the following areas in which auditors typically make judgments: (1) reliability and integrity of information; (2) compliance with policies, plans, procedures, laws, and regulations; (3) safeguarding of assets; (4) economical and efficient use of resources; and, (5) accomplishment of established objectives and goals for operations or programs. Financial risk assessment is largely a qualitative process and is conducted primarily through interviews and examination of documents.

(4) **Managerial Risk Assessment.** Besides the risks considered in financial risk assessment, other aspects of risk, called managerial risk, might be dichotomized as the risk from systems development
(McFarlan and McKenney, 1983) and the risk from systems in use (Buss, 1981).

(5) **Risk in Systems Development.** This assessment involves determining the likelihood that a proposed system cannot be developed to perform as required and the impact that the inability to properly develop this system might have on the organization. Some identified factors include: uncertainty of output, level of technology to be employed, and project size in terms of staff assigned and the duration of their effort. A key point is that the degree of risk inherent in a given systems development project should be recognized and the management approach appropriate for that type of risk applied.

(6) **Risk in Operational System.** This approach evaluates the extent to which the management of IS subscribes to "good management practice." Categories and associated measures of IS managerial performance have been suggested by Dickson and Wetherbe (1985): financial performance, organizational efficiency, managerial performance, and other (all with detailed items). Coopers and Lybrand (1984) have identified 26 "executive issues
in information management" and present them as a checklist. Another factor worth considering in evaluating "good practice" is the extent and quality of communication between IS function and the rest of the organization (Van de Ven and Ferry, 1980).

(7) **Organizational IS Assessment.** Recently, there has been much discussion on the need to use IS strategically or as a competitive weapon (McFarlan, 1984; McFarlan and McKenney, 1983; Parsons, 1983). Organizational IS assessment focuses on determining and satisfying organizational information needs, and seeks to determine the extent to which the competitive business needs of the organization are anticipated and satisfied by the IS function.

**SECTION V: MIS SUCCESS FACTORS**

Research has identified enhancing and hindering factors to management information systems since the late 1960s. Many variables were found to be contributing. However, these individual, operationalized variables can be grouped together into generic classes of variables (Lucas, 1981).

(1) **Technical Characteristics of Systems.** Technical considerations include characteristics such as the accuracy of input and output, timeliness, new
information, reliability of an on-line system, the completion of processing on schedule for a batch system, etc. (Lucas, 1981; Hogue and Watson 1983). There is a group of technical variables that appear to be responsible for creating user satisfaction and which encourage voluntary use of the system. Such variables include the design of interface between users and the system, graphics and format improvements, and training. (Carlson et al., 1977; Zmud, 1979).

(2) **Client Actions.** Two variables in this class are: management support and user involvement and influence (Rubenstein et al., 1967; Radnor, 1968, 1970; Lucas 1978; Swanson, 1974; Schultz and Slevin, 1975). Conducting a study in a large health science center, Mann (1988) asserted the importance of human factors contributing to the success of information system. Higher-level personal needs, norms of one's group and considerate leadership style are associated with successful implementation.

(3) **Attitudes Toward Systems.** In the context of the information system, attitude toward a specific stimulus, such as the input and output quality of
the system, is a good predictor of use of a voluntary system or satisfaction with a mandatory system (Lucas, 1973, 1975, 1976, 1979; Swanson, 1974; Bean and Shewe, 1976).

(4) **Decision Style.** Decision style is the characteristic way one has of approaching a decision problem. The sensing-thinking individual is very analytical and is interested in a detailed picture while an intuitive-feeling problem solver is not concerned with details. For the former, a factual report with many numbers would probably appeal more than it would to the latter type (Lucas, 1975, 1976, 1979; Larreche, 1979).

(5) **Personal and Situational Variables.** Variables such as age, education, length of time in the organization, seem to be important based on implementation research. Situational and personal variables can greatly influence the success of implementation for a given individual or even a class of individuals. The difficulty comes in characterizing each situation since factors are often unique for a specific system. Zmud (1979) relates that individual differences believed most relevant to MIS success are grouped into three
classes: cognitive style, personality, and demographic/situational variables. Goldhaber et al (1984) suggest that relevant personal variables include: (1) the individual's cognitive complexity; (2) the individual personality; (3) the individual's past experience with the information stimulus; and, (4) the individual's personal motivation, need, and goal configuration.

Alternately, an improvement of an information system brings about changes to the organization. People differ markedly in their readiness to try new products. Anything perceived by someone as new is called an "innovation." Innovations take time to spread through the social system. Rogers (1962) defines a person's innovativeness as "the degree to which an individual is earlier in adopting new ideas than the other members of his/her social system." He classifies people into five adopter categories, based on the time of adoption of innovation. The adoption process is represented as a normal distribution when plotted over time.

Rogers (1962) states that earlier adopters tend to be younger, have higher social status, a more favorable financial position, more specialized operations, and a different type of mental ability from later adopters. Earlier adopters utilize information sources that are more impersonal and cosmopolitan
than later adopters and that they are in closer contact with the origin of new ideas. Earlier adopters utilize a greater number of different information sources than do later adopters. The social relationships of earlier adopters are more cosmopolitan than for later adopters. And earlier adopters have more opinion leadership.

**Chapter Summary**

This chapter describes the five major issues of health information systems. Many countries have suffered from some common weaknesses in national information systems. The systems typically only partially represent the health picture. Full utilization is of HIS yet uncommon. Many countries conduct occasional surveys to supplement national reporting systems. Comparison among countries is often problematic and some pertinent data is lacking. Thailand is one of the countries aiming at improving its national health information system. The chapter also describes the experiences of several other countries.

The area of local health management has been considered as a primary element leading to "health-for-all." This level corresponds to that which this study seeks to examine. The chapter features explicit samples of how HIS can support local health organizations in management and operation.
The chapter describes methods of assessing information systems. Measuring system effectiveness by means of user satisfaction is emphasized. While satisfaction may not necessarily reflect performance, dissatisfaction can lead to detrimental consequences to the organization. Though the construct seems to be the best established methodology, several authors warn about the interpretation. Concurrent qualitative investigation is often recommended.

Finally, the chapter presents "success factors" described in the literature. Since system improvement programs usually bring about change, one ought to consider human factors in planning.
CHAPTER III

METHODOLOGY OF THE STUDY

This chapter describes the methods of this cross-sectional study. A two-tiered analysis was used in the study: individuals and provinces. Individuals are referred to information system users. The study assessed individual user satisfaction through a self-administered questionnaire survey. The survey adopted individual users as the unit of analysis. The collective attitudes of system users were treated as the surrogate for regional system effectiveness. Quantitative survey also provided information for provincial assessment. This analytical level used provinces as the unit of analysis. Case study of two selected provinces was added to quantitative analyses to compare qualitative research findings.

Thus, this chapter is divided into two sections. Section I describes the individual-level assessment and Section II features the methods used in provincial assessment. Results of the individual and provincial assessments will be presented in Chapter IV and Chapter V, respectively. Chapter VI will integrate findings of the two approaches and discuss major methodological problems.
SECTION I: INDIVIDUAL SYSTEM USERS

The primary objective of this study section was to estimate regional health information system effectiveness by means of user attitudes towards the system. User attitude was termed as "user satisfaction." User satisfaction in a given situation is the sum of one's feelings or attitudes towards a variety of factors affecting that situation. The operational definition was the sum of the user's reactions to a determined set of factors. The factor set was comprised of components of satisfaction. A component was a main interpretable facet consisting of domains (factors) of satisfaction.

Further, this part of the study aimed to: (1) identify potential problem areas of the system based on the pattern of user satisfaction components; (2) identify distinct satisfaction patterns and user groups who exhibited such patterns; (3) identify significant user characteristics which would predict group membership.

Research Design

Population and Sample

The population of this research design included health information users in all provinces in the northern region of Thailand. The region was made up of seventeen provinces. The survey was confined to governmental health organizations. The health information system was defined as the provincial
system. Provincial health information systems involved operations of four primary local structures: (1) provincial health offices; (2) community (district) hospitals; (3) district health offices; and, (4) subdistrict health centers. Specialized organizations (i.e., provincial hospitals, specialized hospitals, and specific-disease regional centers) were excluded from the study because their main functions and information systems, albeit partially related to provincial systems, were relatively independent of the administrative authority of provincial health offices.

This study defined a user as an organizational participant who accessed the information system to obtain information or received reports for his/her operation. A user might interact directly with the information system, process data, or act upon reports that (s)he received indirectly through intermediaries. Thus, users included managers, data processing staff, and officers, as well as field workers whose operations involved information provided by the provincial information system.

For each of provincial hospitals, only the section implementing community-based activities, the community medicine section, was included in the study.

Davis and Srinivasan (1988) classify these three modes of usage as: direct, autonomous and indirect.
This study classified users based on the organizational structure and the relative distance between users and the provincial health information center. The center was normally a part of the provincial health office. Users were categorized in four groups: (1) provincial health officers; (2) community hospital directors; (3) district health chief officers; and, (4) subdistrict health chief officers. Unlike the other three groups which were comprised of single positions, the first group was composed of administrators, heads of units, and data processing staff.

The above classification implies that the study adopted a purposive sampling. Since the information system was a supporting structure to the organizational functions, the above definition, in effect, entitled nearly any one of health officers to become a user. It was likely that one's job related, no matter how minuscule the connection, in some way to this supporting operation. However, the purpose of the study was to examine the performance of the system. System performance would be more accurately reflected by people who interacted closely with the system rather than those seldom affected by the system. So, the sampling purposively selected system-operating users and those whose positions necessitated their actions upon the information system and/or its outputs (e.g., reports, records, memos). Such actions included presenting, processing, and receiving reports. Further,
except for data processing staff in the first group, the selected positions included top administrators and heads of provincial health offices' subunits. Administratively these officers represented their units. The above classification yielded an assessment which embraced users' opinions from the four major segments of the provincial organization. The first group reflected the position of the provincial administrative center. The second and third exemplified the operational administration. And the last group represented the voice from grassroot operations.

A second rationale for adopting a purposive sampling, was that; if the study focused on stakeholders of the system, the findings would become more meaningful in terms of intervention recommendations. These stakeholders were referred to as people who were susceptibly affected by the system, as well as could induce changes to it locally. Thus, the positions were selected by their proximity to, susceptibility to be affected by, and opportunity to exert influences on the provincial system.

Finally, although the overall sample was purposively selected, sampling within three of the four groups (i.e. except the provincial officers) were either random-type or adopted the whole population. This resulted in representativeness of the group samples and enabled comparisons among groups. The
sampling, therefore, aimed primarily to extract opinions of stakeholding users and, secondly, at comparison among organizational segments.

Operationally, each province consisted of four respondent groups. Members of the groups were selected by positions:

Group 1 (Provincial health officers)
Each province had sixteen persons belonging to this group. The following positions were included in the samples (their numbers are given in brackets):

(1) The provincial health medical chief officer [1];
(2) Provincial deputy officers\(^{27}\) [2];
(3) Head of seven sections within the provincial health office: health planning, health promotion, communicable disease control, sexually transmitted diseases, primary health care and personnel development, internal management, and pharmacy [7];
(4) Head of the community medicine section\(^{28}\) of the provincial hospital [1];
(5) Principal data processing staff [1];

\(^{27}\)This was not official term. "Deputy" was given here for a more understandable connotation. The official terms were the specialist officer (public health) and the specialist officer (preventive medicine).

\(^{28}\)This was the only section (department) of the provincial hospital that implemented community-based programs. The section reported to the provincial health office via the hospital director.
(6) Provincial staff responsible for the four selected programs: expanded immunization, disease surveillance, disease control and family planning [4].

The number of respondents selected totalled 272 in 17 provinces. Group response rate was 81.99 percent.

Group 2 (Community hospital directors)

The community hospital was responsible for curative medical care provided to the entire district and implementing preventive/promotive programs for the central community of the district. The director was, thus, considered an administrator at the operational level. (S)he was also a member of the provincial planning and evaluation committee which was the policy-making body of the province. This group comprised all of the community hospital directors (n=130) in the region. Response rate was 73.85 percent.

29 The selection of these four programs was related to the design of field research described in Part II. Although they did not represent all activities of the provincial health office, they involved the two major target groups, women and children, at their critical periods. They were all community-based activities which enabled comparisons among the programs. The first three programs were also related. See Part II.

30 This was a 20- to 40-member committee. All officers but data processing staff of the first group were usually named in this committee as well as were district health chief officers. However, in certain provinces, only some of these positions were included in the committee.
Group 3  (District chief health officers)  
The district health office implemented community-based programs in the outer area of the district. This jurisdiction included all subdistricts except the one the district center was located in. Administratively, the chief officer directed all health centers. So, (s)he was considered another operational-level administrator. (S)he was also a member of the provincial planning and evaluation committee. This group also adopted a 100 percent sampling of district health chief officers. The total number amounted to 170 officers. This group attained a 77.06 percent response rate.

Group 4  (Subdistrict chief health officers)  
Subdistrict chief health officers worked at subdistrict health centers. Although it was less common, a subdistrict might have more than one health center due to size, population, geography, and, sometimes, political reasons. Even in such a case, only one officer would take care of subdistrict intersectoral planning, and represent the MOPH at the grassroots level. This study considered the subdistrict as the lowest level of the system because this position handled subdistrict data, not only that restricted to the health center operations. However, the position did not have directing authority over other health centers in the area. For this level the study used a 20-percent probability
sampling of the officers in the position. The total number amounted to 286.\textsuperscript{31} The response rate was 71.68 percent.

\textbf{Variables}

The surrogate for system effectiveness, or the "dependent variable," was user satisfaction. This was a composite construct made up of components which, in turn, were arrived at from domains. The derivation of components and domains was conducted and revised step by step (see below). Four major components eventually made up this composite construct: System Management, Utility Enhancements, Input Procedure, and Output Quality. Such a classification was designed for meaningful interpretation. Each of the four components consisted of a number of factors (satisfaction domains).

Explaining variables consisted of two categories: personal and locational. Personal variables were applied to and varied across individuals included age, gender, education, past experience, administrative and medical status, decisional authority, perceived development level of the locality and

\textsuperscript{31}Sample sizes were designed to enable comparisons among groups. So, the number of the two middle groups were used as reference. The number of returned questionnaires was expected to be of comparable sizes. Since the questionnaires were mailed first to the provinces, then delivered downwards via the organizational hierarchical structure, the subdistrict level became the most distant. Thus, an overnumbered sample of this group was designed to compensate the expected lowest return-rate due to their remoteness.
duration assuming one's current position. Locational attributes indicated where a person's work-site was located and included groups, provinces and province sizes.

**Preliminary Interview**

Since, by the time of this study, the health information system in Thailand had not been extensively examined, the study was intended to be exploratory. In addition to the relative lack of literature, substantial changes had occurred over the past few years in the government system. It was commonplace that such changes were not documented but became the experimentation of practitioners. Thus, preliminary information acquisition about what had been going on was very critical to this study. More specifically, this study adopted the interview of expert practitioners and academicians as a means for investigating the following points:³²

1. What were the major concerns of the HIS considered by the experts?
2. What was the direction of current changes?
3. Where did recent changes take place or had been occurring?
4. What were the critical elements on which one should focus in the system assessment?

³²In case of academic reference, their names are available from the researcher.
(5) What were sensitive issues that the researcher should avoid or handle with subtlety?

Because they provided stepping stones for study design and instrumentation, it is worth mentioning some findings at this point. Conclusively, interview indicated that the MOPH was aware that changes had been occurring in at least 10 provinces. Most experts expressed positive attitudes towards the changes. Major directions included: (1) restructuring the record system; (2) automation; and, (3) revision of health indicators. The northern region appeared as a most remarkable mix of innovators and conventional provinces. The element of most concern was the population data and related applications. Critical points raised up by the experts will be illustrated in Chapter V (Provincial-level findings) and discussed in Chapter VI (Discussion, conclusion and recommendations). Preliminary interview also provide practical information for questionnaire construction and framework of field study.

Instrumentation

Self-administered questionnaire was the instrument used in the survey part. The main focus of the instrument was domains of satisfaction. This study adopted the following steps in developing the structure of satisfaction domains. Step 1 through Step 3 took place before the survey was administered while the last step was post-survey.
Step 1: Potential domains were selected from sets of factors in instruments described by Bailey and Pearson (1983), Ives, Olson and Baroudi (1983), Jenkins and Ricketts (1985), and Baroudi and Orlikowski (1988). The five components described by Jenkins and Ricketts (1985) were adopted as fundamental domain categories: (1) understanding of the input procedure; (2) system stability; (3) system utility; (4) output content; and, (5) output form. This researcher excluded items which were directly applied to high-tech electronic systems, product-oriented business, and private enterprise environments. The initial set of domains contained 36 items in five categories.

Step 2: The 36-item set was reviewed by Thai practitioners and researchers. Six items were dropped and an item considered relevant by them was added. This preliminary set was reviewed by health officers in a province (Ayuthya) where an information development

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33This is a revised instrument of that same group of authors presented in 1979. Srinivasan (1985) contends that this approach is superior to others because it is well grounded in a widely accepted theoretical model. Bailey and Pearson (1983) proposed a 39-item instrument without dividing it into main components. Ives, Olson and Baroudi (1983) and Baroudi and Orlikowski (1988) argue for the three components: (1) electronic data processing staff and services; (2) information product; and (3) knowledge and involvement.

34In case of academic reference, their names are available from the researcher.
project had been taking place. The reviewing officers were to respond to each of the domains by means of a 6-point Likert scale. The reviewers considered the items on the "important-unimportant" dimension. All items on this list were considered important. This step resulted in a 31-item working set of satisfaction domains.

Step 3: The domains were operationalized. Items were transformed to situation evaluation questions. For each question, a situation about an item was given with an evaluating phrase, then respondents were asked to provide the degree of their agreement on such an evaluation. The measurement used a four-point Likert scale on the "agree-disagree" dimension. Because each of the four groups experienced a different situation from others, the context in the questions were tailored to suit the respondent groups. Thus, four equivalent sets of questionnaires were designed for provincial, district and subdistrict levels. A pretest was conducted with 37 officers in a province (Phattalung) in the southern region. This province was selected partly because the

35See Chapter 4, Section III - Assessment of the Instrument.

36The survey questionnaire is given in Appendix II.

37It was assumed, albeit arguable, that difference particularly in regional subculture did not play a major role, since the survey was conducted within government organizations (continued...)
researcher had good accessibility and familiarity with officers which was critical for subsequent interview. Participating officers were of the three hierarchical levels coming from the four organizational segments as designed for the survey. After the pretest, interview was conducted with five participants. Since the participants were familiar with the researcher, they were more expected to give open-minded advice on certain sensitive issues. Based on the pretest result and respondents' advices, a subsequent revision followed. Then, the questionnaires were administered.

**Step 4:** The instrument was examined for construct validity and internal consistency. The former was accomplished by examining correlations between user satisfaction and its domains and by using a factor analysis. A Cronbach alpha (1951) test ascertained the latter. At this step, domains which showed

37 (...continued)

of the same level which featured standard protocol and regulation, and similar functional structure.

38 He had worked in the province for nearly four years.

39 For example, participants advised that the first impression when respondents read the question would be: "Why he asked this question?" or "Is he going to find a fault from me?"
incongruence\(^40\) with overall satisfaction scores were removed from the model. Eventually, a new set of satisfaction domains was developed which consisted of four components and 24 domains.\(^41\)

Each of the four sets of questionnaire consisted of six sections:\(^42\)

**Section 1:** This first section contained questions examining contextual and independent variables. These variables included age, gender, education, past experience, administrative and medical status, perceived development level of the locality and duration since assuming one's current position.

**Section 2 to Section 6:** The following 5 sections comprised items measuring the 32 satisfaction domains (the working set). Each of the sections contained related items of the same component. The five working components were: (1) understanding of the input procedure; (2) system stability; (3) system utility; (4) output content; and, (5) output form. An independent variable, decisional authority, was considered sensitive and was addressed in the last section.

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\(^{40}\)Referred to either a negative correlation or low factor loading or both (see Chapter 4: Section III - Assessment of the Instrument).

\(^{41}\)See Chapter IV, Section 3.

\(^{42}\)See Appendix II.
The pretest showed that most people spent 15 to 20 minutes to complete this 10-page questionnaire. The format and length was about the same for the four sets. In each, the sequence and contents of questions were identical, the difference lay in individual wording, which was tailored to match the respondent's situation. Nonetheless, because the questionnaires were delivered through bureaucratic organizational channels which might cause biased responses, the researcher decided not to include the respondent identification on the questionnaires.

**Questionnaire Administration**

The Ministry of Public Health (MOPH) endorsed this study. The cover letter was signed by Dr. Paijitra Pavabutra, the Deputy Permanent Secretary of MOPH. MOPH mailed a package of questionnaires to each of the seventeen provinces.

Each provincial package contained sealed questionnaire envelopes labeled to each of the respondents. Envelopes for

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43 An example is that the phrase "in this province" appeared in the provincial form became "in this district" and "in this subdistrict" in the district and subdistrict forms, respectively.

44 A preliminary interview with four experienced researchers revealed that the mailed questionnaire survey in Thailand usually yield low response rate (less than 20 percent). So, the researcher justified that delivering the questionnaires via the MOPH authority would raise the expected low response rate. This survey attained an overall response rate of 78.21 percent.
provincial officers were found separate. The ones for district and subdistrict respondents were put in district packages, each of which was labeled to the corresponding district. The included instructions recommended that the provincial planning section should handle this distribution procedure. It would distribute the envelopes directly to the addressed provincial respondents and deliver district packages to the labeled districts. Another instruction inserted in each district package notified the district to deliver district- and subdistrict-level envelopes to respective persons, preferably when they came to the district for the monthly meeting. Both provinces and districts were also instructed to collect the filled-out questionnaires on the first possible occasion.

A cover letter concisely describing the survey and giving instructions was attached to each individual questionnaire. Besides describing how to complete the forms, the instruction also assured respondents of confidentiality and mentioned the fact that there was no identification of the questionnaires.

The MOPH’s cover letter asked the provinces to complete the process and to return the filled-out questionnaires to the MOPH in about one-and-a-half months. Furthermore, the Deputy Under-secretary issued an official reminder letter to the
provinces when the deadline elapsed. Finally, all provinces sent back the questionnaires in separate provincial packages.

Data Analysis

Data was coded and transformed from the questionnaires into four separate unformatted files, one for each respondent group. Equivalent items were matched. The SPSS/PC+ program was used for all statistical analyses. Other data processing software included Quattro Pro (Ver. 2.0) and Wordperfect 5.1. Frequency distributions were checked to correct possible editing errors. Descriptive statistics were then produced by groups.

In the next step, working satisfaction domains were evaluated on two bases: construct validity and reliability. Two methods were used for ascertaining construct validity. The first method was to examine the correlation between each domain and overall satisfaction. The overall satisfaction score was the average of its five components. By the same token, the component score was the average of its contributing domains. Taking the assumption that overall satisfaction was valid, each item would be valid to the extent that it correlated positively with the overall. Thus, negatively correlated items were to be removed.
The second method used was a factor analysis of satisfaction domains. It was expected that a factor analysis would reproduce a five-factor clustering of the domains. This was performed after the negatively correlated items were removed. Items with low factor loadings would then be dropped from the model. Remaining factors would be reexamined if they appear "misclassified" or scattering from their original groups. Justifications would be made whether to keep the scattering ones based on the accuracy of conceptual meanings conveyed by the items. Consecutive factor analyses would be performed to arrive at a final meaningful model. For subsequent analyses, justification for using the factor scores or the factor-based, original Likert scores was made on the basis of whether the factor model produced large communalities and an acceptable explanation power (i.e., a large cumulative percent). If this was the case, then the factor scores would be used. On the other hand, had the final factor model failed to exhibit these characteristics, then original Likert scores would be adopted instead.

In this study, reliability was assessed in terms of internal consistency of the domain items. The study adopted the Cronbach alpha (1951) as the indicator. Alphas of multiple-item domains as well as of domain components were examined.
The derivation of overall satisfaction, in effect, answered the first research question. The main part of the data analysis was to answer the four research questions:

(1) How much did the regional health information system accomplish based on user satisfaction? The aggregate overall satisfaction score would be the indicator. Since the four-point Likert score was enumerated between 0 and 3, the study adopted the cut-off point of 1.50 as the minimal satisfactory score. Another way to appraise system effectiveness was to see how many users considered themselves satisfied.

(2) Was there any particular area that the system exhibited a potential problem? The final model yielded by the last-round factor analysis provided a meaningful number of satisfaction components. Each component would capture a construct which was constituted by its domains. Examining the pattern of user satisfaction on the basis of its interpretable components would reveal potential problem areas.

(3) How did users view the provincial information systems and did they exhibit distinct clustering with respect to the similarity of their opinions?
Cluster analysis of responses would disclose significantly different patterns of satisfaction. First, the number of clusters was determined using four methods: (1) within-group average linkage; (2) between-group average linkage; (3) median; and (4) Ward method. Since the SPSS/PC+'s CLUSTER procedure cannot handle the entire sample, the procedure was performed on a ten-percent random subsample. A comparison among the four methods was done to justify the final cluster number. The criteria were to adopt the number that was most agreeable among the four methods, and produced fewest significantly different clusters of comparable sizes. The QUICK CLUSTER procedure\textsuperscript{45} was then used to determine cluster memberships of respondent cases. The cluster analysis also illustrate patterns of satisfaction exhibited by the resulted clusters. This was portrayed by component values at cluster centroids.

(4) Which attributes were good predictors of the emerging satisfaction pattern? Explaining variables were attested to by the discriminant function analysis. First, all variables were in

\footnote{This is a SPSS/PC+'s procedure which can be used to cluster large number of cases efficiently (Norusis, 1990).}
the model, then locational and personal variables were removed and entered in six different combinations. The full model was used to disclose which of the proposed explaining variables would be the most meaningful predicting variables. The other models were aimed at testing whether either personal or locational attributes could accurately predict group memberships. Criteria of determining meaningful variables included: (1) high standardized coefficients of 0.30 or greater; and, (2) showing no redundancy by means of having significant correlations with the discriminant function. Finally, meaningful attributes would provide the interpretation of how to describe members of each clusters.

Operational Definitions

The following terms used in this study were defined:

Information System: The Thai Ministry of Public Health’s reporting system on health status, finance, activities, and resources, and its related activities, such as, survey, research, computerization.

Province: The Thai government public health organization that is responsible for community-based health activities, within the jurisdiction that has a distinct, official geo-political boundary. The organization
specifically includes the provincial health office, community hospitals, district health offices, and their subunits, as well as the section of the provincial or regional hospital that implemented community-based activities.

**User:** Organizational participant who accesses the information system to obtain information or received reports for one's operation.

**User Satisfaction:** The sum of the user's reactions to a determined set of factors which affected one's interaction with the information system.

**Satisfaction Domain:** A single characteristic of the information system which contributes to the user's evaluation on it.

**Administrative Status:** Official positions that may make an organizational decision with regards to policy, resources, and major activities.

**Medical Status:** The degree of Doctor of Medicine.

**Decisional Authority:** The condition that one has been authorized to act out certain functions and his (or her) perception of the extent to which (s)he could exercise major actions with regards to his (or her) position.

**Past Experience:** One's self evaluation about the quality and extent of his (or her) past interaction with the information system.
Perceived Development of the Locality: One's own evaluation of the socio-economic status of the community where his (or her) workplace is located in.

Duration in the Position: The length of time without a remarkable break that one had been acting and responsible for the jobs designated to the current position.

SECTION II: PROVINCIAL ASSESSMENT

This part of the study used provinces as the unit of analysis. The assessment consisted of two parts: quantitative and qualitative. The quantitative analysis employed the user satisfaction survey information. All seventeen of the northern provinces were compared with respect to their user satisfaction patterns. The main objective was to determine whether distinct patterns emerged and how provinces clustered. The qualitative investigation was to ascertain the extent to which the survey information converged with what might be observed in the field. Analysis rested on a case study of two selected provinces in the region. If the two methods agreed with each other, case study would further yield findings on what were major factors contributing to user satisfaction patterns found in the previous analysis. On the other hand, if the two approaches conflicted, primary attributable biases would be proposed. Finally, provided that similar user satisfaction patterns and a convergence occurred, the study made an induction that major features found in the two
provinces would also have happened in the other similar provinces.

**Quantitative Provincial Assessment**

Seventeen provinces made up seventeen cases. For each case, derived patterns of user satisfaction were presented in two dimensions: one by groups and the other by satisfaction components. The group satisfaction pattern consisted of four satisfaction parameters, one for each of the four user groups (i.e., provincial officers, community hospital directors, district health chief officers, and subdistrict health chief officers). A parameter represented the position of the group relative to those of their counterparts in other provinces. The position reflected the average overall satisfaction scores expressed by the group in that particular province.

Satisfaction component patterns also included a set of four parameters corresponding to the four components (i.e., System Management, Utility Enhancements, Input Procedure, and Output Quality). For each province, a parameter represented the satisfaction for a particular component which was the equally-weighted average of responses by the four groups. In both cases of patterns, the parameters used were quartile ranks of satisfaction scores.\(^{46}\)

\(^{46}\)This was to amplify the discriminating power of the figures calculated from the Likert scores.
Although two dimensions were used in this comparison, one would be emphasized more than the other. In the case that locational attributes were meaningful based on the previous analysis, it implied that different groups were affected differently by the information system and that average responses might cancel out, thus, obscuring provincial differences. In such a case, the group pattern would be considered the primary feature and the component pattern the secondary. On the other hand, had the locational attributes proved meaningless, any group of users would feel about the same towards the system, and provincial differences would rest mainly on differences among the four facets. In the latter case, component patterns were considered primary.

The comparison was primarily done by inspection and data reduction. First, the two sets of patterns were reduced to two figures using the quartile ranks as crude Likert scores. The allocation of provinces to groups was based on these reduced figures. If the reduction did not show a distinct discrimination, an inspection of the initial sets would be employed. The comparison was first among the primary set. Provided that no major deviation was found on the secondary set, similar provinces would be grouped together. Unduly deviated provinces on either set were justified as a separate group.
Case Study of Two Selected Provinces

The purpose of the case study was to examine two different situations with respect to their effects on the health information system over the past three years. The first was that major changes in the provincial system had occurred. Since, the study was to find out positive contributing factors, these changes should result in producing a "more successful" provincial system. The second situation would be a "control system." This means that the selected provincial system included much of the conventional MOPH's system and no major change had taken place. The study named the two cases as the "innovative" and the "conventional" provinces, respectively.

The selection of the successful provincial system was primarily based on comments gathered during preliminary interview. Selection criteria included:

(1) The system must have features considered positive and significant by expert opinions;

(2) The province was of a moderate size and exhibited no uniqueness regarding socioeconomic, geographical, ethnic, and subcultural characteristics;

(3) The province should not have been running a special project in association with an external organization, but had the province been
implementing a special project, there was no evidence of a significant amount of resources externally supporting such projects;

(4) The province was practically accessible for the researcher to perform a non-participatory observation for three to four weeks.

The selection of the conventional province rested on the same criteria, with the exception of the first feature above. In addition, there should not be a change in the top management position or a significant event which might affect the provincial information system during the past three years. This last criterion was to ensure that the conventional system had been stable over the past three years.47

Data Collection
The case study employed semi-structured interview as the main method of data collection. Non-participatory observation and an examination of related documents also supplemented the data. The researcher gained access to the provinces by means of official support. Official patronage was considered critical to ensure the cooperation of the host organizations. Dr. Vitoon Saengsinghkaew, the deputy director of the Division of

47Characteristics of the seventeen provinces were given in Appendix I. Under the aforementioned selection criteria, PR4 and PR15 were selected as the conventional and innovative provinces, respectively.
Medical Services, issued an introductory letter to each of the two provinces briefly describing the study and asking for their cooperations. After that the researcher called the two provinces and received positive responses. The researcher subsequently had a one-day preliminary visit about one week before initiating fieldwork. On this occasion, he described the study and presented the study schedule to the provincial administration. The three-week schedule described tentative times and places as well as a list of prospect interviewees. PR15 was the first province where the fieldwork was conducted.

The interview was aimed at extracting opinions from the four segments of the provincial information system users. In each province, the interviewees included: (1) the provincial health chief medical officer; (2) two provincial deputy officers; (3) head of three sections within the provincial health office: health planning, health promotion, communicable disease control; (4) principal data processing staff and the primary computer operator; (5) provincial staff responsible for the four selected programs, i.e., expanded immunization, disease surveillance, disease control and family planning; (6) three pairs of community hospital directors and district health chief officers and their principal data processing staff; and, (8) three subdistrict health chief officers.
In addition, interviews were also conducted: (1) the head of the community medicine section of the provincial hospital; (2) an MOI officer in charge of population data; (3) a primary officer of the municipality; and (4) other closely related informants.

The interviewing plan was comprised of two parts. The first gathered the information about what had been happening for the past three years. This "process inquiry" was responded to only by a deputy, the head of the health planning section, and the principal data processing staff. The process inquiry was conducted before first. The information acquired became the building blocks that steered subsequent interrogation. The PR15 process was more specific and primarily based on the Eight Files system.

The second part investigated users' opinions about the features of the provincial system and was based on expert's identification of the most problematic features of the information system. Since time constraints prevented full

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48 The researcher based at the provincial health office. He had a time constraint when interviews took place off-site, so he did not include this part in the district and subdistrict inquiries. However, the system feature questions included specific contexts based on the process information.

49 See Chapter 5 - The Provincial Findings.

50 This were the opinions expressed during the preliminary interview.
interrogation of all 31 satisfaction domains, only a subset of them were assessed. The most discussed items were included. Interview was structured to examine a person’s opinion considering the four major components: System Management, Utility Enhancements, Input Procedure, and Output Quality.52

The following features were examined:

(1) System Management: Management supports and participation;
(2) Utility Enhancements: Timeliness, problem solving, and computer technical competence;
(3) Input Procedure: Form format, redundancy, understanding of the procedure, and ease of interface; and,
(4) Output Quality: Accuracy, error detection, relevancy, and locality.

Each of the four feature groups consisted of related items. Respondents were first to rate their satisfaction on the four most important items, one from each group: management supports, timeliness, ease of use, and accuracy. Then, the interview continued from each of these major features to cover the remainder of the related items. Another respondent’s

51(...continued)

51Each interview lasted approximately one and a half hour.

52Actual interview included only selected points (items). The classification, which was based on the item clusterings produced by factor analysis, was later done in the analysis (see Section I).
rating was done to point out items which respondents considered themselves to be most dissatisfied. Finally, probe questions were employed, but only for the most deviated items.

The content above has outlined the structure of the inquiry. However, opinions beyond this structure were also included if they appeared to be of relevance. This unstructured part of the discussion contained individual's concerns and varied among respondents.

Non-participatory observation and secondary source document examination supplemented the data in terms of observable materials and interpersonal interactions. The materials included mostly archival documents such as memos, reports and records.

The investigation centered around community-based programs which were the main mission of the provincial health offices and their subunits. All of these programs had specific target groups. Target groups were normally based on population data. Therefore, the case study employed provincial population data as the central subject of investigation. Four community-based programs constituted the study subjects: family planning, perinatal care, disease surveillance, and communicable disease control. Perinatal care and family planning involved the major of community target groups which included mothers,
children and women of reproductive-age. Disease surveillance and control were two related programs that required a sensitive information system. Therefore, while the first two reflected static system performance, the latter would show how the system could make a difference when it responded to the environment.

Data Analysis

Data analysis was done both during and after the case study. When the analysis was performed alongside data collection, it provided inputs for subsequent data collection. This means that every evening the researcher would evaluate the interviews and observations of the day. Daily evaluation yielded relevant points for subsequent investigation.

The final analysis first aimed at illustrating the unique features of the two systems: a conventional system; and, an innovative system which featured the course of a system change. The analysis was first to find out what problems or forces initiated such changes. Then, viewpoints of respondents about their respective provincial system would be presented. The findings from observation and findings on the documents would then be added. The analytical framework was based on the four satisfaction components. For each component, viewpoints of the four organizational segments were given. If conflicts among the viewpoints appeared, the
analysis would look to observe evidence and materials that supported and/or negated such positions. Based on testimonies and observed evidence, the researcher provided an overall evaluation on the four parties' positions on the components. This justification was compared with the surveyed figures. Thus, convergence or divergence between the case study and the survey was determined.

Finally, the major features of the two systems were articulated. Observed features of the innovative system, expected to produce higher satisfaction, would likely contribute to that success. By the same token, the conventional system was expected to be less satisfying and its features were considered potential causes of dissatisfaction. The case study would provide a postulate in terms of process, cause and effects. Further, provided that satisfaction patterns characterized the two provinces were shared by some other provinces, an induction would be made that the two sets of features were likely to be found in those provinces of similar characteristics.

Chapter Summary
This chapter described the two levels of the study. The first level surveyed the attitudes of individual users towards the regional information system. The effectiveness of the regional system was estimated as to how much the system
satisfied the users. Satisfaction components were used to pinpoint strengths and weaknesses of the system. The individual-based analysis, furthermore, delineated the clusterings of users based on their satisfaction patterns. Finally, the study provided statistical models featuring meaningful predictor attributes.

The second level of the study examined the seventeen northern provinces. Attempts were made to group provinces that exhibited similar patterns of user satisfaction. Two facets of patterns were adopted: satisfaction by organizational segments and by components. A case study of two selected provinces illustrated phenomena observed in the field. The study matched observations and survey results to find out the extent of convergence. Provided that an acceptable convergence occurred, an induction was made that the observed system features would have happened in other provinces that exhibited comparable satisfaction patterns. Finally, the study presented a postulate describing the features that contributed to more satisfying and less satisfying systems.
CHAPTER IV
RESEARCH FINDINGS I: INDIVIDUAL USER SATISFACTION

This chapter presents findings at the individual level. It describes how information system users appraised their system. The chapter consists of three sections. The first section describes profiles of the respondents. The main findings in response to the research questions are presented in the middle section. Finally, an assessment of the instrumentation completes the chapter.

SECTION I: PROFILES OF RESPONDENTS

This section describes primarily the "independent" and contextual variables which affect user satisfaction. They include characteristics and psycho-organizational attributes of the surveyed sample. The study adopted an assumption that in government agencies, local level officers were relatively homogeneous with respect to certain socio-economic and demographic characteristics (such as income, marital status, religion). Furthermore, the survey was conducted in a single region - the north. So, it was assumed that these personal attributes would either play a minor role or exhibit small variability. Thus, this study examined only attributes which appeared strongly job-related.  

The characteristic and contextual variables were assigned to two classes: (1) individual characteristics (i.e., age, gender, education, administrative status, medical status, and number of subunits under work-site, decisional authority, (continued...)

117
In terms of their roles within the organization, users and their sample were composed of disproportionate heterogeneous groups. One classification of respondents that helped explain the findings of both the individual and collective levels was the locational grouping of respondents. Classification into groups\(^2\) also absorbed the variability of omitted socio-economic and demographic attributes. This survey collected data from four groups of health information system users: provincial officers, district (community) hospital directors, district chief health officers, and subdistrict chief health officers. Their characteristics are shown in Table 4.1.1 by groups, as well as in comparison, with the unbroken total. For most of the variables, central tendencies (means) were given with standard deviations in parentheses. Numbers and gender were presented by their counts and ratios, respectively. Missing cases amounted to less than 3.05 percent for the four groups and were not shown on the table. Appended to the survey results, the following descriptions presented major qualitative findings from the field study.

\(\ldots\)continued) and perceived development level of the locality); and, (2) locational variables which included group and province. While the individual characteristics varied among individuals, the locational attributes depended on the local situations where the individual works. Everybody working at the same work-site would present the same values for the group and province variables. Thus, they reflected effects of local policies or interventions.

\(^2\)Group, a locational variable, was also designed as a principal dimension in the appraisal of provincial systems (see Chapters III and V).
Group I (Provincial Health Officers)

Group I was comprised of health officers working at the 17 chosen provincial health offices (PHO's). Their diverse backgrounds made the group the most heterogeneous. Their positions ranged from top administrators to office staff. Ages spanned from senior officers to young novices. Although gender disparity looked inapparent, all of the provincial medical chief officers were male and only 3 deputies were female. Their education seemed higher than the other groups, with an exception of Group II. This study regarded the two topmost positions as administrators. Field study also corroborated that deputies were usually delegated substantial amounts of decision-making authority. However, this varied across provinces. Administrators constituted the larger part of the group of individuals graduating with higher than bachelor degrees (n=19 or 59%). Similarly, all medical chief officers and 14 of the 26 deputies were M.D’s.

Group II (Community Hospital Directors)

A general profile of Group II indicates most were young physicians, predominantly male. All but one were M.D’s. Fourteen (15%) were specialists. Two thirds had worked in their then current positions for less than five years. As the heads of organizations, they regarded their decisional authority (empirically and perceivably) more powerful than the other groups did. The field study revealed that their
authority was, however, usually confined to hospital operations. They were involved more in medical services than in field programs. However, their responsibilities included providing medical care for the entire district as well as running field health programs within district center communities. Hospital directors usually came originally from other provinces. Their turnover-rate was rapid; after a few years many either moved to other places or entered specialist training.

**Group III (District Health Chief Officers)**

Mostly middle-age, male, district-level administrators made up this group. They were responsible for health services (primarily prevention and promotion) in outer communities other than district centers. Only 18 percent had attained bachelor degrees or higher. They directed health centers. Although district governors (Ministry of Interior - MOI) were officially their immediate superiors, they reported both to the provincial health office and to the districts (MOI). They tended to be local people. Many started their career at a health center.

**Group IV (Subdistrict Health Chief Officers)**

The largest proportion of female officers formed this group. Although mean age was 36, variation was relatively sizable. The educational profile was not relatively high and looked
similar to Group III’s. Their career appeared the least mobile. Almost 60 percent considered their authority level "powerless" or "somewhat powerless." Field investigation revealed that although the position looked like the principal health officer of the subdistrict, it did not bear any administrative authority over health centers other than the person's own work-site. However, they represented the Ministry of Public Health (MOPH) when subdistrict annual (budgetary) plans were drawn up. These officers handled all the local data of the subdistricts. In contrast, other health centers dealt merely with operational data. This study regarded this group as non-administrators owing to their lack of administrative authority.

SECTION 2: MAIN FINDINGS

This study defined the effectiveness of information systems as the extent to which system users felt satisfied with the system. The more effective the system, the more it satisfied the users. The survey assessed various domains of satisfaction of users towards the systems with which they worked. "Overall satisfaction" consisted of 24 domains. Factor analysis classified these domains into four classes (see Section III) which included: (1) System Management (SM); (2) Utility Enhancements (UE); (3) Input Procedure (IP); and,
(4) Output Quality (OQ).³ Table 4.2.1 shows scores of the 24 domains, the 4 domain groups and the overall satisfaction.⁴

Taking the midpoint of the scale (i.e., score = 1.5) as the cutoff, one would find that only "System Management" showed a satisfactory average. The remaining three components exhibited similar averages. Each component also incorporated rank dispersion among its respective domains.⁵

How much did provincial information systems accomplish as measured by the satisfaction of users?

Only 91 of 655 respondents (13.89%) rated themselves as "satisfied" based on "overall satisfaction (SAT)" scores. The satisfied-dissatisfied ("pass-fail") point assumed the mid-scale (i.e., score = 1.5) as the cutoff. The "satisfied group" had a median SAT of 1.65 (mean=1.67, S.D.=0.13). The "unsatisfied group's" median was 1.20 (mean=1.15, S.D.=0.23). The mean, median, minimum and maximum SAT scores of the whole

³For presentations, the chapter used abbreviations interchangeably between Syst.Mgt., Util.Enh., Input and Output and their contracted forms, namely, SM, UE, IP and OQ.

⁴In computing scores of domains, the analysis employed a Likert scale ranging from 0 (minimum or "very negative") to 3 (maximum or "very positive"). Discrete scores of individual domains became a continuous interval scale (ranging from 0 to 3) when aggregated into groups and overall scores.

⁵This means that the items showing peculiar ranks tended to be considered different from others of the same group. Thus, interpretation of component scores should be regarded as composite rather than truly single-dimension constructs (see also the factor analysis in Section III).
was 1.227, 1.245, 0.219 and 2.205 respectively. In general health information systems were not considered effective in terms of satisfying the users.

The distribution of satisfied and dissatisfied users were examined across the two classes of characteristic attributes. Chi-square tests revealed that discrepancies between observed and expected distributions were significant (at 95% confident level) only for the three variables, namely, "past experience", "number of subunits" and "group." The number of individuals with bad past experiences with information system appeared more than expected, merely by their proportion in the satisfied group. Chi-square test also showed that sites with a larger number of subunits included too many satisfied individuals disproportionately, while they appeared fewer than expected in Group IV.6

How did patterns of satisfaction describe the system and characterize the grouping of users? Was there any particular area where the system exhibited major weakness? A notion of the previous answer was that the systems satisfied only about one in every seven users. However, overall satisfaction was not a single concept. It incorporated 24 different facets. For the sake of interpretation, these

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6Based on the "observed" v. "expected" numbers of the significant Chi-square statistics.
domains were categorized into four classes based on conceptual similarity and statistical coherence. This classification should enhance the precision of interpretation because the overall score might be a covert indicator when the effects of the different components offset each other. To identify what characteristics determined the extent of satisfaction by using the overall scores also presented another statistical flaw. The cutoff value of 1.5 was arbitrarily assigned as the separator. Thus, the resulting "passed" and failed" groups did not exhibit a normal distribution of their scores since they were "cut" from a normal curve.

Considering the scores of the four satisfaction components in Table 4.2.1, one would find that only System Management presented a relatively high average score (1.7) which could be considered the only, yet marginally, strong facet of the regional system. The component scores indicated that the system was not effective in the three other areas.

7Though it reduced the number of satisfaction facets to four interpretable principal areas, even such a grouping did not completely eliminate the within-group discrepancies (see Table 4.2.1 and the factor analysis in Section III).
How did users view the system? Did any distinct picture exist? And, if so, how did users cluster themselves based on patterns of satisfaction?

This study utilized cluster analysis\textsuperscript{8} to identify the grouping (clustering) of respondents based on their satisfaction patterns. The four components of the overall score were examined simultaneously so that all were taken into account and served as the basis for cluster identification. Since the sample size was too large for SPSS/PC+'s CLUSTER procedure, the analysis first utilized a 10-percent random subsample to determine the number of clusters. Cluster combining criteria included the average linkage between group (BAVERAGE), average linkage within group (WAVERAGE) median, and Ward methods. Table 4.2.2 presents the last six stages of the four agglomeration schedules. The four methods presented comparable results. This procedure suggested a three-cluster solution.\textsuperscript{9}

\textsuperscript{8}The cluster analysis adopted squared Euclidian figures in measuring distance between cases and employed agglomerative hierarchical clustering.

\textsuperscript{9}In determining the optimum number of clusters, Norusis (1990) suggests that agglomeration be stopped as soon as the increase between the two steps becomes large. The WAVERAGE and the Ward method resulted in a remarkable increment of the coefficient between stage 65 and 66. Both suggested a three-cluster solution. The median method showed a substantial increase two stages earlier. However, Case 44 was trifling since it appeared for the first time. Neglecting the trivial case, one found significant increment at stages 63-64 and 65-67. These corresponded to 4 and 2 group classifications respectively. The BVERAGE, disregarding the isolated Case 44, also suggested the three-group clustering (Table 4.2.2). (continued...)

125
The QUICK CLUSTER procedure then produced a classification of the entire sample using the three-cluster criterion. The basis for clustering was the four components. This procedure used the nearest centroid sorting algorithm (Anderberg, 1973). The resulting three clusters were named the "Highs," "Moderates" and "Lows" based on the mean SAT scores. Table 4.2.3 shows the SAT scores and their components at the cluster centers.

Table 4.2.3 indicates, first that one could find a small group, (16.3%) of satisfied users, labeled "Highs." However, even in this group, only System Management (SM) exhibited a notably high contentment. The other three components appeared only mediocre. Secondly, almost half (45.6%) the respondents, the "Moderates," expressed negative attitudes towards the components. The last group, "Lows," making up 32.7 percent of the respondents, showed the lowest overall satisfaction scores. Notably, the Moderates and the Lows arrived at comparable overall scores. The Lows looked well contented with System Management (SM), the contribution of which raised the group's overall mean. The Moderates, on the other hand, showed relatively weighty approval on Utility Enhancements (UE). Nonetheless, Input Procedure (IP) and Output Quality (OQ) were consistently low across three groups.

9(...continued)
Examining the dendrograms supported that a 3-group clustering represented the data well.
An analysis of variance (ANOVA) comparing the three groups for each of the variables, shown on Table 4.2.4, all resulted in significant F-statistics. So, the three clusters were well separated.

What attributes were good predictors of the emerging patterns of satisfaction?

Characteristics of the three groups were first examined at the nominal level of measurement by using Chi-square tests. The disproportionate variables significant at the 95-percent confidence level included age, education, past experience, medical status, position, province and group. Gender and administrative status were significant at the 90-percent level. Univariate F-tests also featured agreeable results.

Profiles of the three clusters are shown in Table 4.2.5. Since breakdowns by position and province included too many small categories, they were not presented. Provinces and groups are presented later in this chapter. "Position" also incorporated two other more rudimentary variables, namely, "group" and "administrative status." Other variables, the distributions of which did not significantly differ from that expected across the three groups, were not shown. They included decisional authority (ranks within position), years

However, Norusis (1990) argues that the F tests should be used only for descriptive purposes since cluster analysis is itself a maximization algorithm.
in position (ranks within position), perceived development level of locality, and number of subunits.

The next step was to determine whether any of the variables were statistically good predictors of group membership. This study employed stepwise discriminant function analysis to identify distinguishing variables.\textsuperscript{11} Prior probability assumed an equality (0.33) for each group. The summary of actions is given in Table 4.2.5.

Of the model's 19 variables remaining in the final step, thirteen were locational variables (Table 4.2.6). Two vertically hierarchical groups (G1 and G3) as well as 11 provinces appeared in this model. The univariate assessment showed that significant individual and locational variables included age, education, perceived, past experience, PR4, PR11, PR16, G1, G2 and G3. These were statistically significant at the 95-percent confidence level or better. The analysis produced two stepwise discriminant functions. The Wilk's lambda, transformed into Chi-square values (shown in Table 4.2.7) indicated that both functions were statistically significant. However, the first function explained more - 69.6 percent of the variance. Thus, one could reject the null hypothesis that the population mean was equal, which was

\textsuperscript{11}For the locational variables, 17 (PR1 to PR17) and 4 (G1 to G4) "dummy" variables were assigned to the 17 provinces and the 4 groups, respectively.
applicable to both functions. Table 4.2.8 displayed the F values between pairs of groups indicating significant differences for all of the three pairs.

The values of the functions at group centroids (Table 4.2.9) implied that the user tended to be a Low with a positive discriminant score produced by the first function (FUNC 1). A negative score raised the probability that one belonged to either the Highs or, if the negative appeared even stronger, the Moderates. By the same token, a strongly negative score produced by the second function suggested a High.

To interpret the discriminant functions, Tasuoka (1973) suggests that one use correlations for substantive interpretation of discriminant functions, but use coefficients to determine redundant variables given others in the set.\(^{12}\) This study followed Tasuoka's notion. Correlations between variables and discriminant functions were adopted as primary

\(^{12}\)Stevens (1986) suggests that two methods of interpretation be considered: (1) the standardized coefficients; and/or, (2) the discriminant function - variable correlations. He points out that the two methods could give different results. Meredith (1964), Porebski (1966) and Darlington et al (1973) have argued in favor of using the correlations for two reasons: (1) the assumed greater stability of the correlations in small and medium-sized samples, especially when there are high or fairly high intercorrelations among the variables; and, (2) the correlations give a direct indication of which variables are most closely aligned with the observed traits which the discriminant function represents. On the other hand, the coefficients are partial coefficients, with the effects of the other variables removed.

129
criteria for interpretation. Pedhazur (1982) suggests that correlations of 0.30 or more be treated as meaningful. Table 4.2.11 revealed that, for the first function, five variables appeared meaningful, namely; age, education (EDUCSIM), medical status (MD), G2, and PR11. Absence of MD and G2 on the standardized coefficient list (Table 4.2.10) indicated that they were redundant. In fact, education, medical status and district hospital director (a physician) were highly correlated among themselves. Regarding the second function, the two meaningful variables, namely, G1 and past experience, appeared on the model (Tables 4.2.10 and 4.2.11).

If one disregarded the locational variable (PR11), one might propose "modern generation" as the underlying construct of Function 1. A possible construct for Function 2 was "proximity to provincial center with bad experience." The following features an example of interpretation based on the centroid values (Table 4.2.9): Should one be an officer of the modern generation (young and well educated), he/she tended to be a Moderate. On the other hand, a user working at a center (provincial health office), especially with a less satisfied experience, would have a greater chance of being a High.

One might consider more on an individual basis. By removing all of the locational variables (province and group) from the first model, a new model would reveal whether and what
individual's traits become good predictors. Except for the reduced set of predicting variables, the same stepwise discriminant function analysis was used in establishing the second model. After the final step, six variables remained in the model. They were administrative status (ADMIN), education (EDUCSIM), gender (GENDER), age (AGE), past experience (EXP), and decisional authority quartile ranked within position (QDEC). The result contained two discriminant functions. Both functions were significant at 99 and 95 percent confidence level (Table 4.2.12). Table 4.2.12 also showed that the first function was the main contributor, explaining about 73 percent of the variance. The difference in means between each pair was still significant even though all locational variables were not in the model (see Table 4.2.13 for F statistics).

It was found that age and education (and gender to a lesser extent) were considered the primary underlying constructs of the first function.\(^\text{13}\) The effects of old age and high education were reversed as in the first model. The vector of the second model's first function looked parallel to that of the first model. An evaluation of the function at group centroids (Table 4.2.16) also pointed out that a young individual

\(^{13}\)The correlations between discriminating variables and the canonical discriminant functions suggested that age, education, medical status and gender contribute much to Function 1. However, the standardized coefficients indicated that medical status (MD) be redundant (Table 4.2.14).
with high education tended to be a Moderate. The second function incorporated only one non-redundant attribute - past experience (EXP). Table 4.2.15 suggests that an individual with a negative score (i.e., less satisfactory past experience) tended to be a Low. Others with positive scores were likely to be either a High or a Moderate. Although the second function was significant (p=0.0015), it explained only 27 percent of the variance (Table 4.2.13).

The two models did not perform equally in producing results in terms of correct classification of cases. Tables 4.2.17 and 4.2.18 present the classification results. In a three-cluster situation one has a 33.33 percent probability chance to correctly assign an individual to a group without any information. Although their discriminatory powers were not so high, both models did raise accurate prediction rates by 52 and 40 percent, superior to that occurring by chance alone.

How good were locational attributes at predicting group membership given that they became the sole predictors?

This question simply asserted whether the locational effects would influence an individual tendency to belong to a group. If so, what had been occurring locally (e.g., in a particular province and experienced by particular groups) would become a crucial determinant of systems satisfaction. This argument sounded sensible considering the information system as a
supporting structure inseparable from the management which might be uniquely experienced by different organizational segments.

A stepwise discriminant function analysis produced the third model using only locational variables – province and group – as dependent variables. The results (Table 4.2.19) contained two significant functions. The first explained 59.93 percent of the variance. Meaningful attributes were district hospital directors (G2) and PR11. Both favored the Moderates. The second function incorporated 3 meaningful variables: provincial officers (G1), PR7 and PR16. G1 inclined towards the Highs while both provinces exhibited opposite vectors. Classification results are given in Table 4.2.20. However, when either provinces or groups were removed from the model, the percent of correct classification dropped to 34.9 and 35.57, respectively. Thus, they were no better than probability chance alone.

Different sets of predictor combinations were tested. Table 4.2.21 indicates that with all variables in the model, the predicting power is 50.67 percent correct which is significantly higher than a probability chance of one-third. Furthermore, neither province nor group when used as the only predictor appear as a good predictor. However, when combined, the two locational variables provided a 48.17 percent correct
prediction which is almost as good as the all-variable model. Nonetheless, even if all the variables were included, the resulting model provides only modest prediction power. Therefore, one would argue that other potentially meaningful variables might not be included in the model. The two case studies examines this expectation and will be described in Chapter V. Chapter VI will further discuss the potential determinants.

SECTION III: INSTRUMENTATION
This section describes the validity and reliability of the questionnaires. As rendered in Chapter III, three equivalent sets of questionnaires were used for the four groups of respondents. The contents and phrasing in each instrument were alike, however, the context changed where people working at different levels experienced the system differently.\(^\text{14}\) The middle two groups answered the same set of questions\(^\text{15}\) since both worked at the district level, where similar situations occurred.

\(^{14}\)For example, questions addressing data accuracy used precisely the same phrasing but substituted "district" for "subdistrict" to accommodate the responders' position.

\(^{15}\)Except for the first section of the questionnaire which addressed characteristics of respondents. (Appendix II).
Content and Construct Validity

Validity is defined as the extent to which the measurement instrument measures what it is supposed to measure. Content validity and construct validity are main concern here. Content validity implies that all aspects of the attribute being measured are included in the instrument. Thus the questionnaires should capture all relevant aspects of user satisfaction appropriate for the then current Thai government's provincial health organizations.

This study initially adopted the five categories of user satisfaction described by Jenkins and Rickettes (1979). The domains fitting each of the five categories included those suggested by Jenkins and Rickettes (1979), Bailey and Pearson (1983), and Ives, Olson, and Baroudi (1983 and 1988). All of these instruments had been well established in the MIS literature. However, all emphasized an electronic data processing system which was still embryonic in the Thai case.

To modify the initial domains to better fit the survey, the researcher interviewed seven distinguished practitioners. The interviewed district and subdistrict practitioners had good reputations among their colleagues. They included: (1) a Chairperson of the General Communicable Diseases Control Division (also a former provincial medical chief officer), well-known for his interest in the information system; (2) a
Chairperson of Health Statistics Division; (3) two deputies of the Ayuthya provincial health office (both were former community hospital directors); (4) one district health chief officer in Phattalung; and, (5) two subdistrict health chief officers (one of Phattalung and the other of Ayuthya).

After the interview, each was asked to review the initial domains. Adjustments were made based on their comments. The adjusted set of domains were further validated by the rating of practitioners in Ayuthya. The province had been running a health information system improvement program (Ayuthya Provincial Health Office, 1990). Table 4.3.1 shows the importance of satisfaction domains rated by the three levels of Ayuthya's health officers. Since only two community hospital directors returned the questionnaires, they were grouped together with district health chief officers. The rating employed a six-point Likert score for each item. The score ranged from 1 (minimum or "extremely unimportant") to 6 (maximum or "extremely important").

The result illustrated that all items but one were considered important. A score of 4 was labeled "very important." All items received a score of 3.5 or greater for at least two levels of respondents. Nineteen of the thirty items were rated over 4.00 by all three levels. Only "computer technical competence" showed consistently low scores across the levels.
However, the provinces had only two computers operating at the provincial health office. Since automation, albeit just beginning, would become a crucial instrument in the near future, this item was retained in the assessment. However, this domain would be exclusive only to two levels—province and district—which were more accessible to the machine.

Another domain, "lack of redundancy," was also added to the list. All of the interviewees mentioned redundancy as a problem; and seven of the Ayuthya respondents noted it in the open space provided for "other significant problems." On the other hand, some initial domains were dropped. They included those oriented towards either electronic data processing systems or product-based business firms; such as, vendor supports, integration of systems, charge-back method of payment for services.

The methodology used to develop the factor list suggests strong content validity of the satisfaction domains. Even though satisfaction for different users was influenced by a variety of different factors, the methodology and its result suggests a high probability that any pertinent factors was included.

Construct validity is established by showing that the measure is an appropriate operational definition of the construct it purports to be measuring (Stone, 1978). Two methods of
construct validation used by Ives, Olson, and Baroudi (1988) were adopted here.

The first method examined the correlations between each scale and overall satisfaction score. This method assumed that the overall score was valid and so each item became construct valid to the extent that it correlated positively with the overall score (SAT). Table 4.3.2 presents the 24 correlations of the "final set" of domains used in subsequent analyses (in Section II). Although one might expect the spurious part-whole correlations incorporated in the figures, their effects should be minimal. Since the number of factors in the model was large (24), a single factor's influence would be greatly diluted by that of the others. Because "computer technical competence" was not addressed with subdistrict personnel, they were excluded from the calculation for this factor. The figures significantly ratified that each of the final domains positively correlated with the overall score.

Seven domains in the previous list did not appear in the final domain set, namely; data processing training, security, dependability, accessibility, benefit-costs, job effects, graphics. The first three exhibited negative correlations with the overall score which included them in the model. Reexamination of the questionnaires revealed that these questions were phrased ambiguously, as was that inquiring
about "Accessibility," though it showed a positive correlation. "Training" clustered with "Understanding of Input Procedure" in the first-round factor analysis (described later). However, they exhibited strong negative correlation. Closer examination revealed that those who favored past training tended to be those who had never undertaken it. Those who had partaken in a training gave mixed responses. It became likely that the former group responded on the basis of their wants (to attend a training course) rather than actually evaluating the training. "Benefit-cost" and "Job Effects" both correlated positively with overall scores. However, the questions appeared so obscurely phrased that responses shaped by political reasons became a likely peril. "Graphics" produced a positive correlation; but field study revealed that the item was not meaningful. Very little graphics existed in the reporting system. All of these items were rejected along with consideration of factor analysis results.

The second method ascertaining construct validity was factor analysis. It examined the underlying structure of the measure (Pedhazur and Schmelkin, 1991). Campbell (1976) states that factor analysis of the components making up the total measure is an important method of construct validation. Here the purpose was twofold. Exploratory factor analysis was performed on the proposed domains to reduce the number of
components constituting the user satisfaction construct.\textsuperscript{16} Furthermore, provided that the reduced set, called "factors," represented the data well, their scores would be used in place of the original item scores for subsequent analyses. This resulted in a few components accounting for most of the variation of the correlated items (Stevens, 1986).

The factor analysis using principal component extraction and varimax and oblique (oblimin) rotations were conducted. It was performed first on the original thirty domains. Stevens (1986) advises that Kaiser's criterion (Kaiser, 1960) provides good accuracy when the number of variables is less than 30 and the communalities are large (0.70 or greater). The first factor analysis produced modest communalities (mean = 0.51, range = 0.31 to 0.73). A minimum eigenvalue of 1 resulted in 10 factors explaining 53 percent of the variance (cumulative percent = 53). To achieve a cumulative percent of 70, sixteen factors were required. The item reduction was deemed unsatisfactory. The factor patterns of both rotations looked similar. Large clusters appeared as the first four factors, which contained high-loadings\textsuperscript{17} for 5, 5, 5 and 3 "correct"

\textsuperscript{16}A few major components would become more interpretable, than the original thirty plus domains or the like.

\textsuperscript{17}Factor loading was the correlation between the individual item (domain) and the factor. Generally speaking, the higher the factor loading, the more meaningful it was deemed to be, or the greater the impact of the factor on the item.
items. Graphics, understanding and training, locality, dependability, and computer technical competence seemed to form five "solitary" factors.

Pedhazur and Schmelkin (1991) suggest that the researcher revise the items and repeat the process until he becomes satisfied with the items. Reviewing the questions and the correlations between the domains and the overall satisfaction, six domains were eventually removed from the factor model. The second-round factor analysis produced the final statistics shown in Table 4.3.3.

Table 4.3.3 indicates that the revised model consisted of six factors exhibiting eigenvalues greater than one. However, it explains only 45.5 percent of the variances. Other results shows that the original Classes I (Input Procedure) and V (Report Format) mingled as one cluster. The other classes were reasonably reproduced. Ease of Interface produced high loadings on both System Stability and Output Format-Input Procedure clusters (0.47 and 0.46 respectively). Two small but distinct groups were Rationality - Problem Solving - Locality and Sequence - System Confidence.

Factor analysis was successful in sorting out spurious items and help reexamine domain classification. However, since the explanation power (cumulative percent) was nominal, the
resulting factors would not represent the item scores well. Thus, subsequent analyses retained item Likert scores for computations of user satisfaction. While the first four large clusters rendered reasonable grouping, the smaller two did not show congruous meanings. Another factor analysis, restricting the number of factors to four, was conducted. This final step was to determine the best grouping regardless of the representativeness of the factors. Tables 4.3.4 and 4.3.5 show the loadings and their patterns under varimax and oblique rotations. The four factors were renamed based on the composite meanings of their components.

To identify meaningful loadings, Stevens (1986) recommended the value of two times of critical values of 99-percent confident significance (one-tailed test). For a sample size of 600 (as in this study), the critical value was 0.105, thus significant loading would be of greater than 0.21 (Stevens, 1986).

The varimax and oblique rotations produced identical patterns of factors. Most domains showed high loading on a single factor. However, three exhibited low yet significant loadings

---

Researchers often treated loadings exceeding 0.3 or 0.4 as meaningful (Stevens, 1986; Pedhazur and Schmelkin, 1991). Cliff and Hamburger (1967) assert that sample size usually affect the statistical significant level. They advise that investigators stop using the arbitrary rule and that sample size be taken into account.
on multiple factors, namely: Understanding of Input Procedure, Ease of Interface, and Error Detection and Recovery. Here, the justification either adopted the highest loading or classified the domain into the group based on its meaning.

Reliability

Reliability refers to the extent to which the questionnaire is free from measurement error. To assess precision, repeated measurements may be taken so as to note how consistent they are. One way to obtain a reliable measurement is using forms composed of multiple items to measure a single construct (Pedhazur and Schmelkin, 1991). The study employed Cronbach's alpha (1951) as reliability estimate. Table 4.3.6 presented the results.

Notably the survey employed self-administered questionnaires which faced a cardinal constraint - questionnaire length. The researcher tried to keep the time spent by respondents to 20 minutes or less to complete the questionnaire. As a result, only a few obscure items were assessed by multiple questions. Among the satisfaction domains, only Accuracy used multiple items. Thus, internal consistency here could not be ascertained to the greatest specificity. On the other hand, overall user satisfaction simply implied a "broad attitude" towards the system, rather than to a single entity. Although the overall satisfaction was comprised of the various domain
components, each of them established a relatively distinct construct by itself, so one would expect merely modest consistency among them (i.e., 0.721 for 24 items). Nevertheless, stronger internal consistency was produced within each class of more related domains.

Chapter Summary

Chapter IV first presented the characteristics of respondents in the user satisfaction survey. Respondents were classified into four groups which represented the four organizational segments considered critical to the information system. Besides personal characteristics, group and province, termed "locational variables," were regarded as meaningful individual attributes determining an individual's attitudes towards the system.

The first main finding was that the northern regional information system was not considered effective based on the extent to which it satisfied its users. The strongest area of the four system components, albeit registering only marginal satisfaction, was System Management. Average scores of the three other areas appeared dissatisfying. Users clustered themselves in three groups: Highs, Moderates and Lows. Profiles of the three clusters were presented. Finally, the selected variables constituted a modest predicting model. Nonetheless, the two locational variables
formed a comparable predicting model to the all-variable model. Thus, other meaningful attributes were expected not to have been included in the model. The last section described the evaluation of the survey instrument, which needs a considerable improvement if future studies will follow the approach of a user satisfaction survey.
### Table 4.1.1
Characteristics of Respondents

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>GROUP I</th>
<th>GROUP II</th>
<th>GROUP III</th>
<th>GROUP IV</th>
<th>ENTIRETY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>223</td>
<td>96</td>
<td>131</td>
<td>205</td>
<td>655</td>
</tr>
<tr>
<td>Age</td>
<td>40.08</td>
<td>31.47</td>
<td>45.51</td>
<td>36.60</td>
<td>38.78</td>
</tr>
<tr>
<td>(9.44)</td>
<td>(5.58)</td>
<td>(4.83)</td>
<td>(8.66)</td>
<td>(9.05)</td>
<td></td>
</tr>
<tr>
<td>Gender M:F</td>
<td>0.90 : 1</td>
<td>12.7 : 1</td>
<td>12.1 : 1</td>
<td>0.86 : 1</td>
<td>1.68 : 1</td>
</tr>
<tr>
<td>Education</td>
<td>1.87</td>
<td>2.16</td>
<td>1.19</td>
<td>1.11</td>
<td>1.15</td>
</tr>
<tr>
<td>(0.63)</td>
<td>(0.36)</td>
<td>(0.43)</td>
<td>(0.32)</td>
<td>(0.63)</td>
<td></td>
</tr>
<tr>
<td>Administrative Status</td>
<td>0.16</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.40</td>
</tr>
<tr>
<td>(0.36)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.49)</td>
<td></td>
</tr>
<tr>
<td>M.D. Status</td>
<td>0.14</td>
<td>0.99</td>
<td>0.00</td>
<td>0.00</td>
<td>0.19</td>
</tr>
<tr>
<td>(0.38)</td>
<td>(0.10)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.40)</td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td>9(4%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9(1%)</td>
</tr>
<tr>
<td>P.M.C.O.</td>
<td>26(12%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>26(4%)</td>
</tr>
<tr>
<td>Deputies</td>
<td>115(51%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>115(18%)</td>
</tr>
<tr>
<td>S. Heads</td>
<td>73(33%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>73(11%)</td>
</tr>
<tr>
<td>Staff</td>
<td>-</td>
<td>96(100%)</td>
<td>-</td>
<td>-</td>
<td>96(15%)</td>
</tr>
<tr>
<td>C.H.Dir.</td>
<td>-</td>
<td>-</td>
<td>131(100%)</td>
<td>-</td>
<td>131(20%)</td>
</tr>
<tr>
<td>D.H.C.O.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>205(100%)</td>
<td>205(31%)</td>
</tr>
<tr>
<td>S.H.C.O.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Duration in the</td>
<td>2.19</td>
<td>1.87</td>
<td>2.62</td>
<td>2.86</td>
<td>2.33</td>
</tr>
<tr>
<td>position</td>
<td>(1.19)</td>
<td>(1.00)</td>
<td>(1.16)</td>
<td>(1.06)</td>
<td>(1.15)</td>
</tr>
<tr>
<td>Decision Authority</td>
<td>2.31</td>
<td>3.30</td>
<td>2.94</td>
<td>2.25</td>
<td>2.56</td>
</tr>
<tr>
<td>(0.85)</td>
<td>(0.67)</td>
<td>(0.67)</td>
<td>(0.79)</td>
<td>(0.87)</td>
<td></td>
</tr>
<tr>
<td>Past Experience</td>
<td>2.45</td>
<td>2.17</td>
<td>2.68</td>
<td>2.46</td>
<td>2.46</td>
</tr>
<tr>
<td>(0.59)</td>
<td>(0.54)</td>
<td>(0.58)</td>
<td>(0.65)</td>
<td>(0.62)</td>
<td></td>
</tr>
<tr>
<td>Local Development</td>
<td>2.50</td>
<td>2.01</td>
<td>2.19</td>
<td>2.24</td>
<td>2.28</td>
</tr>
<tr>
<td>(0.89)</td>
<td>(0.97)</td>
<td>(0.56)</td>
<td>(0.91)</td>
<td>(0.92)</td>
<td></td>
</tr>
</tbody>
</table>
Notes (for Table 4.1.1)

* Education had three attributes and scores: below bachelor degree (1), bachelor (2), and higher than bachelor (3).

** Administrative and medical status adopted the two possible values: one for "yes" and two for "no." The values indicated whether the person assumed the administrative position (or having an M.D.) or not.

/ Positions were abbreviated after the following: provincial medical chief officers, deputies, section heads, data processing staff, community hospital directors, district health chief officers, and subdistrict health chief officers.

// The classification included four intervals: (1) 2 years or less; (2) 2 to 5; (3) 5 to 10; and (4) longer than years. The scores ran ascendingly from one to four.

+ Scores ranged from powerless (1) to powerful (4).

++ Scores raged from "very dissatisfied" (1) to "very satisfied" (5).

# Scores ranged from "low" (0) to "high" (4).
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Abbrev.</th>
<th>Means</th>
<th>S.D.</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTEM ADMINISTRATION</td>
<td>SYST. MGT.</td>
<td>1.70</td>
<td>0.53</td>
<td>--</td>
</tr>
<tr>
<td>1. Management Support</td>
<td>MGT</td>
<td>1.82</td>
<td>0.86</td>
<td>3</td>
</tr>
<tr>
<td>2. Participation</td>
<td>PART</td>
<td>1.84</td>
<td>0.92</td>
<td>2</td>
</tr>
<tr>
<td>3. Relationship among staff</td>
<td>STAFF</td>
<td>1.91</td>
<td>0.78</td>
<td>1</td>
</tr>
<tr>
<td>4. Supervision</td>
<td>SUPV</td>
<td>1.30</td>
<td>0.86</td>
<td>10</td>
</tr>
<tr>
<td>5. Confidence in the system</td>
<td>CONF</td>
<td>1.64</td>
<td>0.74</td>
<td>4</td>
</tr>
<tr>
<td>UTILITY ENHANCEMENTS</td>
<td>UTIL. ENH.</td>
<td>1.16</td>
<td>0.47</td>
<td>--</td>
</tr>
<tr>
<td>1. Critical information</td>
<td>CRITFACT</td>
<td>1.22</td>
<td>0.64</td>
<td>14</td>
</tr>
<tr>
<td>2. Documentation</td>
<td>DOC</td>
<td>0.76</td>
<td>0.79</td>
<td>21</td>
</tr>
<tr>
<td>3. Problem solving</td>
<td>PROB</td>
<td>1.27</td>
<td>0.89</td>
<td>12</td>
</tr>
<tr>
<td>4. Timeliness</td>
<td>TIMELY</td>
<td>1.41</td>
<td>0.64</td>
<td>6</td>
</tr>
<tr>
<td>5. Computer technical</td>
<td>TECH</td>
<td>0.43</td>
<td>0.65</td>
<td>24</td>
</tr>
<tr>
<td>competency*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT PROCEDURE</td>
<td>INPUT.</td>
<td>1.02</td>
<td>0.41</td>
<td>--</td>
</tr>
<tr>
<td>1. Form format</td>
<td>FORM</td>
<td>0.79</td>
<td>0.58</td>
<td>19</td>
</tr>
<tr>
<td>2. Language and vocabulary</td>
<td>LANG</td>
<td>0.79</td>
<td>0.72</td>
<td>20</td>
</tr>
<tr>
<td>3. Volume</td>
<td>VOL</td>
<td>1.34</td>
<td>0.88</td>
<td>8</td>
</tr>
<tr>
<td>4. Sequencing of data items</td>
<td>SEQ</td>
<td>0.56</td>
<td>0.62</td>
<td>22</td>
</tr>
<tr>
<td>5. Lack of redundancy</td>
<td>REDUN</td>
<td>0.94</td>
<td>0.91</td>
<td>16</td>
</tr>
<tr>
<td>6. Understanding of procedure</td>
<td>UNDER</td>
<td>1.49</td>
<td>0.59</td>
<td>5</td>
</tr>
<tr>
<td>7. Ease of interface</td>
<td>EASE</td>
<td>1.26</td>
<td>0.82</td>
<td>13</td>
</tr>
</tbody>
</table>
Table 4.2.1 (Continued)

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Abbrev.</th>
<th>Means</th>
<th>S.D.</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTPUT QUALITY</td>
<td>OUTPUT.</td>
<td>1.03</td>
<td>0.37</td>
<td>--</td>
</tr>
<tr>
<td>1. Completeness</td>
<td>CMPT</td>
<td>0.85</td>
<td>0.71</td>
<td>17</td>
</tr>
<tr>
<td>2. Relevancy</td>
<td>RELV</td>
<td>1.08</td>
<td>0.80</td>
<td>15</td>
</tr>
<tr>
<td>3. Precision</td>
<td>PRECI</td>
<td>0.52</td>
<td>0.70</td>
<td>23</td>
</tr>
<tr>
<td>4. Accuracy</td>
<td>ACCU</td>
<td>1.28</td>
<td>0.64</td>
<td>11</td>
</tr>
<tr>
<td>5. Rationality</td>
<td>RATN</td>
<td>1.33</td>
<td>0.76</td>
<td>9</td>
</tr>
<tr>
<td>6. Locality</td>
<td>LOC</td>
<td>1.34</td>
<td>0.64</td>
<td>7</td>
</tr>
<tr>
<td>7. Error detection and</td>
<td>ERR</td>
<td>0.83</td>
<td>0.74</td>
<td>18</td>
</tr>
<tr>
<td>recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OVERALL SATISFACTION</strong></td>
<td>SAT</td>
<td>1.23</td>
<td>0.29</td>
<td>--</td>
</tr>
</tbody>
</table>

**Note**

* Since none of the health centers had acquired a computer, the Computer Technical Competence (TECH) variable was not questioned to Group IV. The System Management (Syst.Mgt.) for this group represented only the averages of the four other variables.
Table 4.2.2
Agglomeration Schedule of Cluster Analysis
Performing on A 10 Percent Subsample
(Accepted cases = 63, rejected = 4)

1. Average Linkage (Within Group) - WAVE RAGE

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Coefficient</th>
<th>Cluster 1st Appears</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>2</td>
<td>44</td>
<td>0.842204</td>
<td>60</td>
</tr>
<tr>
<td>63</td>
<td>6</td>
<td>28</td>
<td>0.918460</td>
<td>61</td>
</tr>
<tr>
<td>64</td>
<td>1</td>
<td>5</td>
<td>1.052698</td>
<td>58</td>
</tr>
<tr>
<td>65</td>
<td>6</td>
<td>9</td>
<td>1.202983</td>
<td>63</td>
</tr>
<tr>
<td>66</td>
<td>1</td>
<td>2</td>
<td>1.434144</td>
<td>64</td>
</tr>
<tr>
<td>67</td>
<td>1</td>
<td>6</td>
<td>1.677114</td>
<td>66</td>
</tr>
</tbody>
</table>

2. Average Linkage (Between Groups) - Bavaverage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Coefficient</th>
<th>Cluster 1st Appears</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>2</td>
<td>5</td>
<td>1.495401</td>
<td>54</td>
</tr>
<tr>
<td>63</td>
<td>1</td>
<td>2</td>
<td>1.627192</td>
<td>58</td>
</tr>
<tr>
<td>64</td>
<td>9</td>
<td>28</td>
<td>1.767484</td>
<td>60</td>
</tr>
<tr>
<td>65</td>
<td>1</td>
<td>9</td>
<td>2.251960</td>
<td>63</td>
</tr>
<tr>
<td>66</td>
<td>4</td>
<td>44</td>
<td>2.863593</td>
<td>61</td>
</tr>
<tr>
<td>67</td>
<td>1</td>
<td>4</td>
<td>3.112684</td>
<td>65</td>
</tr>
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</table>

150
<table>
<thead>
<tr>
<th>Clusters Combined</th>
<th>Stage</th>
<th>Cluster 1st Appears</th>
<th>Stage Cluster 1st Appears</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coefficient Cluster 1</td>
<td>Coefficient Cluster 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Median Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>63</td>
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<td>56</td>
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<td>1</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>67</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

| 4. Ward Method    |       |                      |                          |
|                   | 62    | 9                   | 28                       | 20.808636               | 54 | 28 |
|                   | 63    | 1                   | 5                        | 24.284029               | 60 | 56 |
|                   | 64    | 6                   | 9                        | 28.259794               | 58 | 62 |
|                   | 65    | 2                   | 10                       | 33.481026               | 61 | 49 |
|                   | 66    | 1                   | 6                        | 43.065758               | 63 | 64 |
|                   | 67    | 1                   | 2                        | 56.183308               | 66 | 65 |
### Table 4.2.3
**Final Cluster Centers**

<table>
<thead>
<tr>
<th>Cluster</th>
<th>SM</th>
<th>UE</th>
<th>IP</th>
<th>OQ</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highs (n=107)</td>
<td>2.14</td>
<td>1.48</td>
<td>1.48</td>
<td>1.35</td>
<td>1.617 (0.150)</td>
</tr>
<tr>
<td>Moderates (n=299)</td>
<td>1.40</td>
<td>1.38</td>
<td>0.91</td>
<td>1.03</td>
<td>1.180 (0.241)</td>
</tr>
<tr>
<td>Lows (n=221)</td>
<td>1.87</td>
<td>0.71</td>
<td>0.96</td>
<td>0.87</td>
<td>1.102 (0.225)</td>
</tr>
<tr>
<td>28 missing cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Standard deviations were given in parentheses.*

### Table 4.2.4
**ANOVA for Classification Variables Between the Three Clusters**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cluster</th>
<th>MS</th>
<th>DF</th>
<th>Error MS</th>
<th>DF</th>
<th>F</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>26.9324</td>
<td>2</td>
<td>.1962</td>
<td>624.0</td>
<td>137.2370</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>UE</td>
<td>34.9363</td>
<td>2</td>
<td>.1101</td>
<td>624.0</td>
<td>317.2842</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>13.8089</td>
<td>2</td>
<td>.1266</td>
<td>624.0</td>
<td>109.0512</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>OQ</td>
<td>8.6456</td>
<td>2</td>
<td>.1073</td>
<td>624.0</td>
<td>80.6059</td>
<td>.000</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4.2.5
Profiles of the Three Clusters

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>HIGHS</th>
<th>MODERATES</th>
<th>LOWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.51 (0.89)</td>
<td>2.14 (0.90)</td>
<td>2.54 (0.89)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males : Females</td>
<td>1.41 : 1</td>
<td>2.08 : 1</td>
<td>1.38 : 1</td>
</tr>
<tr>
<td>Education</td>
<td>1.61 (0.62)</td>
<td>1.65 (0.67)</td>
<td>1.36 (0.53)</td>
</tr>
<tr>
<td>Administrative Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admin:Staff</td>
<td>1 : 2.15</td>
<td>1 : 1.30</td>
<td>1 : 1.66</td>
</tr>
<tr>
<td>Medical Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDs. : Non-MDs.</td>
<td>1 : 7.15</td>
<td>1 : 3.04</td>
<td>1 : 9.43</td>
</tr>
<tr>
<td>Past Experience</td>
<td>2.63 (0.60)</td>
<td>2.39 (0.57)</td>
<td>2.45 (0.65)</td>
</tr>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prov. Officers (G1)</td>
<td>5.30</td>
<td>1.45</td>
<td>4.79</td>
</tr>
<tr>
<td>Hosp. Directors(G2)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Dist. Chief Off. (G3)</td>
<td>1.80</td>
<td>0.80</td>
<td>4.14</td>
</tr>
<tr>
<td>Subdist. Chief Off. (G4)</td>
<td>2.60</td>
<td>1.42</td>
<td>5.86</td>
</tr>
<tr>
<td>TOTAL</td>
<td>107 (16%)</td>
<td>299 (46%)</td>
<td>221 (34%)</td>
</tr>
</tbody>
</table>

**Notes**

* Figures were means and standard deviations (in parentheses). Genders, administrative and physician status, and groups were given in ratios.

** The three figures corresponded to ages of 40.1, 36.4 and 40.4, respectively.
### Table 4.2.6
Summary of Steps
Determining the Model by Discriminant Analysis

<table>
<thead>
<tr>
<th>Step</th>
<th>Entered</th>
<th>Removed</th>
<th>In Lambda</th>
<th>Sig.</th>
<th>Variable Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EDUCSIM</td>
<td></td>
<td>.95168</td>
<td>.0000</td>
<td>Education</td>
</tr>
<tr>
<td>2</td>
<td>AGE</td>
<td></td>
<td>.91624</td>
<td>.0000</td>
<td>Age</td>
</tr>
<tr>
<td>3</td>
<td>PC11</td>
<td></td>
<td>.90215</td>
<td>.0000</td>
<td>Province No. 11</td>
</tr>
<tr>
<td>4</td>
<td>G1</td>
<td></td>
<td>.88836</td>
<td>.0000</td>
<td>Provincial Officers</td>
</tr>
<tr>
<td>5</td>
<td>EXP</td>
<td></td>
<td>.87562</td>
<td>.0000</td>
<td>Past Experience</td>
</tr>
<tr>
<td>6</td>
<td>PC16</td>
<td></td>
<td>.86442</td>
<td>.0000</td>
<td>Province No. 16</td>
</tr>
<tr>
<td>7</td>
<td>PC7</td>
<td></td>
<td>.85412</td>
<td>.0000</td>
<td>Province No. 7</td>
</tr>
<tr>
<td>8</td>
<td>PC4</td>
<td></td>
<td>.84748</td>
<td>.0000</td>
<td>Province No. 4</td>
</tr>
<tr>
<td>9</td>
<td>PCDEC</td>
<td></td>
<td>.84115</td>
<td>.0000</td>
<td>Quartile Ranked</td>
</tr>
<tr>
<td>10</td>
<td>PC9</td>
<td></td>
<td>.83499</td>
<td>.0000</td>
<td>Province No. 9</td>
</tr>
<tr>
<td>11</td>
<td>PC6</td>
<td></td>
<td>.83053</td>
<td>.0000</td>
<td>Province No. 6</td>
</tr>
<tr>
<td>12</td>
<td>PC3</td>
<td></td>
<td>.82614</td>
<td>.0000</td>
<td>Province No. 3</td>
</tr>
<tr>
<td>13</td>
<td>GENDER</td>
<td></td>
<td>.82161</td>
<td>.0000</td>
<td>Gender</td>
</tr>
<tr>
<td>14</td>
<td>PC8</td>
<td></td>
<td>.81719</td>
<td>.0000</td>
<td>Province No. 8</td>
</tr>
<tr>
<td>15</td>
<td>PC17</td>
<td></td>
<td>.81232</td>
<td>.0000</td>
<td>Province No. 17</td>
</tr>
<tr>
<td>16</td>
<td>PC5</td>
<td></td>
<td>.80899</td>
<td>.0000</td>
<td>Province No. 5</td>
</tr>
<tr>
<td>17</td>
<td>PC13</td>
<td></td>
<td>.80573</td>
<td>.0000</td>
<td>Province No. 13</td>
</tr>
<tr>
<td>18</td>
<td>PCREIGN</td>
<td></td>
<td>.80277</td>
<td>.0000</td>
<td>Quartile Ranked</td>
</tr>
</tbody>
</table>

### Table 4.2.7
Canonical Discriminant Functions

<table>
<thead>
<tr>
<th>Fcn</th>
<th>Eigenvalue</th>
<th>Variance</th>
<th>Pct Corr</th>
<th>Fcn</th>
<th>Lambda</th>
<th>Chisquare</th>
<th>DF</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>w1492</td>
<td>63.97</td>
<td>63.97</td>
<td>1</td>
<td>.9225</td>
<td>46.901</td>
<td>17</td>
<td>.0001</td>
</tr>
<tr>
<td>2*</td>
<td>.0840</td>
<td>36.03</td>
<td>100.00</td>
<td>.2784</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * Marks the 2 canonical discriminant functions remaining in the analysis.
### Tables 4.2.8

*F Tests of Difference and Significance between Pairs of Clusters*

<table>
<thead>
<tr>
<th>Cluster No.</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.2650</td>
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</tr>
<tr>
<td>3</td>
<td>2.7659</td>
<td>4.6385</td>
</tr>
<tr>
<td></td>
<td>.0001</td>
<td>.0000</td>
</tr>
</tbody>
</table>

### Table 4.2.9

*Canonical Discriminant Functions Evaluated at Group Means (Centroids)*

<table>
<thead>
<tr>
<th>Group</th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highs</td>
<td>-.07673</td>
<td>-.66255</td>
</tr>
<tr>
<td>Moderates</td>
<td>-.32825</td>
<td>.21534</td>
</tr>
<tr>
<td>Lows</td>
<td>.49028</td>
<td>.01082</td>
</tr>
</tbody>
</table>
### Table 4.2.10
Standardized Discriminant Function Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR3</td>
<td>0.23051</td>
<td>0.21246</td>
</tr>
<tr>
<td>PR4</td>
<td>0.16567</td>
<td>0.39021</td>
</tr>
<tr>
<td>PR5</td>
<td>0.17735</td>
<td>0.10872</td>
</tr>
<tr>
<td>PR6</td>
<td>0.11267</td>
<td>0.32061</td>
</tr>
<tr>
<td>PR7</td>
<td>-0.15029</td>
<td>0.37674</td>
</tr>
<tr>
<td>PR8</td>
<td>0.12915</td>
<td>0.29845</td>
</tr>
<tr>
<td>PR9</td>
<td>-0.14118</td>
<td>0.25104</td>
</tr>
<tr>
<td>PR11</td>
<td>-0.30001</td>
<td>-0.04595</td>
</tr>
<tr>
<td>PR13</td>
<td>0.18988</td>
<td>0.01296</td>
</tr>
<tr>
<td>PR16</td>
<td>-0.23226</td>
<td>0.38601</td>
</tr>
<tr>
<td>PR17</td>
<td>-0.06843</td>
<td>0.25457</td>
</tr>
<tr>
<td>G1</td>
<td>0.22769</td>
<td>-0.58019</td>
</tr>
<tr>
<td>EDUCSIM</td>
<td>-0.55034</td>
<td>-0.12896</td>
</tr>
<tr>
<td>GENDER</td>
<td>0.18383</td>
<td>0.17067</td>
</tr>
<tr>
<td>AGE</td>
<td>0.47529</td>
<td>0.09981</td>
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<tr>
<td>EXP</td>
<td>0.01042</td>
<td>-0.40236</td>
</tr>
<tr>
<td>QDEC</td>
<td>0.20893</td>
<td>-0.13171</td>
</tr>
<tr>
<td>QREIGN</td>
<td>-0.01668</td>
<td>-0.23287</td>
</tr>
</tbody>
</table>
Table 4.2.11
Pooled-within-groups Correlations
Between Discriminant Variables and Discriminant Functions
(Variables ordered by size of correlation within function)

<table>
<thead>
<tr>
<th>Variable</th>
<th>FUNC 1</th>
<th>FUNC 2</th>
<th>Variable</th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>.56263*</td>
<td>-.11126</td>
<td>G1</td>
<td>.06063</td>
<td>-.46132*</td>
</tr>
<tr>
<td>EDUCSIM</td>
<td>-.52552*</td>
<td>-.33774</td>
<td>EXP</td>
<td>.18417</td>
<td>-.40883*</td>
</tr>
<tr>
<td>MD</td>
<td>-.45969*</td>
<td>.02285</td>
<td>G4</td>
<td>.10675</td>
<td>.28344*</td>
</tr>
<tr>
<td>G2</td>
<td>-.43657*</td>
<td>.12399</td>
<td>PR7</td>
<td>-.15347</td>
<td>.27527*</td>
</tr>
<tr>
<td>PR11</td>
<td>-.30837*</td>
<td>-.21106</td>
<td>PR16</td>
<td>-.20168</td>
<td>.26039*</td>
</tr>
<tr>
<td>GENDER</td>
<td>.23543*</td>
<td>.03454</td>
<td>PR4</td>
<td>.19261</td>
<td>.24855*</td>
</tr>
<tr>
<td>PR3</td>
<td>.21951*</td>
<td>.04984</td>
<td>DEV</td>
<td>-.11784</td>
<td>.23334*</td>
</tr>
<tr>
<td>ADMIN</td>
<td>-.20771*</td>
<td>.06495</td>
<td>PR12</td>
<td>.01554</td>
<td>-.21206*</td>
</tr>
<tr>
<td>QREIGN</td>
<td>.19883*</td>
<td>-.17769</td>
<td>PR15</td>
<td>-.00945</td>
<td>-.18562*</td>
</tr>
<tr>
<td>PR5</td>
<td>.18303*</td>
<td>-.00776</td>
<td>PR14</td>
<td>.04434</td>
<td>-.14679*</td>
</tr>
<tr>
<td>G3</td>
<td>.18103*</td>
<td>.10788</td>
<td>PR17</td>
<td>-.11111</td>
<td>.14343*</td>
</tr>
<tr>
<td>QDEC</td>
<td>.17286*</td>
<td>-.16645</td>
<td>PR6</td>
<td>.13798</td>
<td>.14258*</td>
</tr>
<tr>
<td>PR9</td>
<td>-.15014*</td>
<td>.09928</td>
<td>PR2</td>
<td>.00409</td>
<td>-.13770*</td>
</tr>
<tr>
<td>PR13</td>
<td>.12481*</td>
<td>-.10770</td>
<td>PR8</td>
<td>.04747</td>
<td>.13336*</td>
</tr>
<tr>
<td>SIZE</td>
<td>.08762</td>
<td>.09616</td>
<td>PR10</td>
<td>-.03562</td>
<td>-.11057*</td>
</tr>
</tbody>
</table>

Table 4.2.12
Canonical Discriminant Functions
(Model 2 - Locational variables removed)

<table>
<thead>
<tr>
<th>Fcn</th>
<th>Eigenvalue</th>
<th>Variance</th>
<th>Pct Corr</th>
<th>Pct of Cum</th>
<th>After Wilks' Lambda</th>
<th>Chisquare</th>
<th>DF</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>.8872</td>
<td>.70323</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>.0000</td>
</tr>
<tr>
<td>1*</td>
<td>.0903</td>
<td>72.76</td>
<td>72.76</td>
<td>.2878</td>
<td>.9673</td>
<td>19.533</td>
<td>5</td>
<td>.0015</td>
</tr>
<tr>
<td>2*</td>
<td>.0338</td>
<td>27.24</td>
<td>100.00</td>
<td>.1808</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * Marks the 2 canonical discriminant functions remaining in the analysis.

157
### Table 4.2.13
**Model 2**
*F Tests of Difference and Significance between Pairs of Groups*
(Each F statistics has 7 and 584 degrees of freedom. After Step 7.)

<table>
<thead>
<tr>
<th>Cluster No.</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.3865</td>
<td>.0002</td>
</tr>
<tr>
<td>3</td>
<td>3.8221</td>
<td>8.7114</td>
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<td></td>
<td>.0010</td>
<td>.0000</td>
</tr>
</tbody>
</table>

### Table 4.2.14
**Model 2**
*Standardized Canonical Discriminant Function Coefficients*

<table>
<thead>
<tr>
<th></th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMIN</td>
<td>-.06461</td>
<td>-.0791</td>
</tr>
<tr>
<td>EDUCLM</td>
<td>-.60044</td>
<td>.61483</td>
</tr>
<tr>
<td>GENDER</td>
<td>.21964</td>
<td>-.24464</td>
</tr>
<tr>
<td>AGE</td>
<td>.64354</td>
<td>.29894</td>
</tr>
<tr>
<td>EXP</td>
<td>-.03412</td>
<td>.64226</td>
</tr>
<tr>
<td>QDEC</td>
<td>.23184</td>
<td>.23224</td>
</tr>
</tbody>
</table>
### Table 4.2.15
**Model 2**
**Pooled-within-groups Correlations**
**Between Discriminant Variables and Discriminant Functions**
(Variables ordered by size of correlation within function)

<table>
<thead>
<tr>
<th></th>
<th>FUNC 1</th>
<th>FUNC 2</th>
<th></th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>.70843*</td>
<td>.29480</td>
<td>EXP</td>
<td>.19532</td>
<td>.68047*</td>
</tr>
<tr>
<td>EDUCSIM</td>
<td>-.70508*</td>
<td>.41719</td>
<td>QDEC</td>
<td>.20467</td>
<td>.29797*</td>
</tr>
<tr>
<td>MD</td>
<td>-.55497*</td>
<td>-.12395</td>
<td>ADMIN</td>
<td>-.20268</td>
<td>-.24379*</td>
</tr>
<tr>
<td>GENDER</td>
<td>.30440*</td>
<td>-.00381</td>
<td>DEV</td>
<td>-.07478</td>
<td>-.19384*</td>
</tr>
<tr>
<td>QREIGN</td>
<td>.27784*</td>
<td>.10404</td>
<td>SIZE</td>
<td>.04344</td>
<td>.10065*</td>
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</tbody>
</table>

### Table 4.2.16
**Model 2**
**Canonical Discriminant Functions**
**Evaluated at Group Means (Centroids)**

<table>
<thead>
<tr>
<th>Group</th>
<th>FUNC 1</th>
<th>FUNC 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.33639</td>
<td>.25232</td>
</tr>
<tr>
<td>2</td>
<td>-.25949</td>
<td>.14873</td>
</tr>
<tr>
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<td>.20242</td>
<td>-.32361</td>
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</table>
### Table 4.2.17
Classification Results - Model 1

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>No. of Cases</th>
<th>Predicted Group Membership</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>98</td>
<td>51</td>
<td>19</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.0%</td>
<td>19.4%</td>
<td>28.6%</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>289</td>
<td>75</td>
<td>142</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>26.0%</td>
<td>49.1%</td>
<td>24.9%</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>209</td>
<td>50</td>
<td>50</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.9%</td>
<td>23.9%</td>
<td>52.2%</td>
<td></td>
</tr>
<tr>
<td>Ungrouped Cases</td>
<td>25</td>
<td>7</td>
<td>13</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.0%</td>
<td>52.0%</td>
<td>20.0%</td>
<td></td>
</tr>
</tbody>
</table>

Percent of "grouped" cases correctly classified: 50.67%

### Table 4.2.18
Classification Results - Model 2

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>No. of Cases</th>
<th>Predicted Group Membership</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>100</td>
<td>38</td>
<td>27</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>38.0%</td>
<td>27.0%</td>
<td>35.0%</td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>290</td>
<td>68</td>
<td>135</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23.4%</td>
<td>46.6%</td>
<td>30.0%</td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>212</td>
<td>51</td>
<td>53</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.1%</td>
<td>25.0%</td>
<td>50.9%</td>
<td></td>
</tr>
<tr>
<td>Ungrouped Cases</td>
<td>25</td>
<td>3</td>
<td>14</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.0%</td>
<td>56.0%</td>
<td>32.0%</td>
<td></td>
</tr>
</tbody>
</table>

Percent of "grouped" cases correctly classified: 46.68%
Table 4.2.19
Canonical Discriminant Functions
(Model 3 - Locational variables only)

<table>
<thead>
<tr>
<th>Fcn</th>
<th>Eigenvalue</th>
<th>Variance Pct</th>
<th>Corr</th>
<th>Fcn</th>
<th>Lambda</th>
<th>Chisquare</th>
<th>DF</th>
<th>Sig</th>
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<tbody>
<tr>
<td>0</td>
<td>0.8635</td>
<td>85.815</td>
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<td></td>
<td></td>
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<tr>
<td>1*</td>
<td>0.0914</td>
<td>59.93</td>
<td>59.93</td>
<td>.2894</td>
<td>1</td>
<td>.9424</td>
<td>34.680</td>
<td>11</td>
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<tr>
<td>2*</td>
<td>0.0611</td>
<td>40.07</td>
<td>100.00</td>
<td>.2400</td>
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</tbody>
</table>

Note: * Marks the 2 canonical discriminant functions remaining in the analysis.

Table 4.2.20
Classification Results - Model 3

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<tr>
<th>Actual Group</th>
<th>No. of Cases</th>
<th>Predicted Group Membership</th>
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<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Group 1</td>
<td>107</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40.2%</td>
</tr>
<tr>
<td>Group 2</td>
<td>299</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.4%</td>
</tr>
<tr>
<td>Group 3</td>
<td>221</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.1%</td>
</tr>
<tr>
<td>Ungrouped Cases</td>
<td>28</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.3%</td>
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</table>

Percent of "grouped" cases correctly classified: 48.17%
Table 4.2.21
Summary of Results of 7 Models

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<tr>
<th>MODEL</th>
<th>VARIABLES</th>
<th>NO. SIG. FNC.</th>
<th>MEANINGFUL VARIABLES FNC. 1</th>
<th>MEANINGFUL VARIABLES FNC. 2</th>
<th>% CORRECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All</td>
<td>2</td>
<td>Age, education, G2, PR11</td>
<td>G1, experience</td>
<td>50.67</td>
</tr>
<tr>
<td>2</td>
<td>Individuals (Locationals removed)</td>
<td>2</td>
<td>Age, education, gender</td>
<td>Experience</td>
<td>46.68</td>
</tr>
<tr>
<td>3</td>
<td>Groups and provinces</td>
<td>1</td>
<td>G2, PR11</td>
<td>G1, PR7, PR16</td>
<td>48.17</td>
</tr>
<tr>
<td>4</td>
<td>Groups only</td>
<td>1</td>
<td>G2</td>
<td>G1</td>
<td>40.99</td>
</tr>
<tr>
<td>5</td>
<td>Provinces only</td>
<td>2</td>
<td>PR11, PR3, PR5</td>
<td>PR16, PR7, PR17, PR9, PR8</td>
<td>39.71</td>
</tr>
<tr>
<td>6</td>
<td>Individuals plus provinces</td>
<td>2</td>
<td>Age, education, PR11</td>
<td>Experience PR7, PR16</td>
<td>50.00</td>
</tr>
<tr>
<td>7</td>
<td>Individuals plus groups</td>
<td>2</td>
<td>Age, education</td>
<td>G1, experience G4</td>
<td>47.99</td>
</tr>
<tr>
<td>DOMAINS</td>
<td>PROVINCE (n=13)</td>
<td>DISTRICT (n=11)</td>
<td>SUBDISTRICT (n=22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>--------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASS I: INPUT PROCEDURE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Understanding the input procedure</td>
<td>4.92</td>
<td>4.45</td>
<td>4.18</td>
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<td></td>
</tr>
<tr>
<td>2. Documentation</td>
<td>4.62</td>
<td>3.82</td>
<td>3.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Processing training</td>
<td>3.69</td>
<td>3.82</td>
<td>3.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Supervising</td>
<td>3.92</td>
<td>3.82</td>
<td>3.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Ease of interface</td>
<td>4.46</td>
<td>4.27</td>
<td>4.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASS II: SYSTEM STABILITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Error detection and recovery</td>
<td>3.69</td>
<td>3.91</td>
<td>3.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Confidence in the system</td>
<td>4.23</td>
<td>4.27</td>
<td>3.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Relationship among data processing staff and other users</td>
<td>4.54</td>
<td>3.91</td>
<td>3.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Accessibility</td>
<td>4.08</td>
<td>3.73</td>
<td>3.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Computer technical</td>
<td>2.92</td>
<td>2.64</td>
<td>2.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>competence</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>11. Data security</td>
<td>3.54</td>
<td>3.91</td>
<td>4.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Management supports</td>
<td>4.54</td>
<td>4.55</td>
<td>4.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Feeling of participation</td>
<td>4.23</td>
<td>3.91</td>
<td>3.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CLASS III: SYSTEM UTILITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Critical information and alternatives provision</td>
<td>4.54</td>
<td>4.36</td>
<td>4.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Problem recognition</td>
<td>4.23</td>
<td>4.09</td>
<td>4.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and alternatives provision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Local properness</td>
<td>4.00</td>
<td>4.36</td>
<td>3.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Benefit/cost</td>
<td>4.38</td>
<td>4.27</td>
<td>4.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Job effects</td>
<td>4.23</td>
<td>4.09</td>
<td>4.73</td>
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Table 4.3.1 (Continued)

<table>
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<th>DOMAINS</th>
<th>PROVINCE (n=13)</th>
<th>DISTRICT (n=11)</th>
<th>SUBDISTRICT (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS IV: OUTPUT CONTENTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Accuracy</td>
<td>4.69</td>
<td>4.73</td>
<td>4.41</td>
</tr>
<tr>
<td>20. Relevancy</td>
<td>4.08</td>
<td>4.09</td>
<td>4.41</td>
</tr>
<tr>
<td>21. Completeness</td>
<td>4.31</td>
<td>4.09</td>
<td>4.32</td>
</tr>
<tr>
<td>22. Rationality</td>
<td>4.31</td>
<td>4.27</td>
<td>4.09</td>
</tr>
<tr>
<td>23. Dependability</td>
<td>4.31</td>
<td>4.18</td>
<td>4.18</td>
</tr>
<tr>
<td>CLASS V: OUTPUT FORMATS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Precision</td>
<td>3.69</td>
<td>3.91</td>
<td>4.05</td>
</tr>
<tr>
<td>25. Form formats</td>
<td>4.00</td>
<td>3.82</td>
<td>4.91</td>
</tr>
<tr>
<td>26. Volume of data</td>
<td>4.23</td>
<td>4.18</td>
<td>4.95</td>
</tr>
<tr>
<td>27. Sequence of data on the form</td>
<td>4.23</td>
<td>4.09</td>
<td>4.77</td>
</tr>
<tr>
<td>28. Vocabulary and language used in the form</td>
<td>4.69</td>
<td>4.36</td>
<td>4.77</td>
</tr>
<tr>
<td>29. Timeliness</td>
<td>4.85</td>
<td>4.18</td>
<td>4.91</td>
</tr>
<tr>
<td>30. Graphics</td>
<td>4.08</td>
<td>4.09</td>
<td>4.64</td>
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Table 4.3.2
Correlations between Overall Score and Domains

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<th>DOMAINS</th>
<th>CORRELATION</th>
<th>ONE-TAILED SIGNIFICANCE</th>
<th>CASES</th>
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</thead>
<tbody>
<tr>
<td><strong>CLASS I: SYSTEM ADMINISTRATION</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1. Management Support</td>
<td>0.4824</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>2. Participation</td>
<td>0.3173</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>3. Relationship among staff</td>
<td>0.4557</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>4. Supervision</td>
<td>0.4571</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>5. Confidence in the system</td>
<td>0.4094</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td><strong>CLASS II: UTILITY ENHANCEMENTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Critical information</td>
<td>0.2763</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>2. Documentation</td>
<td>0.4589</td>
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<td>627</td>
</tr>
<tr>
<td>3. Problem solving capability</td>
<td>0.3320</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>4. Timeliness</td>
<td>0.4042</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>5. Computer technical competency</td>
<td>0.2854</td>
<td>0.000</td>
<td>421</td>
</tr>
<tr>
<td><strong>CLASS III: INPUT PROCEDURE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Form format</td>
<td>0.4449</td>
<td>0.000</td>
<td>627</td>
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<td>2. Language and vocabulary</td>
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</tr>
<tr>
<td>3. Volume</td>
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<td>627</td>
</tr>
<tr>
<td>4. Sequencing of data items</td>
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<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>5. Lack of redundancy</td>
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<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>6. Understanding of procedure</td>
<td>0.4196</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td>7. Ease of interface</td>
<td>0.4849</td>
<td>0.000</td>
<td>627</td>
</tr>
<tr>
<td><strong>CLASS IV: OUTPUT QUALITY</strong></td>
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<td></td>
</tr>
<tr>
<td>1. Completeness</td>
<td>0.3922</td>
<td>0.000</td>
<td>627</td>
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<td>2. Relevancy</td>
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<td>7. Error detection and recovery</td>
<td>0.4016</td>
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### Table 4.3.3
### Final Statistics of the Second-round Factor Analysis

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<th>Factor</th>
<th>Eigenvalue</th>
<th>Pct of Var</th>
<th>Cum Pct</th>
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<td>2.20688</td>
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<td>24.3</td>
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<td>3</td>
<td>1.52013</td>
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<td>30.6</td>
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<td>4</td>
<td>1.39785</td>
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<td>36.4</td>
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<tr>
<td>5</td>
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<td>41.2</td>
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</table>

<table>
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<tr>
<th>Variable</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
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<tr>
<td>ERR</td>
<td>.33580</td>
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<td>.43715</td>
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<td>LANG</td>
<td>.44240</td>
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<td>RATN</td>
<td>.57499</td>
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<td>SUPV</td>
<td>.44201</td>
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<td>EASE</td>
<td>.46200</td>
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</table>

<table>
<thead>
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<th>Communality</th>
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<td>.31011</td>
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<td>UNDER</td>
<td>.45408</td>
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<td>CONF</td>
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</tr>
<tr>
<td>Management Support</td>
<td>.663</td>
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<tr>
<td>Participation</td>
<td>.611</td>
</tr>
<tr>
<td>Relationship among staff</td>
<td>.639</td>
</tr>
<tr>
<td>Supervision</td>
<td>.599</td>
</tr>
<tr>
<td>Confidence in the system</td>
<td>.498</td>
</tr>
<tr>
<td>Critical information</td>
<td>-.057</td>
</tr>
<tr>
<td>Documentation</td>
<td>.031</td>
</tr>
<tr>
<td>Problem solving capability</td>
<td>-.029</td>
</tr>
<tr>
<td>Timeliness</td>
<td>.078</td>
</tr>
<tr>
<td>Computer technical competency</td>
<td>.115</td>
</tr>
<tr>
<td>Form format</td>
<td>-.042</td>
</tr>
<tr>
<td>Language and vocabulary</td>
<td>.064</td>
</tr>
<tr>
<td>Volume</td>
<td>.160</td>
</tr>
<tr>
<td>Sequencing of data items</td>
<td>-.147</td>
</tr>
<tr>
<td>Lack of redundancy</td>
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</tr>
<tr>
<td>Understanding of procedure</td>
<td>.342</td>
</tr>
<tr>
<td>Ease of interface</td>
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</tr>
<tr>
<td>Completeness</td>
<td>-.019</td>
</tr>
<tr>
<td>Relevancy</td>
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</tr>
<tr>
<td>Precision</td>
<td>-.042</td>
</tr>
<tr>
<td>Accuracy</td>
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</tr>
<tr>
<td>Rationality</td>
<td>.095</td>
</tr>
<tr>
<td>Locality</td>
<td>-.090</td>
</tr>
<tr>
<td>Error detection and recovery</td>
<td>.065</td>
</tr>
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Table 4.3.5
Factor Loadings Using Oblimin (Oblique) Rotation

<table>
<thead>
<tr>
<th>DOMAINS</th>
<th>SYSTEM MANAGEMENT</th>
<th>UTILITY ENHANCEMENTS</th>
<th>INPUT PROCEDURE</th>
<th>OUTPUT QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Support</td>
<td>-.678</td>
<td>.213</td>
<td>-.096</td>
<td>-.020</td>
</tr>
<tr>
<td>Participation</td>
<td>-.637</td>
<td>.008</td>
<td>-.200</td>
<td>-.059</td>
</tr>
<tr>
<td>Relationship among staff</td>
<td>-.632</td>
<td>.027</td>
<td>.093</td>
<td>-.011</td>
</tr>
<tr>
<td>Supervision</td>
<td>-.587</td>
<td>-.017</td>
<td>.187</td>
<td>-.088</td>
</tr>
<tr>
<td>Confidence in the system</td>
<td>-.483</td>
<td>-.041</td>
<td>-.087</td>
<td>.369</td>
</tr>
<tr>
<td>Critical information</td>
<td>.028</td>
<td>.741</td>
<td>-.112</td>
<td>-.179</td>
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<tr>
<td>Documentation</td>
<td>-.021</td>
<td>.594</td>
<td>.189</td>
<td>-.058</td>
</tr>
<tr>
<td>Problem solving capability</td>
<td>.014</td>
<td>.532</td>
<td>-.092</td>
<td>-.014</td>
</tr>
<tr>
<td>Timeliness</td>
<td>-.066</td>
<td>.461</td>
<td>.090</td>
<td>.099</td>
</tr>
<tr>
<td>Computer technical competency</td>
<td>-.112</td>
<td>.363</td>
<td>.027</td>
<td>.057</td>
</tr>
<tr>
<td>Form format</td>
<td>.107</td>
<td>.259</td>
<td>.673</td>
<td>.010</td>
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<td>Language and vocabulary</td>
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<td>.075</td>
<td>.606</td>
<td>.122</td>
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<tr>
<td>Volume</td>
<td>-.095</td>
<td>-.276</td>
<td>.660</td>
<td>-.039</td>
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<tr>
<td>Sequencing of data items</td>
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<td>.249</td>
<td>.445</td>
<td>.030</td>
</tr>
<tr>
<td>Lack of redundancy</td>
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<td>-.176</td>
<td>.452</td>
<td>-.012</td>
</tr>
<tr>
<td>Understanding of procedures</td>
<td>-.300</td>
<td>.060</td>
<td>.327</td>
<td>.157</td>
</tr>
<tr>
<td>Ease of interface</td>
<td>-.483</td>
<td>-.004</td>
<td>.309</td>
<td>-.038</td>
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<td>.100</td>
<td>.584</td>
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<tr>
<td>Relevancy</td>
<td>-.041</td>
<td>.122</td>
<td>.088</td>
<td>.547</td>
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<tr>
<td>Precision</td>
<td>.077</td>
<td>-.140</td>
<td>-.036</td>
<td>.559</td>
</tr>
<tr>
<td>Accuracy</td>
<td>-.147</td>
<td>-.173</td>
<td>-.035</td>
<td>.533</td>
</tr>
<tr>
<td>Rationality</td>
<td>-.081</td>
<td>.335</td>
<td>-.065</td>
<td>.350</td>
</tr>
<tr>
<td>Locality</td>
<td>.121</td>
<td>.036</td>
<td>.034</td>
<td>.413</td>
</tr>
<tr>
<td>Error detection and recovery</td>
<td>-.028</td>
<td>.293</td>
<td>.247</td>
<td>.221</td>
</tr>
</tbody>
</table>
Table 4.3.6
Reliability Estimates of Multiple-item Variables

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>VARIABLE TYPE</th>
<th>ITEMS</th>
<th>CRON-BACH'S ALPHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Satisfaction</td>
<td>Total</td>
<td>24</td>
<td>0.721</td>
</tr>
<tr>
<td>System Management Class</td>
<td>Class</td>
<td>5</td>
<td>0.634</td>
</tr>
<tr>
<td>Utility Enhancements Class</td>
<td>Class</td>
<td>4</td>
<td>0.507</td>
</tr>
<tr>
<td>Input Procedure Class</td>
<td>Class</td>
<td>7</td>
<td>0.638</td>
</tr>
<tr>
<td>Output Quality Class</td>
<td>Class</td>
<td>7</td>
<td>0.534</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Domain</td>
<td>3</td>
<td>0.784</td>
</tr>
<tr>
<td>Decisional Authority Individual</td>
<td>5</td>
<td>0.775</td>
<td></td>
</tr>
<tr>
<td>Past Experience</td>
<td>Individual</td>
<td>2</td>
<td>0.693</td>
</tr>
</tbody>
</table>

Note: * Excluding computer technical competence.
CHAPTER V

RESEARCH FINDINGS II: PROVINCIAL ASSESSMENTS

This chapter presents the findings of the second part of the study. In this part, the focus will be on the provincial level. First, the chapter will describe the survey findings. These illustrations include provincial profiles and satisfaction scores by components and groups. Provinces are described by similarity of satisfaction patterns. The final part of the chapter will relate qualitative findings from the case study of two selected provinces to the survey profiles. If the two converge, an induction is made that a similar phenomenon will apply to situations in the other provinces which show comparable satisfaction patterns. Thus, the study will explore the practical applicability of the user satisfaction measurement as well as suggest "process attributes" meaningful to information system development.

SECTION I: QUANTITATIVE PROVINCIAL FINDINGS

Characteristics of the seventeen provinces were given in Table 5.1.1. The provinces were placed in descending order by overall satisfaction score and grouped by quartiles. Size was presented both by area and population, as well as population density. The table also contained two health facility indicators. Basic health services were estimated by number of health centers per ten thousand people. Health centers normally featured a good distribution since each subdistrict
usually had at least one health center. The number of hospital beds\(^1\) per ten thousand people provided a proxy of advanced medical services. A crude indicator of average living condition was derived from subjective evaluation by survey respondents. Finally, subunit numbers provided another indicator of organization size. All of these organizational and environmental characteristics were expected to affect the outcome of provincial user satisfaction.

Univariate and multiple regressions were performed between the characteristic variables and the provincial satisfaction scores. None of these variables showed significant association with either the satisfaction scores or their quartile ranks. Thus, the satisfaction level did not depend on any of these organizational and environmental attributes. At this point, the study would assume that the effectiveness of a provincial system was intrinsic to information system management.

Table 5.1.2 presented the overall satisfaction scores, their rank and two satisfaction profiles. The satisfaction classifications were shown by group and component. The overall satisfaction score of one group from each province was quartile ranked with those of the same group of the remaining sixteen provinces. The score was labeled "High" (H) and "Low"

\(^1\)Including both public and private hospital beds.
if it appeared among the highest and lowest quartiles, respectively. A similar procedure was done for component classification. In this latter case, the label showed the relative position of the province based on a satisfaction component. The position was the average of all four groups' scores.

Table 5.1.2 presented two ways of looking at a provincial system. One would notice that high-ranking provinces all exhibited relatively high scores of provincial officers and community hospital directors, as well as those of System Management, Utility Enhancements, and Output Quality. Alternately, the lowest-ranking provinces showed consistently low scores expressed by community hospital directors and subdistrict health chief officers. For these provinces, Output Quality also exhibited depressed scores.

Since the previous analysis indicated that locational variables were meaningful (specifically G1 and G2 - See Chapter IV), a group profile would portray the provincial system more meaningfully than a component profile. Table 5.1.3 focused on the group profiles. Data reduction produced a classification, which took into account not only the overall scores expressed by the group, but also, the contributions from each of the components making up the group rank. Based on the group profile, one can see two distinguishable patterns.
on the extremes and a mixed pattern in the middle. While the same five provinces remained at the bottom, PR13 showed a similar pattern as the top four provinces. PR13 also exhibited relatively high scores on System Management and Output Quality although Utility Enhancements was depressed (Table 5.1.2).

Both Tables 5.1.2 and 5.1.3 indicate that PR15 and PR4 were situated in the top and bottom groups, respectively. These two provinces were the ones selected for case study. One might consider PR15 one of the most successful provinces and PR4 one of the least. The study assumed that some common features contributed to satisfaction and others to dissatisfaction. Thus, assumingly, PR15's and PR4's features were be also observable in the two respective extreme groups (on Table 5.1.3). The case study described in Section II will reveal specific features of the two selected systems.

SECTION II: CASE STUDY OF TWO PROVINCES (PR4 AND PR15)
Investigation of the two case studies took place between September and October 1990. The researcher spent three weeks in each of the two provinces. The two are neighbor provinces separated by a mountain range. PR15 is about three hours by car to the northwest of PR4. The researcher visited PR15 first. After completing his fieldwork in PR4, it was realized that some relevant information was missing from data collected
at PR5. A three-day second visit to PR15 was made in December 1990 to correct this.

As described in the review of the literature, major aspects of health information at the provincial level included the following applications: (1) resource allocation; (2) health promotion and disease prevention; (3) delivery of basic health services to cover the entire population; and, (4) intersectoral and community participation. Resource allocation was a sensitive issue. An external researcher would unlikely have adequate accessibility to official materials and the study demanded a sound knowledge on local matters (such as geography and politics). Alternately, intersectoral and community participation was considered a complex event. It was assumed to depend on time, personal relationship, organizational constraints, as well as local and cultural practice. This case study emphasized only the two middle items above.

The study focused on four community-based programs: family planning, perinatal care, disease surveillance, and communicable disease control. Perinatal care and family planning involved major target groups, namely, mothers, children, and reproductive-age residents. The other two programs were related and required a sensitive information system. Therefore, while the first two reflected a static
performance, the latter would exhibit how the system reacted to a changing environment. The study did not evaluate the four programs but only used them as discussion materials. Thus, the field study aimed at understanding what and how data was handled rather than program implementation or outcomes. Since data structure and flow were assumingly similar among the various community-based programs, the findings would provide an adequate picture describing these programs. However, it should be stressed that the picture was derived from only a portion of the organization.

**PR4 - The Conventional Province**

During the preliminary interview, no respondents mentioned a significant change having occurred in PR4 for the last few years. The field study found no provincial policy or project that specifically affected the reporting system. Thus, the province was assumed to have been implementing MOPH conventional system. PR4 was shown to be situated in the lowest quartile of provincial overall satisfaction scores.

The main feature of the conventional system was that much of the data was activity counts. The number of cases were normally estimated by the number of encounters. Denominators, such as target groups or at-risk populations, were estimated. Population figures appeared to be the most commonly used denominators. The province used population estimates from
three sources - MOPH\(^2\), the Ministry of Interior (MOI)\(^3\), and the National Board of Economic and Social Development (NBESD).\(^4\) Data was usually delivered upwards through the organizational hierarchy by means of institutional reports. Periodic reports normally included: community-based programs, births and deaths, accidents, disease surveillance, and outpatient and inpatient services. Occasionally, special project reports were included. Besides these reports, subunits also submitted paperwork\(^5\) regarding supplies and inventory controls. Paperwork which did not require a transfer were record keeping in encounter books. At the operational level, a few major encounter books contained

\(^2\)The various departments of MOPH also used population data from different sources. See the discussion in Chapter VI.

\(^3\)Recently, MOPH ruled that population figures be based on the MOI’s household registration. However, for a given province, this source provided only the total number of male and female registered residents. Furthermore, despite their appearance in official reports, contentious arguments usually arose between the MOPH and provinces. Such arguments propagated down through the hierarchical supervisory structure to health centers. Interviewees reported multiple conclusions which were usually condoned to temporarily resolve conflicts.

\(^4\)The National Board of Economic and Social Development (NBESD) based their projection models on the census data. At the time of this study, the nationwide census was being conducted. The census takes place every ten years.

\(^5\)The study did not obtain an exact count of paperwork. However, a community hospital director in PR15 (the other province) showed a list of monthly reports including 23 items. Earlier, PR15 discarded 21 conventional reports. Operation research conducted in a northeastern province, which ran a conventional system, revealed that each level processed about 70 odd items of paperwork every month. (See literature review.)
activities done normally in chronological order. Thus, reports were compiled based on the counts in these books.

Four Dimension Assessment

No significant event which definitely affected the provincial information system was observed in PR4. From the background information presented above, the next strategy was to compare survey and qualitative findings. The assessment is presented for each of the four dimensions (components) of user satisfaction. First, the surveyed user satisfaction pattern is given in Table 5.2.1. Qualitative materials are related to the situations and viewpoints of selected health officers. One may consider both approaches to see the extent to which they are agreeable. To understand the provincial picture more comprehensively, both methods combined are used to illustrate system features.

The satisfaction matrix showed the degree of user satisfaction expressed by each of the four user groups. It also presented the patterns of each group with respect to the four satisfaction components, as well as the overall profiles. Grading was based on the quartile ranks within the group. So, for example, the satisfaction scores of PR4 district health chief officers were situated in the third quartile when the output quality average scores were ranked among their Group III colleagues from all seventeen provinces.
The matrix in Table 5.2.1 exhibits a picture indicating that the PR4's provincial system satisfied two groups, but two others expressed dissatisfaction. The least satisfied people were community hospital directors, who expressed lesser scores for all four components. Provincial officers and district health chief officers, on the other hand, made up the greater-score segment. Subdistrict personnel showed moderate discontent to three components and cited Utility Enhancements as the most dissatisfying area. Furthermore, this component received consistently low scores by all four groups. The other area for which average rank came out weakest was Output Quality. Compared to the other sixteen provinces, PR4 occupied the fourth place from the last.

(1) System Management

The present provincial medical chief officer in PR4 had been in the position for three years and was in his last two years in the office. Before taking the position, he was the director of a general hospital in the province for 15 years. A veteran head section described her boss' personality:

"He is a very decent official. He has a good relationship with other high-ranking officers in the province. He often has a gift for them in a special occasion or after coming back from a trip. To us, the boss looks very respectable."

The mechanics of provincial administration conformed to the bureaucratic structure. The person who was assigned to look
after important programs, and sometimes acted on behalf of the top master, was a deputy. A 38 year old physician, he was one of the youngest who had obtained the "level 8" position.\(^6\) Section heads were considered senior and appeared to have a good amount of authority. The provincial medical chief officer regarded them as his most significant source of information. One of them described their group:

"I heard that novices from other provinces are reluctant to accept administrative posts here because they fear the 'Chao Mae'\(^7\) group. That is nonsense. As you see, we are nice to you\(^8\) and everybody who is a friend."

Section heads also acted as liaison persons with other provincial organizations. The connection was both formal and informal. One described an example:

"In October, we have the biggest celebration - the 'Poa-tien Len-fai.' You know it is the one the province is famous for. Every year I [and other senior officers] wander around the town asking for donations. But this year the new governor dictated that no fund raising be collected from businesses.\(^9\) I doubt if the coming feast will be successful."

\(^6\)This level was considered rare. The qualification included a certain number of academic works.

\(^7\)'Chao Mae' means influential mothers.

\(^8\)The researcher received significantly good attention. One of the heads closely looked after him and often followed him to the field.

\(^9\)The new governor was renowned for his honesty. There had been a lot of teak smuggling in the province. The governor, reportedly, believed dependence of government officers on local influences was one of the problem. So, he declared the policy. The festival, albeit having less magnificent activities than previously, was attended by a great crowd of visitors.
Personal relationship was a significant administrative feature. This was incorporated in supervision. Indeed, supervision was a primary way for information exchange between levels. On several occasions the researcher heard about personal lives from section heads. On a visit to a community hospital, he witnessed a conversation between a section head and a hospital officer. The matter was about the hospital's internal management and the section head was instructing the officer to respond against the director's authority. Another observation occurred at the PHO when a member of personnel came from another hospital to see a section head and discussed an internal management matter.

PR4 had seven community hospitals. Two of the seven directors were senior. One had served for five year and the other, a little more senior, had just completed a master program. Both of them were well recognized and given significant roles. Others were young and a few were described as trouble-makers. A young director visited by the researcher showed no interest in discussing administration issues or community-based programs. He also showed unfamiliarity with terms and items on the reports.

A senior director (the former above), on the other hand, discussed the matter in detail. Notably, he expressed
discontent with the provincial information system. He initiated a new system implemented only in his district:

"I admire PR15's system. So, I convinced the district coordinating committee\textsuperscript{11} to do it here. Last year we visited that province and brought with us the Eight Files.\textsuperscript{12} We did it here and it proved itself sensible. I have tried to advocate it to the provincial management but heard so little from them."

Although his counterpart from the district office mentioned that the system was sensible and data was easier to retrieve, he noted that often personnel did not understand the procedure. In fact, they had two other officers—a nurse and a subdistrict officer—who helped shape up the system. Besides the system's intrinsic features and a competent team, other main reasons that possibly made the district chief adopt the new system were that the hospital provided all needed

\textsuperscript{10}The other senior director said that he approved the new system and was thinking whether to follow suit. His hospital was the first unit in the province that acquired a computer. But while he went for study outside the province, the PHO borrowed the machine (and at the time of this research still kept it). The conversation with him was brief. He did not express satisfaction with the current system.

\textsuperscript{11}In 1982, MOPH proclaimed that there be a coordinating committee at the district level. The committee consisted of the district health chief officers, the community hospital director, and a few staff of theirs. This team was mentioned as the best in the province.

\textsuperscript{12}See PR15—the innovative system in this chapter.
resources and that operations\textsuperscript{13} of the district's subunits depended, to an extent, on the hospital's facilitation.

The above hospital - district health office (DHO) companion was likely an exception rather than the rule. The researcher observed that in another district the two parties were not familiar with each other, which was reported as common to other districts. A representative, rather than the director, attended the district meeting. A district chief officer described the typical meeting and his handling of the population data:

"I told them what I was informed by of the PHO. Then, I assigned tasks to health centers. We often discussed personnel welfare. .... Speaking of the figures, health centers normally follow the district's data [which were sent from the province]."

One main concern he expressed was that he needed more staff. Thus, it seemed likely that he favored the current situation. The PHO provided most figures for target setting and health centers reported how many they accomplished monthly on each program. All the district was required to do was to process the paperwork (which was considered enormous) and to relay the figures up and down. This vertical operation resulted in closer contact between the district chief and the provincial supervisor, than with the hospital director.

\textsuperscript{13}Such as case referral, inventory of supplies, clinical supervision.
Health centers were supervised primarily by the district and secondarily by the PHO. A district chief contended that his supervising focused on the inventory and how many cases under surveillance the health center reported. The latter meant that regular reporting was maintained. On the other hand, a subdistrict officer argued that she was disliked and that promotion criteria were subjective or relied only on performance for a special project.\textsuperscript{14} Another cited problem was the lack of communication between institutions:

"For example, when a pregnant woman in this community has a delivery at the provincial hospital, the baby normally gets the B.C.G. there. So, I lose my case. I am informed about the case later, usually by the village health volunteer."

To summarize the researcher’s estimate of the current situation found in the field on the System Management satisfaction, an evaluation profile is presented in Table 5.2.2. The qualitative evaluation was compared with the survey pattern.

(2) Utility Enhancements
This dimension refers to regulations and materials that enhanced the utilization of information. The first feature was the timeliness of data. The province did not exhibit a strong procedure to obtain timely reports. The report registration book was examined. For a randomly selected two

\textsuperscript{14}The cited project was the sterilization campaign.
months of the past year, subunits' monthly reports normally reached the PHO after the fifth day of the month and a few were not yet submitted as late as the seventeenth.\textsuperscript{15} A provincial staff who was in charge elaborated:

"Late submitters are about the same places every month. Typically, they include the municipalities, general hospitals, and a few districts."

The system was meant to provide program monitoring features. The conventional reports mainly presented counts of activities. Performance was measured by comparing number of jobs done against the target. The target was normally based on the estimated population within a locality. However, people might receive the service at a different location than where they lived. So, the count might outnumber the target at one place but the figure may be small relative to the target at another location. This was recognized as an unfair measure by both superiors and subordinates. A subdistrict officer who was a nurse at a community hospital which improved the district system elaborated the point:

"Many people [outside the hospital's responsible area] normally come to receive services at the hospital. If I counted all of them, the figures would exceed the targets. Yet I am not sure how many clients in the area got adequate services. The figures would not tell coverage. Realizing this problem, the director and I convinced the district to adopt PR15's Eight Files. Now, I have two lists, and notify health centers of their

\textsuperscript{15}The period ended on the 25\textsuperscript{th} day of the past month.
clients receiving the services at the hospital. This eliminated double counts."

Another way to appraise the utility was whether the figures led to appropriate action. A district-level staff described an event when an outbreak of dengue hemorrhagic fever was detected but they failed to stop it because:

"I knew of its arrival a few weeks before the outbreak. In fact, we expected an endemic that year so we requested more abate sand than usual. But they (the regional communicable disease control center) gave us the same amount as the previous year. Our gadgets were old and it was troublesome to borrow from another place. It took two months before we got everything needed. And that was after the outbreak."

Documentation was also regarded as inadequate. Two health center officers mentioned a special project report\(^{16}\) which was a piece of confusing paper. The form was sent directly from the PHO to health centers with an order. The district was bypassed, and thus, could not clarify practical questions.

Finally, the PHO housed a computer. The deputy and a young staff were primary operators. Both trained themselves. Although there was no specific policy and regulation, two initial objectives included uses for research\(^{17}\) and

\(^{16}\)This was a special nutrition project initiated by the Red-Cross supported by the province governor’s wife.

\(^{17}\)The deputy conducted research which was mainly based on institutional and survey data. But the research activities appeared confined to a few colleagues. Nonetheless, by the (continued...)
epidemiology. Later the application extended to wordprocessing which became increasingly popular. An epidemiological application program was supplied by MOPH and the machine produced regular outputs. However, a few provincial officers showed an appreciation for this utility. The head of the disease surveillance unit remarked:

"I find it no better than the manual way I used before. It (the machine) produces exactly the same thing I could do by hand. In a few months the young lad will move to a health center but I believe I can handle the task."

Table 5.2.3 presented a comparison between the survey and the qualitative evaluation.

(3) Input Procedures

The subdistrict level personnel in PR4 appeared to struggle most in processing data. The major input problem expressed by subdistrict and health center officers was the redundancy of forms. Transitory forms were considered a bother, especially when new target groups were required. A health center personnel described an example:

"I have the number of pupils for grades one to six but the project demanded the figure of a particular class. So, I had to go to all the schools and

17(...continued)
time of the study, he had initiated a short training course for research.

18The outputs appeared specific as to case, diagnosis, time, and place.

186
asked for it. And I wonder how long they will want it reported."

For the district and provincial levels, inputting was primarily aggregating figures reported by subunits. The most mentioned problem was miscalculation. The checking process was reported to take about fifty to sixty percent of the processing time. Satisfaction of Input Procedure is given in Table 5.2.4.

(4) Output Quality

Accuracy of data was considered primary during the preliminary interview. Three aspects can reveal the likely degree of data accuracy: quality control measures, sources of data, and sources of errors.

Two primary quality control mechanisms used in PR4 included: report checking and supervision. The provincial and district levels checked reports submitted by their subunits to make sure that calculations were correct and figures concurred with trends. Most data processing staff admitted that this task took more that a half of the processing time. Supervision helped reduce errors in the sense that the supervisor examined reports and instructed subordinates on how numbers should be correctly handled. A subdistrict officer commented on the supervision he received:
"I am supervised by both the province and district. The latter comes more frequently. However, oftentimes they say something different in reference to the same thing and that confuses me."

As described previously, the principal data related to almost all community-based programs was population data. PR4 used population figures from multiple sources: MOI, MOPH, the NBESD projection and figures reported by subdistrict personnel. To assess the output of the provincial system, a critical point would be at the starting point of the data stream - the health center. Recently, MOPH ruled that MOI's figures should be the reference. The health center obtained the figures from the local MOI office. DHOs also received another set from the PHO. When they appeared to not agree, a compromise was made. Another important set was figures gathered by the health center itself. They were usually either reported by village health volunteers or surveyed by health center officers. MOI figures were totals of males and females, so, breakdowns by genders and age groups were based on proportions of the projection and "surveyed figures." A health center personnel described how she dealt with the population data:

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19 Although MOPH recently maintained that MOI figures should be the reference, these figures were only totals. At the provincial level, PR4 used the proportions from the NBESD projection model for determining subgroup numbers. The model was based on regional population growth rates established after the last census in 1980. At the other two levels, the subgroup calculation was usually based on both the provincial and the health center figures.
"Sometimes the DHO said that my targets were too few or too many. I needed to make another adjustment. Since the MOI number was just a total, it becomes possible to play with subgroup figures."

The magnitudes of discrepancies between the two most commonly used population data were presented in Table 5.2.4. At the provincial level the difference was 13.09 percent of MOI’s figure. The difference varied in magnitude across 11 districts and municipalities. Nonetheless, no jurisdiction showed a "surplus" of the surveyed figures. In the two subdistricts visited, the differences appeared sizable.\textsuperscript{20} The two subdistrict officers reported that the differences were discouraging.\textsuperscript{21} To correct this problem, one of them successfully convinced the district coordinating committee to bring in the new system from PR15.

The three sources of population data to which health centers relied included: village health volunteers, the local MOI office, and DHO. The general and community hospital also informed them via referral documents, but this occurred at will rather than as a system regulation.

\textsuperscript{20}Even though both were situated in two outlaying districts, they were central communities for those areas, so geographical barrier would unlikely cause a problem in the field survey annually conducted by health officers.

\textsuperscript{21}Such great discrepancies meant that they would hardly achieve the targets based on MOI’s figures. Thus, had MOI’s numbers been inaccurate, the evaluation would be unfair for them.
Finally, sources of error that respondents described included: (1) migration; (2) detention or failure to register or update with MOI or registering at a different location that where the person actually lived; (3) political manipulation; and, (4) disguises for illegal practices.

Failure to update the official records was not uncommon. Migration and seasonal circulation were reported to be another major cause of errant figures. Rural people tended to emigrate. Another rationalization of why MOI’s figures tended to be inflated was that the number of positions and MOI’s appraisal system depended upon the size of the community (i.e., population). Nonetheless, migration was also vulnerable to illegal ploys. A respondent revealed a possible explanation why there were a lot of immigrants in deforested areas:

"Typically, they were from the northeast. Some came to the province by themselves but others were lured to settle in the area. Local influences allowed them to live there but just for a while. The Department of Land revised their record periodically. A deforested area was usually allowed to be owned if dwellers lived there for a certain time. Once that happened, the immigrants were forced to return the land to local influences."

Furthermore, a MOI officer revealed that provincial MOI’s population data were divided into two pools. One were residents living within the various provincial jurisdictions, and the other, contributing about five to ten percent to the
total, included unidentifiable names. They might be dead or exist elsewhere. A health officer reported:

"So, when an election came these names were possibly released to the general pool. It became a tactic to win the election."

Another example of illegal disguise in population figures was for the sale of wood and logs. The number of houses tended to be inflated. Even though selling logs was prohibited by law, it was legal to sell or purchase used wooden boards or pre-built houses.

It was likely that not only health center personnel but officers at higher levels knew of the potential sources of inaccuracy. One argument suggested that since data was unbelievable one should not rely on them. This might be a reason why supervision remained as a prevailing communication channel. However, the provincial system looked stable, and, on the average, provincial officers and district health chiefs were not too concerned. Subdistrict officers did not like MOI’s figures and became frustrated. Young hospital directors could run their medical services without reports and demeaned them. Nonetheless, the hospital director who imported the PR15 system contended:

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22The norther region is rich in forest resources. The most valuable wood is teak which is currently banned for trade.
"Besides I needed other items such as inventory, financial, and sensitive surveillance. I believed that the district’s system makes much more sense."

Finally, satisfaction estimation of the last component would appear like in Table 5.2.6. The satisfaction matrix agrees with the fields findings to a good extent. In the area of Output Quality the scores appear to be a little inflated.

PR15 - The Innovative Province

In 1987, province PR15 had a new medical chief officer. In his mid-forties, Dr. M. was considered relatively young for the position. In fact, PR15 was the second province for which he had assumed the top administrative post. Only a short while after taking the position, he launched a health information system improvement policy in his new province.

Two major driving forces kindled this project. The first, a situation experienced by health officers nationwide, was the problematic population data that all community-based health programs used for reference. The second was the new leader’s determination to establish a systematic tool partly to solve this problem.

The population figures were normally required as epidemiological denominators and as program targets. Previously, PR15 had experienced similar problems to those of
PR4. At the time of this study, the province still relied on two sets of population data. One was figures periodically surveyed by local health workers, the other was the MOI figures and their projections. However, PR15 had decided to use the provincial figures for program monitoring, evaluation and target setting.

As described earlier, although the MOPH contended that the difference was marginal for ministerial-level uses, smaller-magnitude figures made operational-level officers anxious because even a little change contributed to a larger proportion of denominator figures. These figures often showed operational performances negatively, especially in the countryside where intractable emigration tended to occur. Moreover, since it was believed that MOI’s figures were doubtful, supervisors became reluctant to use them as an absolute reference.

The second, more pronounced force that propelled the change was the new medical chief officer’s tenacity which guided and maneuvered the movement. Provincial officers had been made aware, even before his arrival, that they would have to face the change. A data processing staff related:

"He did it before in another province. He has a strong reputation. I heard that two officers in that province received a punishment for disputing his policy. However, he was still in the middle of the implementation when he was appointed to my province."
"Health information is the heart of the public health development," Dr. M. was reported to have declared to his colleagues on the very first day of taking the position. The researcher regarded this affirmation as the starting point of the information system improvement project. The practical "formula" rehearsed by all of the PR15 interviewees (which might more or less represent the PR15 health officers) and heard throughout the chief medical officer's time, and extending to the time of the study,23 sounded: "Your figures must be complete, accurate, and timely."

**Major Events in PR15**

During the three years from 1987 to 1990, major events in PR15 were as follows:

1. **Vitalization of the epidemiological program.**
   Disease surveillance and reporting had been a "routine procedure" of the province. The provincial health office (PHO) had used a computer mainly for this program24 since 1985. However, the procedure formerly produced outputs for the provincial administrators and the central Epidemiology Division. The new policy aimed not only at

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23The case study was conducted in August 1990 which was about one year after the provincial medical health officer had moved to take the same position of a larger province in the north-eastern region, Korat.

24The MOPH's Department of Epidemiology was the only central unit that supplied the computer application to provinces.
reporting but also relied on the interpretation of the data. The policy emphasized: (1) accurate diagnosis; (2) case referral system; (3) presentation of the disease situation; and (4) disease control actions. A district health chief officer related:

"We have been urged to report. Every month the PHO gives us the list of health centers that did not report during the period. With the list, I can check with my subunits. The PHO also has the hospital reports which show from which district and subdistrict the cases came. So, if a patient’s name appear in theirs but we do not have it, that is an error. The health centers might really find no case. Another possibility is that they neglect reporting the case. The list makes it easier to supervise, when combined with the fact that I know my personnel well enough. I can defend for them if the cases are by-passed by the health centers. Moreover, we have to follow up every case in the area no matter whether we reported them or not."

The policy proclaimed that the diagnoses of certain diseases must be done only by physicians at community and provincial hospitals. The referral system was emphasized so that either cases visiting health centers or diagnostic specimens (e.g., stool, blood) be transferred to the hospital. After the diagnosis was made, the hospital reported to the PHO and notified the health center. Then, the health center’s report was overridden. The hospital also instructed the health center how the case should be followed up.
Since 1987, epidemiological presentation had been a formal part of the monthly conference of the provincial planning and evaluation committee. Each month one or two districts would be randomly selected to present their epidemiological situations. A community hospital director reported:

"Nobody knew beforehand who would be presenting since the name was picked up on the day. So, everybody needed to prepare the figures. The presentation was about the district situation, so the hospital and the DHO must incorporate their data. An interesting point is that we presented incidence rates of diseases, not just their case numbers. I almost left the concept at medical school. Previously, we used numbers of cases in surveillance, and even today other provinces still use them. You know that that is both theoretically wrong and unfair for between-district comparison."

(2) Restructuring the record system.

In preliminary interview, when one talked about the PR15 information system, (s)he mostly referred to the restructured record system, termed the "Eight Files," of which the latest version was called the "Ten Files." Previously, cases were recorded chronologically by

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25The committee was the provincial policy administrative body which composed of provincial medical chief officer and his deputies, section heads, community hospital directors, district health chief officers, and delegates from the provincial hospital and the municipality.

26The record structure first included seven major sections. Later, three more section were added to the version in use, which was known as the "Ten Files." The last two included data concerning: (1) non-communicable conditions (i.e., neoplasms, hypertension, heart diseases, and diabetes mellitus); and, (2) disable individuals in the community.
activities, procedure, or programs. The main problem was that one only knew how many times each particular activity was performed during the period. This number was assumed to indicate the number of cases. But, for example, the number of pregnant mothers receiving the antenatal care (ANC) did not reflect the adequacy (coverage) of the service in the community. Thus, the health care provider could hardly associate the (proxy) case number with the target population in the community.

The new system was target-population oriented. It contained general profiles of the community. The preface of the Ten Files Book described its content:

"The village health data files is the record book showing the list of all the residents in the community and the services provided to the various groups of the target population, as well as [some aspects of] the community health status. .... The objectives [of using this record system] were to be: (1) the handbook [or tool] for subdistrict-level health officers in their daily operations; and, (2) the managerial device for the district and provincial levels."

The initial eight sections included: (1) the name list of all community dwellers, by gender ordered descendingly by dates of birth; (2) numbers of health-related constructions (e.g., houses, latrines, clean water sources, rubbish furnaces); (3) newborns and babies under the age of one year and related services (i.e., immunization, nutrition, and well-baby care); (4) one to
four year old children, their nutrition and immunization; (5) school-age children (Grades 1 to 6), school-health and dental-health services; (6) reproductive-age women (15 to 44), their family planning practices, number of children, and cervical cancer detection; (7) perinatal cases, their histories and related services (i.e., ANC, delivery, PNC); and (8) communicable diseases (i.e., tuberculosis and leprosy). Each of the eight files contained not only numbers but also the name list for each group. The lists were ordered by age so the youngest appeared the last. This sorting enabled a relatively easy update when new names were added. So, for example, when an infant was born, its name would be appended to File No. 3. And when a child became older than twelve months, its name, which now had moved to appear at the beginning of the file, would be crossed out.

The province used the new record system side by side with MOPH conventional records during the first two years. In February 1989, about one and a half years after the Eight Files were first used, PHO discarded MOPH’s 21 record books and forms. For health center personnel, the Eight Files book was also the primary operational notebook which they used daily. Practical uses included identifying and locating cases, as well as tracing
follow-ups. Every three months, DHOs processed the aggregated data contributed by the health centers. This was called the "summary of the books." Four times a year, DHO reported these summaries to the PHO. All three DHOs visited during this study also posted these periodic summaries on the office walls. These coverage figures showed how much of each service had been delivered to the respective communities, compared to the period's targets. By the same token, PHO used these figures mainly for supervision.

(3) Field surveys and village health volunteers interface.

Once the new record books were distributed to health centers and hospitals, they were filled out with the initial lists by means of a survey. Of the eight files, the first was the foundation for all the others. The first grand survey, lasted almost three months, aiming at getting the full list of community residents. The plan was to have the survey done mainly by village health volunteers. However, all the subdistrict interviewees contended that villagers could successfully collect the data only for what concerned discrete physical objects. As one reported:

"Not a little data came from village health volunteers, but we had to work out the technical stuff ourselves. They can tell you accurately about objects like numbers of houses, latrines,
wells. But when it came to, for example, nutritional status of children [which volunteers were formerly instructed to do the measurements] and contraceptive practices [which they were supposed to ask their neighbors], they did not understand what we wanted. Or, I think, perhaps they didn’t care about these. So some simply left the survey form blank [on these matters]. I had to do these parts myself. The first survey was very laborious. However, the biggest thing that we got was the nearly complete list of the First File. The sorting took tremendous amount of time. But after it was done, all the other files could be easily filled out."

The initial survey provided baseline data to begin the project. Also important, was the subsequent update for which health officers obtained data mainly from two sources: village health volunteers and the provincial network. The latter will be described later. Village health volunteers were regarded as primary suppliers of updated data, so the interface between these people and health center officers was adjusted. Formerly, the health officer went to the village to perform activities in which village volunteers often helped by telling other villagers to come for the scheduled times and locations. An officer might meet some helpful volunteers quite often, but less active ones were not often seen. Under the new policy, contacting village volunteers was considered a priority task. Once a month, the health officer had to visit all the health volunteers, doing nothing else but talking with them about what events had taken place for the period concerning the priority
services that the various target groups, based on the Eight Files, should have received. This, in effect, meant that they became a target group with whom the health officer must exchange information. The policy also led to consequent measures for volunteer evaluation, term extension and recruitment.  

Another type of field survey was spot-checkings. During the first two and a half years of the project, the province conducted two community surveys. The primary objective was to estimate the coverage of health services. The surveys also aimed at assessing health status and health care utilization. The samples were five percent of villages. Besides comparisons between surveys and reported health coverage, the survey also asked villagers about their recent sicknesses and their opinions on services that they encountered at health centers and hospitals. The province considered this measure as a quality control.

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27 The term was usually one or two years. Then, the district considered whether it should be extended. Volunteers could resign any time. Although they did not receive any monetary return, they could obtain free health services. The extent of benefits varied among provinces.

28 The emphasis was the area outside the municipality. The new record system had not yet been implemented in the municipality area where health services were mainly provided by the provincial hospital, private clinics, and the municipality health center (which was under the Ministry of Interior).
(4) **The district coordinating committee.**

In 1982, MOPH proclaimed that a coordinating committee would be set up at the district level. Although coordinating committees were appointed long before, it was not until about six months after the project started, that the province urged DHOs and community hospitals to combine their data. The monthly epidemiological presentations before the provincial planning and evaluation committee became a regular venture. As a result, meetings between the two parties became consistent. The researcher noticed the meeting schedules in all three districts visited. In addition, copies of meeting reports were found at the PHO. Besides the general administration issues, the reports usually included disease surveillance and control information. Notably, PHO provided a prize for the most successful coordinating committee.

(5) **Birth reports and the communication network.**

Almost all births were delivered at either the provincial hospital or one of the community hospitals. In 1989, Numbers of births were: 5,767 (or 58%) at the provincial hospital, 2,556 (or 26%) at community hospitals, 1,078 (or 11%) at health centers, and 515 (or 5%) at the municipality clinic. There were 86 private clinics in 1990. Reportedly, they provided only outpatient services.
at any unit and the pregnant mother could choose where to
attend. However, she was usually encouraged to visit the
nearest facility and to give birth at a hospital. A
birth becomes legal when a birth certificate is issued.
By law, the parents must request the certificate from the
district (or the municipality) within 15 days after the
child is born, but delayed applications were not
uncommon. PHO contended that birth data was critical
because it could be the start of data for persons in the
community. A "neonate" of today would become a toddler,
pre-school, and school-age child later. If the
individual did not move to another place, the record
would remain in the Eight Files book. It was, therefore,
essential to have the individual in the book at the time
of birth.

The province set up a system to check among three sources
of birth information: MOI-issued birth certificates,
delivery reports from hospitals (or health centers), and
reports of neonates within responsible areas from
hospitals and health centers. Of the three, the delivery

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30 The municipality is the urban area. In 1989, 6.59
percent of the 767,434 population lived in the municipality.
 Both the municipality and districts are under the Ministry
of Interior (MOI). The hospital issued a hospital birth
certificate to the family as the infant was discharged,
which was normally a few days after birth. The MOI
certificate followed the information on the hospital
document.
report was usually the earliest coming to the system center at PHO. The provincial hospital, which accounted for 60 percent of the deliveries, reported daily by radio to PHO. Community hospitals and health centers reported every seven days and every month, respectively. PHO, then, sent a radio message about hospital deliveries to respective health centers nearest the family location. Not all health centers had radio receivers, so for the rest the message was directed to the district. Health center personnel, coming to the district at least three times a month, checked the posted delivery information. Another communication channel was through the referral form. By the hands of the parents, the hospital provided delivery information to the health center which was normally the place where they received post-natal care. A health center officer reported:

"By one way or another, I know about the case usually within ten days after the delivery. This is timely enough for the second PNC.\(^{31}\) In fact, the health center should be aware of the case even beforehand because the estimated date of delivery was shown in the Seventh File. So, I can expect how many cases and who will likely go to the hospital this month."

One officer at the PHO was devoted to checking delivery information. Every month, the final figures were supposed to agree among the three sources. Each month,

\(^{31}\)The first PNC was done at the hospital before discharging the case.
DHOs and hospitals were given the final birth figures, based on which they were to verify against their own figures. Critically, PHO demanded that not only figures should agree, but also that the cases appear in the First, Third and Seventh files. The PHO also produced a monthly report about deaths at birth. The information included case identification, date and place of delivery, adequacy of ANC, and cause of perinatal/maternal death.

(6) Computerization.

By the time of this study, the PHO had two IBM-compatible computers and a thirty-bed community hospital housed another. The provincial hospital had two machines but they were used only for hospital purposes. At the PHO, main applications included epidemiological data processing, personnel records, word-processing, and processing some parts of monthly reports and the provincial Eight-File book summary. Pharmaceutical inventory was about to start. A spreadsheet program and the epidemiological program supplied by the MOPH were mainly used. Several personnel had access to the machines but only a few completed the short-course training. Besides the mentioned major tasks, other uses depended on the personnel's preferences, so they typically used the computers in processing their own jobs.
The district computer was a vital part of a project which the province, in association with the Health Statistics Division, began to implement in a pilot district. The project started in 1987 and had passed the second year by the time of this study. The main objective of the project was to reduce the input load of health workers by using a single input sheet instead of numerous existing forms. Coding was designed to replace the writing of full information and a 12-digit identification (ID) number\(^\text{32}\) was to replace the individual's name. The coded sheet would provide data to the computer which had been loaded with the individual's basic data such as name, birthdate, gender, and address. So, the working coded sheet needed to be filled out only for the ID and the encountered procedures. Any new event was linked automatically to the person's basic information by means of the ID.

Three interviewees (a district health chief officer, a data processor, and a subdistrict health officer) maintained a similar position with respect to the computerized system. They reported that the weakness of greatest concern was output errors. The existing system did not have the capacity to verify inputted cases, so it

\(^{32}\text{This number was issued by the MOI. It is one's citizen ID number. The MOI started this centrally computerized project in 1985.}\)
produced duplicated cases and other erroneous records (e.g., an infant receiving ante-natal care). Since there was no specialized computer personnel and the inputting sometimes had to be done after office hours, the printout was often delayed. Another cited problem was illegible handwriting. The program data processor showed an evaluation of the computerized system which he had just conducted to the researcher. His questionnaire survey revealed that of the 25 respondents, 82 percent favored the Ten Files system, only 9 percent each preferred using the computerized or the MOPH conventional system.

(7) Data Presentation.

There had been two major occasions on which the province presented its achievements. These occurred between 1989 and 1990, when the former Permanent Secretary was in the office. At that time, MOPH had a policy that the provinces present their accomplishments twice a year. This was considered a competition because prizes were given to the most successful group. They were judged on the basis of their field performance and presentation. PR15 and eight other nearby provinces, which together formed a group, won first prize in the second presentation.\textsuperscript{33}

\textsuperscript{33}The presentation took place in mid-1990. At this time, Dr. N. who was the former provincial hospital director succeeded Dr. M. as the provincial medical chief officer.
The PHO also published two provincial annual statistical reports. Significant figures included births and deaths, morbidity and mortality rates\(^{34}\) of conditions under surveillance, and coverage of services. Most figures were presented by area (districts). The reports\(^{35}\) illustrated the figures with epidemiological graphs and maps which were differentially shaded based on relative incidence.

**Four Dimension Assessment**

Now that the major events have been described above, this provincial information system can be appraised with regards to the four basic dimensions of user satisfaction: System Management, Utility Enhancements, Input Procedure, and Output Quality. Regarding the overall satisfaction score averaged from the four groups, PR15 was the fourth highest in the region. Table 5.2.7 indicated that while the first two groups felt very good with the system, this was not true for district and subdistrict respondents. District health chief officers expressed the most dissatisfaction. Alternately, one can see that the input procedure was considered the least satisfying component, whereas the output quality and utility enhancements appeared as a strength of this provincial system.

\(^{34}\)Expressed as incidence rates.

\(^{35}\)Districts also produced their own reports using similar formats.

208
Qualitative findings will be presented through the same framework. Each of the components will be described together with viewpoints from the four levels.

(1) System management

There was almost a consensus among the interviewees that the former provincial medical chief officer initiated and led the changes. As Dr. M. was the leader, his closest followers included the young, well-educated provincial staff. They transformed his idea into reality. They worked out the details of the Eight Files, designed and supervised the surveys, processed incoming filled-out forms, and trained the district-level officers. Previously, they had been distant from the provincial planning and evaluation committee, but during the project they became regular attenders who normally presented relevant data to committee members and discussed operational issues. Besides the monthly meeting, they had regular conferences with the medical chief officer. A provincial staff reported:

"We met 'Ajan' about every two weeks and even more frequently when we had a special mission. We were really close to him. When he first came I feared his strong reputation. But he showed that

36 Of the 95 PHO officers, 9 and 54 obtained master and bachelor degrees, respectively. This, the 1990 figures, was relatively higher than the regional average. The former administration, reportedly, had a policy that the PHO supported the further education of its health officers.

37 "Ajan" literally means a teacher. Several staff called Dr. M. by this name.
he liked to hear from us, and after the first few
sessions many of us spoke up. Sometimes when
facing a deadline, we worked until late at night
and he was always there. Since his time, the
provincial staff have had the mid-month meeting
with district staff so we can detect operational
problems and present them to the committee at the
end of the month."

Another provincial staff made a comment on her former boss:

"Unlike the present boss who seldom talks, Dr. M.
had a great communicating skill. He didn't joke
but taught. I worked at a community hospital in
another province where he then was the medical
chief officer before coming here. There, Ajan
taught district-level personnel himself. He
related his firm concept in an understanding way.
After the session I felt energized and ready to do
it. I think the staff here felt the same thing."

Section heads38 were also invited to the staff conference.
However, the material was reportedly presented in a technical
manner which interested them less. Section heads were made
heads of supervisory teams. The majority responses expressed
positive agreement to this role. Nonetheless, a section head
remarked that she followed the policy because it was an order.

Policy and practices were transferred to the district level
mainly by provincial supervisory teams. They taught district
officers how to deal with the Eight Files and the surveys.
The district, in turn, passed these on to health center
personnel. At the district level, staff, rather than district

38 Most of the section heads on the average were less
educated. No one finished a master's degree and some were
below a bachelor degree. Most were typically in their late
forties or fifties.
health chief officers, were more likely to get involved. Only one of the three interviewed district chief officers responded clearly about the system operation. Another talked about what he found in the field. A third made an excuse and the staff related the issue on behalf of the district office.

Another group which the project generated a greater participation from was community hospital directors. Previously, they were primarily concerned with hospital management and regarded community-based programs as a less important priority. That the project demanded that the district coordinating committee\(^3\) was to represent the district, brought about an active role for community hospital directors. As the most accepted, knowledgeable members of a district coordinating team, they played a significant role in data analysis and presentation. A hospital director contended:

"I believed in objective information. Previously, we just talked about what we felt which really bothered me. Now, I can argue for the district with the figures. I even established an evaluating system\(^4\) for the hospital use. Each section is to give me a brief report before the hospital monthly meeting. I use these figures for monitoring the hospital operations."

\(^3\)The board consisted of the district health chief officer, the hospital director, and staff of both parties.

\(^4\)The forms were shown to the researcher.
Of the three pairs of hospital-DHO administrators visited by the researcher, a PHO officer who was in a supervisory team mentioned that only one pair showed a good compatibility to work together. A district health chief officer described the supervisor, who was a section head, and his colleague:

"He [the head] seems to have a special relationship with the doctor. They look like lovers. I like the doctor but detest the other person. I think he has been trying to find fault of me."

Another comment came from another provincial staff. This was about another team:

"The director is perhaps the most energetic of all but the chief is very quiet. It would be a better combination if the doctor works with Mr. S.. But if so what about Dr. B., [they are already good companions.] We have too few Mr. S.-type."

Perhaps, the greatest burden was felt by the subdistrict and health center personnel. For more than a year, they had to input the data to both the new and conventional systems. It was mainly the district, and not the provincial officers, who trained them how to maneuver the Eight Files and how to conduct the first field survey. The former were, reportedly, often confused themselves. Moreover, the province did not consider the data system as a separate task. The PHO wanted not only coverage figures but health center officers were also demanded for accomplishing full coverage in providing their field services. Thus, besides processing the two parallel systems, they had to invigorate their efforts to approach the
full coverage. All three interviewed personnel reported that they experienced tremendous pressure.

With respect to System Management, Table 5.2.8 shows that the survey responses and the qualitative findings agreed to a good extent. Conclusively, the system created a new distribution of roles (and authority). Most remarkably, provincial staff had a chance to express their potential. While provincial staff and hospital directors extended their roles, district chiefs seemed to have their authority reduced. They appeared less familiar with the new figures. Indeed, their program monitoring task did not change much - only substituting one set of figures for another.\textsuperscript{41} Provincial section heads still maintained their status, albeit sharing the supervisory role with young staff. Remaining quiet at the bottom were the subdistrict and health center personnel.

Finally, it should be noted that most of the happenings in PR15 occurred from the momentum set by the previous provincial medical chief officer. His successor, Dr. N., followed through and provided supports to the information system improvement project. In fact, the Ninth and Tenth Files were added during his period. However, some provincial staff commented that some measures became less stringent and less

\textsuperscript{41}Previously, counts of activities relative to estimated targets guided the district monitoring measure.
regular, such as epidemiological presentation and disease surveillance reporting. Reportedly, it reduced the pressure carried by district, subdistrict and health center officers.

(2) Utility Enhancements

PR15 regulated that district-level reports be submitted before the last day of the month, when the monthly provincial meeting usually took place. Dates and times of submission were recorded. This became a part of the district evaluation. Besides timeliness, district reports were also scored based on their completeness and calculating accuracy. All three districts visited established similar schedules for receiving health center reports. The researcher examined provincial and district registrations and rarely found late reports.

In terms of utility, all four groups showed an approval of the Eight (Ten) Files. Two health center personnel demonstrated to the researcher how the Ten Files facilitated their field and office operations. They rendered easily retrievable data to complete reports, as well as provided names of persons who were supposed to obtain particular services. Two of the three district health chief officers could not interpret the figures\(^\text{42}\) well. However, their staff did somewhat better. Hospital directors showed minor mistakes of interpretation.

\(^{42}\)Interviewees were asked to interpret a few tables prepared by the researcher. The test included concepts of incidence, perinatal and infant mortality rates.
They also asserted that the system provided data items used only for outside-of-hospital programs. They gave examples of information they needed for hospital management. Provincial officers expressed the greatest approval since the system provided figures that they could use to monitor the districts as well as to argue with MOPH units with a greater confidence. Regarding utility enhancements, the only unsatisfactory element was the lack of practical documentation.

Utility of information was likely confined to monitoring community-based programs. Uses of morbidity figures for identifying health problems appeared limited. For example, many interviewees suspected that the lignite generator plant located in a district would discharge harmful pollution to the community, but no existing data gave a clue to the matter. The community hospital director described:

"People told me that their breathing became uncomfortable when they moved to the district. But the diagnoses given to them were not specific enough to identify the cause. The most specific I can tell is allergic rhinitis or bronchitis, but they might be called as broad as chronic cough. Moreover, not only the district hospital and health centers, but patients also visit the provincial hospital because it is just thirty minutes away. Each of these units has a separate record. And even they are combined, the figure does not show a definite meaning, because respiratory problems are No. 1 for all districts, not only for mine. Furthermore, last year the MOPH people came here with a sophisticated gadget [to detect the pollution] but since then they have remained silent."

215
Another example of limited utility was when provincial and district interviewees were asked to identify the highest-risk group for the family planning or contraceptive services. A PHO staff gave an informative response mentioning teenagers. When asked how she knew so, she replied "I heard a MOPH supervisor speaking." In fact, the answer to this question can be ascertained by disaggregating morbidity figures (e.g., abortions) by age and location, which then did not exist. The satisfaction evaluation for Utility Enhancements for PR15 is shown in Table 5.2.9. The field findings well matched the survey responses.

(3) Input Procedure
The new system in PR15 inflicted an additional workload on all four levels, especially when the two systems were run in parallel. Hospital directors seemed to be the best-off, while provincial and district staff and subdistrict officers were most negatively affected. Since the transfer of the new data handling occurred from one level to another, it seemed likely that the level of understanding was diluted down the

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The researcher examined the provincial hospital abortion records of a randomly selected month (May 1990). He found that of the 475 total cases, sixty (12.63%) and 165 (34.74%) happened to women of 15-19 and 20-24 year old groups, respectively. Many of these cases were diagnosed septic and/or criminal abortions.
hierarchy. A subdistrict officer related about the first-year situation:

"At first it confused me a lot. The district taught me how to process the forms but they themselves, when asked, were often puzzled. The biggest trouble was the initial survey which took me more than three months. After I made myself understand the procedure, I had to teach village volunteers on what I was first exposed to. But once the First File was completed, it became easier to fill out the others."

Another subdistrict officer pointed out the critical time of the reporting period:

"The province maintained that a period starts on the 26th day of the month. Since we must update the book by then, on the 24th or 25th I need to go out to visit the volunteers. Sometimes, the health center dispensed a particular service on that day which cannot be postponed. If you have two officers at the center, it becomes hectic for the one left behind. Moreover, I have only a few remaining days to process the data to meet the district schedule."

Paperwork was alleviated after one and a half years when PHO discarded the older 21 forms, and the Eight Files became established as the primary record book. The PHO also adapted some forms for easier processing. For example, the district monthly report was changed, not in content, but in item sequence and paging. Previously, after a copy was submitted, this 12-page MOPH-supplied form, had to travel from one desk to another around the PHO. The new version changed the paging so it could be separated and only one or two pages went directly to the corresponding staff. The Eight Files were reported to be good for data updating and easy retrieval.
Most data processing personnel expressed that the task was boring and mentioned points which could be improved. These included: regular supply of forms, form consistency, appropriate sequence of items, and clear definitions.

Computer application was still limited at both provincial and district levels. Only a few personnel attained a short-course training. The PHO also obtained technical assistance from outside persons via personal contact. There was no clear policy regarding the application, priority and security. Table 5.2.10 presents the satisfaction evaluation for Input Procedure. The two approaches agree to an acceptable extent.

(4) Output quality
Input and output were closely related. Output of one level would be input of another. The primary concern about Output Quality reported by most interviewees was data accuracy. Accuracy of data can be considered in two aspects: (1) whether the processing (e.g., the calculation) was correct; and, (2) whether it was factual. The former was typically easier to ascertain than the latter. PR15 featured data verification mechanisms with respect to both considerations. These measures included: (1) checking reports for calculations and plausibility; (2) processing data together between officers of different levels; (3) supervision; (4) periodic checks (i.e., book summary); (5) cross-checking between the three sources of
the population data; and, (6) spot-check surveys. Also, at
the PHO a portion of data processing, especially for disease
surveillance and periodical provincial book summary, was
carried out with computers eliminating miscalculation due to
human factors.

A specific part of the data that received the greatest
confidence from majority system users was birth data. The
system exercised a cross-check between the three sources:
legal certificates, institutional reports and community-based
surveillance. Neonate data affected related services (and the
accuracy of data on the target groups), namely, ANC, PNC,
preschool and school-age child services. Health workers were
压ured to look for existing pregnancies and keep them in
their records. The Seventh File, containing all critical
events, eased the tracing of pregnant cases to their
destination.

A slight difference between survey and field study was seen in
the attitudes of district health chief officers (Table
5.2.11). The satisfaction survey showed that district health
chiefs expressed less approval with output quality. Field
study found a reason for this. The process at the middle
level did not change much, perhaps in their views. The
district still spent a lot of time checking figures and yet
often found errors which might seem magnified due to
unfamiliarity with some new processes (e.g., the book summary).

However, the field study found that every party responded positively with regards to the data quality. Several interviewees expressed a strong confidence in the system. Nonetheless, a provincial staff admitted about the spot-check survey:

"On a random sampling, I once picked a remote subdistrict which extended to the mountain range. You would spend days to travel across the area. So, we just did the best we could, basically asking volunteers and other villagers. I can't bet if we got a perfect list of dwellers."

The last critical point about the outputs was sources of error. Even though the system featured specific quality control measures and verified the population data among multiple sources, it was subject to similar sources of error described previously in the conventional system.

Chapter Summary
Chapter V describes the survey and qualitative findings at the provincial level. The study indicated that certain provincial characteristics, including size, population density, health facilities, living condition, and organizational hierarchical size were not significantly associated with level of user satisfaction. Thus, the study contended that information system effectiveness was intrinsic to information system
management and did not depend on organizational structure or external environment.

The study presented user satisfaction scores of seventeen provinces. Their patterns were shown by two facets: groups and components. Previous analysis indicated that group had meaningful attributes, were considered for primary profile. Provincial systems were classified primarily based on group satisfaction profiles.

The case study selected PR15 and PR4 for investigation. PR15 was among the more satisfying systems and PR4 was situated in the bottom cluster. The case study was to determine the extent to which survey satisfaction patterns agreed with field observation. In both provinces, the two approaches converged to an acceptable degree.

The case studies further described the two systems' features. PR15, the innovative province, showed the following characteristics: (1) strong leadership; (2) participation of the young, educated officers; (3) changes in the record structure; (4) quality control mechanisms; and, (5) exercising uses of data. PR4, which was considered a MOPH's conventional system depended primarily on interpersonal information flow.
The study assumed that the system features would be commonly found among the two respective groups of provinces. For the conventional system, which exhibited no significant unique events, generalization might be more plausible than the high-end group. However, for more satisfying systems, some of the features, namely, good leadership and extended roles of the young, educated officers, were more common features than others. Successful provinces would likely exhibit uniqueness. Besides PR15, PR12 was another example. Reportedly, the province had implemented a special project in association with Mahidol University. It was arguable that the project affected information system effectiveness in this province.
Table 5.1.1
Profiles of the 17 Northern Provinces
Grouped by Quartiles of Overall Satisfaction Scores

<table>
<thead>
<tr>
<th>Province</th>
<th>Area ( \text{km}^2 )</th>
<th>Population ( \times 10^3 )</th>
<th>Population Density</th>
<th>Basic Health Services</th>
<th>Hospital Beds/ POP.</th>
<th>Living Conditions</th>
<th>SUB-Units Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR12</td>
<td>9,598</td>
<td>1,040</td>
<td>108.40</td>
<td>1.60</td>
<td>1.14</td>
<td>2.63</td>
<td>Large</td>
</tr>
<tr>
<td>PR2</td>
<td>7,839</td>
<td>441</td>
<td>56.30</td>
<td>1.66</td>
<td>1.43</td>
<td>2.14</td>
<td>Small</td>
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<tr>
<td>PR1</td>
<td>4,531</td>
<td>550</td>
<td>121.40</td>
<td>1.71</td>
<td>0.93</td>
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<tr>
<td>PR15</td>
<td>12,534</td>
<td>729</td>
<td>58.20</td>
<td>1.51</td>
<td>1.53</td>
<td>2.37</td>
<td>Large</td>
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<tr>
<td>H. Mod.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR11</td>
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<td>410</td>
<td>91.00</td>
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<td>758</td>
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<td>1,367</td>
<td>68.00</td>
<td>1.57</td>
<td>3.90</td>
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<td>295</td>
<td>43.80</td>
<td>2.20</td>
<td>1.25</td>
<td>1.94</td>
<td>Small Large</td>
</tr>
<tr>
<td>L. Mod.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1.67</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR8</td>
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<td>1,052</td>
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<td>1.03</td>
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</tr>
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<td>PR4</td>
<td>6,335</td>
<td>560</td>
<td>84.90</td>
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</tr>
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<td>PR7</td>
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<td>158</td>
<td>12.50</td>
<td>2.85</td>
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<td>1.31</td>
<td>Medium Small</td>
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<tr>
<td>PR9</td>
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<td>417</td>
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<td>1.66</td>
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<td>10583</td>
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<td>1.53</td>
<td>2.29</td>
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</tbody>
</table>

223
Notes (for Table 5.1.1)

* Estimated by number of health centers per ten thousands of population.

** Hospital beds per ten thousands.

/ Subjective evaluation on the level of locality’s development by surveyed respondents. Provincial figures were averages. The scale ran between 0 to 4.

// Classified based on enumerations by weighing numbers of provincial and community hospitals and health centers.
### Table 5.1.2
Provincial Satisfaction and Quartiles by Groups and Components

<table>
<thead>
<tr>
<th>PROVINCE</th>
<th>RANK</th>
<th>SAT</th>
<th>G1</th>
<th>G2</th>
<th>G3</th>
<th>G4</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
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<tr>
<td>PR12</td>
<td>1</td>
<td>1.33</td>
<td>HM</td>
<td>H</td>
<td>H</td>
<td>HM</td>
<td>H</td>
<td>H</td>
<td>LM</td>
<td>H</td>
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<tr>
<td>PR2</td>
<td>2</td>
<td>1.31</td>
<td>H</td>
<td>H</td>
<td>LM</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>HM</td>
</tr>
<tr>
<td>PR1</td>
<td>3</td>
<td>1.30</td>
<td>H</td>
<td>HM</td>
<td>H</td>
<td>H</td>
<td>HM</td>
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</tr>
<tr>
<td>*PR15</td>
<td>4</td>
<td>1.29</td>
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<td>H</td>
<td>L</td>
<td>LM</td>
<td>HM</td>
<td>H</td>
<td>LM</td>
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<tr>
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<td>HM</td>
<td>LM</td>
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<td>LM</td>
<td>HM</td>
<td>LM</td>
<td>H</td>
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<tr>
<td>PR10</td>
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<td>1.25</td>
<td>LM</td>
<td>LM</td>
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<td>HM</td>
<td>HM</td>
<td>HM</td>
<td>LM</td>
<td>LM</td>
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<td>HM</td>
<td>LM</td>
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<tr>
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<td>9</td>
<td>1.23</td>
<td>LM</td>
<td>LM</td>
<td>H</td>
<td>LM</td>
<td>H</td>
<td>L</td>
<td>HM</td>
<td>LM</td>
</tr>
<tr>
<td>PR14</td>
<td>10</td>
<td>1.21</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>HM</td>
<td>HM</td>
<td>HM</td>
</tr>
<tr>
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<td>1.21</td>
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<td>HM</td>
<td>HM</td>
<td>HM</td>
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<td>L</td>
<td>LM</td>
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<td>HM</td>
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<td>L</td>
<td>LM</td>
<td>LM</td>
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<td>L</td>
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<tr>
<td>*PR4</td>
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<td>HM</td>
<td>L</td>
<td>LM</td>
</tr>
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<td>L</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>L</td>
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</tbody>
</table>

**Legend:**
- * = Provinces in the case study.
- **Components:**
  - S1 = System Management
  - S2 = Utility Enhancements
  - S3 = Input Procedure
  - S4 = Output Quality
  - SAT = Overall Satisfaction
- **Groups:**
  - G1 = Provincial Officers
  - G2 = Community Hospital Directors
  - G3 = District Health Chief Officers
  - G4 = Subdistrict Health Chief Officers
- **Ranking:**
  - H = High (Fourth quartile)
  - HM = High Moderate (Third quartile)
  - LM = Low Moderate (Second quartile)
  - L = Low (First quartile).
<table>
<thead>
<tr>
<th>PROVINCES</th>
<th>PROVINCIAL OFFICERS</th>
<th>COMMUNITY HOSPITAL DIRECTORS</th>
<th>DISTRICT CHIEF OFFICERS</th>
<th>SUBDIST. CHIEF OFFICERS</th>
<th>OVERALL</th>
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</thead>
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<td>PR2</td>
<td>H</td>
<td>H</td>
<td>HM</td>
<td>H</td>
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<td>* PR15</td>
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<td>LM</td>
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<td>HM</td>
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<td>LM</td>
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Legend:

H = High; HM = High Moderate; LM = Low Moderate; L = Low.
### Table 5.2.1
**PR4's Satisfaction Matrix**

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<tr>
<th></th>
<th>SYSTEM MANAGEMENT</th>
<th>UTILITY ENHANCEMENT</th>
<th>INPUT PROCEDURE</th>
<th>OUTPUT QUALITY</th>
<th>TOTAL SATISFACTION</th>
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<tr>
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<td>Low</td>
<td>Moderate</td>
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<tr>
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<td>Low</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>DIST.</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>SUBDIST.</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>TOTAL</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
<td>Rank = 14 of 17</td>
</tr>
</tbody>
</table>

### Table 5.2.2
**Satisfaction of System Management (PR4)**

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>High</td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>Low</td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>High Moderate</td>
</tr>
<tr>
<td>Subdistrict Health Chief Officers</td>
<td>Low Moderate</td>
</tr>
</tbody>
</table>
### Table 5.2.3
Satisfaction of Utility Enhancements (PR4)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th>FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial Officers</td>
<td>Low</td>
<td>L.Mod.</td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>Low Moderate</td>
<td>Low - L.Mod.</td>
</tr>
<tr>
<td>Subdistrict Health Chief Officers</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

### Table 5.2.4
Satisfaction of Input Procedure (PR4)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th>FIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial Officers</td>
<td>H. Mod.</td>
<td>L. Mod.</td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>L. Mod.</td>
<td>L.Mod. - H.Mod.</td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>High</td>
<td>H. Mod.</td>
</tr>
<tr>
<td>Subdistrict Health Chief Officers</td>
<td>L. Mod.</td>
<td>L. Mod.</td>
</tr>
</tbody>
</table>
### Table 5.2.5
Differences between the two Major Population Data

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>MOI FIGURES</th>
<th>LOCAL SURVEY</th>
<th>DIFFERENCE(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Province</td>
<td>588,890</td>
<td>511,793</td>
<td>13.09</td>
</tr>
<tr>
<td>District A</td>
<td>39,879</td>
<td>34,701</td>
<td>12.98</td>
</tr>
<tr>
<td>District B</td>
<td>90,454</td>
<td>73,031</td>
<td>19.26</td>
</tr>
<tr>
<td>Subdistrict X</td>
<td>6,868</td>
<td>4,492</td>
<td>34.60</td>
</tr>
<tr>
<td>Subdistrict Y</td>
<td>8,153</td>
<td>10,262</td>
<td>20.55</td>
</tr>
<tr>
<td>Two Municipalities</td>
<td>43,433</td>
<td>42,888</td>
<td>1.25**</td>
</tr>
</tbody>
</table>

**Notes:**

* The survey figures were about half a year earlier.

** There was no survey in the municipality areas. Both figures belonged to MOI.

### Table 5.2.6
Satisfaction of Output Quality (PR4)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
<td>FIELD</td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>H. Mod.</td>
<td>H. Mod. - L. Mod.</td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>H. Mod.</td>
<td>H. Mod. - L. Mod.</td>
</tr>
<tr>
<td>Subdistrict Health Chief Officers</td>
<td>L. Mod.</td>
<td>Low - L. Mod.</td>
</tr>
</tbody>
</table>
### Table 5.2.7
**PR15’s Satisfaction Matrix**

<table>
<thead>
<tr>
<th></th>
<th>SYSTEM MANAGEMENT</th>
<th>UTILITY ENHANCEMENT</th>
<th>INPUT PROCEDURE</th>
<th>OUTPUT QUALITY</th>
<th>TOTAL SATISFACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROVINCE</strong></td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>COM. HOSP.</strong></td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td><strong>DIST.</strong></td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>SUBDIST.</strong></td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td><strong>TOTAL SATISFACTION</strong></td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

*Rank = 4 of 17*

### Table 5.2.8
**Satisfaction of System Management (PR15)**

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>High</td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>High</td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>Low Moderate</td>
</tr>
<tr>
<td>Subdistrict Health Chief Officers</td>
<td>Low Moderate</td>
</tr>
</tbody>
</table>
### Table 5.2.9
Satisfaction of Utility Enhancements (PR15)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
<td>FIELD</td>
<td></td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>High Moderate</td>
<td>High Moderate</td>
<td></td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>Low Moderate</td>
<td>Low Moderate</td>
<td></td>
</tr>
<tr>
<td>Subdistrict Health Chief</td>
<td>High</td>
<td>High</td>
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</table>

### Table 5.2.10
Satisfaction of Input Procedure (PR15)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
<td>FIELD</td>
<td></td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>High Moderate</td>
<td>High Moderate</td>
<td></td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>Low</td>
<td>Low Moderate</td>
<td></td>
</tr>
<tr>
<td>Subdistrict Health Chief</td>
<td>Low</td>
<td>Low</td>
<td></td>
</tr>
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</table>

### Table 5.2.11
Satisfaction of Output Quality (PR15)

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>SATISFACTION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY</td>
<td>FIELD</td>
<td></td>
</tr>
<tr>
<td>Provincial Officers</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>District Hospital Directors</td>
<td>High</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>District Health Chief Officers</td>
<td>Low Moderate</td>
<td>H.Mod.-L.Mod.</td>
<td></td>
</tr>
<tr>
<td>Subdistrict Health Chief</td>
<td>High Moderate</td>
<td>High Moderate</td>
<td></td>
</tr>
</tbody>
</table>
This chapter will summarize the major relevant materials described in earlier chapters, provide conclusions drawn from research findings in Chapters IV and V, and, based on these findings, suggest a possible interpretation of the findings and their implications. In a latter section, potential determinants of effective systems will be identified and strategies for improving provincial health information systems proposed for consideration by the Ministry of Public Health (MOPH). Finally, the chapter will assert major current system deficiencies on which still little attention has been paid, address main methodological problems, and suggest future research possibilities.

Summary of the Study

This dissertation investigated health information systems among the seventeen northern provinces in Thailand. The health information system under study was referred to as the institutional reporting system. The study focused on community-based programs implemented by the provincial health offices and their hierarchical subunits, including community hospitals, district health offices, subdistrict health centers, and the community-medicine division of the provincial hospital. The northern region was selected because it was comprised of a good mix of innovative and conventional
provincial systems. The research aimed at exploring the effectiveness of regional and provincial health information systems with respect to the degree to which they satisfied the users.

The study began with an assumption of a natural system organization (Scott, 1987). Besides specific features and goals, this view asserts that human behavior also plays a major role in manifesting support goals for the organization. Further, when conflicts between output and self-maintenance goals emerge, the latter dominate. This paradigm suggested that user satisfaction was a tenable measure of system effectiveness. In each province, the study surveyed four primary organizational segments: provincial health officers, community hospital directors, district chief health officers, and subdistrict chief health officers. These personnel held specific positions which required action upon the system or its outputs. Presumably, they were therefore affected by the information system, as well as had a potential influence on it.

In addition to a user satisfaction survey, a case study of two selected provinces supplemented the evaluative approach by focusing on user behavior and process attributes of the selected systems. Province PR15 was selected because it reportedly featured significant changes over the past three
years. Province PR4 was considered as a comparison province where the MOPH conventional system had remained stable and relatively intact during the same period. The case study was restricted to the four community-based programs which were used as discussion materials during the field interview (the study did not evaluate these specific programs). A focus was the population data which provided references for all community-based programs with respect to their target groups. The field study explored the current situation and traced recent events significant to the information system. Analysis was based on four dimensions of system features: Systems Management, Utility Enhancements, Input Procedures, and Output Quality. These dimensions corresponded to the four user satisfaction components assessed by the survey.

The study generated findings at two levels: individual users, and provinces. At the former level, results were obtained solely by means of the survey. In the case of provincial assessment, a combination of aggregated survey results and qualitative information were used. Major findings for the individual level were as follows:

(1) The regional health information system was not effective in terms of satisfying users at large. Only 91 of 655 respondents (13.9%) rated themselves as "satisfied" based on the overall scores. Taking the mid-scale point (score=1.5) as the "pass-fail"
point, the whole group exhibited a mean score of 1.23 with a 0.29 standard deviation.¹

(2) User satisfaction patterns showed that only the Systems Management dimension was considered marginally satisfying (score=1.7) for all respondents. All other components presented less satisfying scores. This phenomenon suggested that the regional system needed improvement across all four areas.

(3) Based on satisfaction patterns, three clusters of users were identified. They were labeled "Highs," "Moderates" and "Lows" according to their overall satisfaction scores. The labels were adopted only for simplicity. Though the overall scores of the three clusters presented only a slight difference, their constituent combinations were considered significantly distinctive. The "Highs" expressed remarkable satisfaction with Systems Management and minimal dissatisfaction with the other components. The overall scores of the "Moderates" and the "Lows" appeared comparable. The "Moderates" presented marginal dissatisfaction on Systems

¹The scale ranged between 0 to 3. The scores had a range from 0.219 to 2.205.
Management and Utility Enhancements but expressed deeper disapproval of Input Procedures and Output Quality. Finally, the "Lows" showed a remarkable satisfaction with the first component while considered the others very dissatisfying. The proportions of the three clusters amounted to 16.3, 45.6 and 32.7 percent, respectively.

(4) Models consisting of different combinations of individual and locational variables were established. The discriminant function models included those taking all independent variables, locational variables only, individual variables only, provinces only and groups only, as cluster membership predictors. The predicting powers of the discriminant function models were somewhat better than the probability of categorization by chance alone.² Correct prediction rates ranged between 46.68 to 50.67 percent. The full model (i.e., all independent variables included) resulted in seven meaningful predictors; including, age, education, community hospital directors, provincial

²A three-group classification had an equal prior probability of one-third. Thus, by chance one would predict the group membership correctly once in every three times.
health officers, past experience. The two locational variables - province and group - when used as the sole predictor did not provide a significant prediction power. However, when combined they yielded a comparable correction rate to the full model even though all individual attributes were excluded. This manifestation suggested that province and group might exert such a strong influence that the influence of individual attribute variables would become overwhelmed. It further suggested that a more powerful model, which would yield a greater proportion of correct prediction, be explored by adding other potentially relevant independent variables.

(5) Based on meaningful characteristics, the profiles of the three clusters of respondents were identified. The "Highs" tended to be senior, educated, and positively experienced, and included a greater proportion of provincial officers. The

3Gender appeared meaningful in a model not consisting of the locational variables. One particular province was also a meaningful predictor. Variables which appeared either not statistically meaningful or redundant included: district and subdistrict health chief officers, administrative and medical status, number of subunits, decisional authority, and perceived development level of the locality as well as other provinces (Chapter IV).

4This investigation was done by means of the supplementary qualitative study.
"Moderates," by and large, were youngest, most highly educated, and had acquired the worst informational experience. This cluster comprised the largest proportion of community hospital directors and the smallest fraction of district chief health officers. The "Lows" had a slightly older average age than the "Highs." They appeared the least educated. Their past experience was situated in the middle of the others. Subdistrict and district chief health officers fell in this cluster in a larger proportion than in the other clusters.

The second level of findings used the province as unit of analysis. First, the seventeen cases were examined as to whether any of the provincial characteristics showed a statistical association with the provincial satisfaction scores. Then satisfaction patterns, presented by groups and by components, were compared. Finally, a case study was performed to determine the extent to which the survey satisfaction patterns matched those of field observation. The provincial findings were as follows:

(1) None of the provincial characteristics, namely; size, population density, basic health services, advanced medical facilities, organizational subunits, and local living conditions, were
considered associated with either provincial satisfaction scores or their (quartile) ranks. This finding suggested that effectiveness of the information system was independent of these factors. Thus, HIS effectiveness would be affected by factors internal to the system elements.

(2) The two selected provinces were situated in the first and fourth quartiles of provincial overall satisfaction scores. PR15, the innovator province, appeared to be among the more satisfying systems as expected. Alternately, PR4 which constituted presumably the conventional system was positioned the fifth from the least-satisfied province. A subgroup analysis revealed the patterns of the most and least satisfied province groups. The former featured high relative satisfaction scores of the provincial health officers and community hospital directors, whereas low relative scores from the hospital directors and subdistrict health officers characterized the latter. The more effective provinces also showed high relative scores on

5The lack of significant association was determined by using univariate and multiple regression analyses. However, since the average overall satisfaction scores did not show a great variation among the provinces, this study suggested that this independence be reexamined possibly by using different criteria of systems effectiveness and different ways of operationalizing the dependent and independent variables.
Systems Management, Output Quality, and Utility Enhancements. Alternately, the least satisfying systems featured consistently low relative scores on Output Quality.

(3) The researcher, by means of the field observation, provided an evaluation of the two studied provincial systems using the four components and four organization segments. It was found that field evaluation appeared convergent with the survey satisfaction patterns of the two systems. The case study found that PR15 featured a number of system attributes that would plausibly tend to make it a more effective system than that of PR4.

(4) The case study revealed that characteristics of the innovative province (PR15) included: (1) Strong leadership of the top management; (2) extended participatory roles for the young and educated staff officers, namely; provincial staff and community hospital directors, albeit the "top-down" administration being dominant; (3) significant changes in the record structure which exhibited practical instrumental features for both management and field operations; (4) systematic handling of population data, especially birth records; (5)
strengthened organization and extended roles of district coordinating committees; (6) two-way vertical information flow as well as interinstitutional communication; (7) changed roles of community health workers which emphasized the interface between them and health center officers; (8) multiple quality control mechanisms, including periodic spot-check surveys; (9) presentations of health information at the provincial and district levels which became an obvious and regularly practiced way of action upon collected data; (10) introduction of computerized systems emphasizing epidemiological surveillance and service coverage at the provincial level as the main part of a pilot project within a district.

The PR15's satisfaction profile showed relatively high scores for provincial health officers and community hospital directors and low scores for district and subdistricts health officers. Utility Enhancements and Output Quality were rated relatively high while Input Procedures appeared as the least satisfying component.

(5) PR4 was considered a conventional system in which the following features were found: (1) the institutional record system emphasized counts of
activities; (2) less evidence of accountable data gathering and processing which would have help ensure accurate denominator figures (target population); (3) reliance on interpersonal information flow which was mediated by the dominant roles of supervisors; (4) stringent "top-down" mechanistic organization with trivial roles of staff personnel; (5) quality control emphasizing minimal calculation error rather than factual data; (6) Occasional survey augmenting information needs; (7) embryonic automation, albeit an emphasis on epidemiological application.

PR4 presented a satisfaction profile in which the community hospital directors and the subdistrict health officers expressed relatively low scores whereas the other two groups rated themselves approximately "high-moderate." Both Utility Enhancements and Output Quality showed low satisfaction scores.

(6) The study proposed that the conventional system of PR4 features were likely common to other low-scoring provincial systems. Alternately, some of the PR15's features were considered unique, namely,

"The figures were adjusted to compromise those from multiple institutional sources rather than emphasized factual data."

242
benevolent authoritative leadership, changed record structure, thorough processing of birth data, and, to a lesser extent, the epidemiological presentations. The other system characteristics were possibly found in the other high-scoring provinces. The study suggested that these features be explored by other researchers.

The individual and provincial findings appeared supporting and complementary of one another. The survey indicated that young, educated users formed a well-delineated cluster of respondents who expressed a slight dissatisfaction with the systems. They showed the lowest scores on Systems Management and expressed a strong discontent with both Input Procedures and Output Quality. The case study found that young and educated provincial staff and community hospital directors were the main engine driving the system development forward in PR15. In PR4, the young and educated officers at the district level expressed a discontent with the current system and initiated changes within their jurisdictions. On the other hand, the "Lows" which were composed largely of senior, less-educated, subdistrict, district and provincial health officers considered all the components but Systems Management very dissatisfying. It was possible that they approved of long-
time stable systems. However, they rated themselves more dissatisfied with all of the other components. The case study also supported this survey finding. In PR15 veteran officers (namely district chief health officers and provincial section heads), and subdistrict health officers expressed more negative responses than others. Finally, in both provinces, provincial officers comprised the most satisfied group with the management of the systems. In PR4, provincial section heads and district chief health officers appeared as the most content with the conventional system. In PR15, provincial officers were the most content group. This again supported the characteristics of the "Highs" derived from survey responses. Thus, the two approaches provided convergent evidence which formed a foundation for further discussion.

Discussion of Findings
While the survey identified five meaningful user characteristics associated with how users viewed their provincial systems, a review of the predictive powers of the discriminant function models indicated that some other important factors were yet not included in the models. Moreover, the survey did produce pertinent provincial findings that agreed with the field findings in both direction (of

7Modified provincial systems were fewer than conventional systems.

8All the three subdistrict interviewees in PR15 were relatively young.
overall effectiveness) and patterns. This discussion will be based on the case study findings which featured much more specific information than did the survey results. However, the plausible relations between the two approaches would substantiate the soundness of the interpolation. The focus of this discussion aims at suggesting policy elements that would bring about an effective information system. Deduction will be derived from the differences between the two studied provincial systems’ characteristics, and theoretical materials.

This study proposed that the following features were essential for an effective information system:

(1) **Leadership:** Natural system theorists, in particular, maintain that leadership is a mechanism that influences the behavior of individual participants of organizations (Scott, 1987). The literature widely describes the importance of top management support for successful project implementation. McNurlin and Sprague (1989) contend that in order to play an effective role as information system manager one must be in a position high enough in the management structure. In the PR15 case, the project was initiated by the top management. The leader started the project with his authority, and later he gained
participation from his subordinates, especially from the young, educated officers. It appears likely that his leadership style was somewhere on the continuum between an authoritarian and a democratic leader. However, later studies stress the relational aspects of leadership rather than style and indicate that effective leaders usually have both favorable job-oriented and people-oriented skills (French, 1990). The PR15 leader was perceived to emphasize the jobs and induced more participation. Besides his official authority, the PR15 leader exhibited three positive qualities perceived by the followers: (1) sound knowledge; (2) skillful communication; and, (3) risk-taking decision-making that enabled the followers to get through operational obstacles. The path-goal theory suggests that effective leadership qualities include adherence to a set of goals that potential followers will see as worthwhile, and also, being perceived by followers as capable of providing a path that leads others to the achievement of such goals (House, 1971; Parker, 1989). Thus, official authority alone would be

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9White and Lippitt (1953) describe three leadership styles: authoritarian, democratic and laissez-faire.

10This is one of the most respected and the least controversial theories on leadership.
unlikely to result in successful implementation of the project.

To determine this particular leadership style might be a minor point. Style was a means rather than an end. Though one could determine accurately the leadership style, (s)he would hardly affirm that it would always be an effective means under different situations. What the PR15 leader achieved, therefore, becomes a more meaningful matter. First, the participation of the young, educated staff was evident. But the study also suggested that a less apparent but, perhaps, more critical accomplishment was that he established a new organizational purpose or value. On the very first day he declared: "Health information is the heart of public health development." He infused this statement into the organization by means of a practical precept. Everyone of the organizational participants recited the "complete-timely-accurate" motto, even a year after his departure.

Barnard (1938) contends that organizations rely on the willingness of participants to make contributions toward a common purpose. Both Barnard and Selznick (1957)

"Later leadership studies emphasized the importance of situational factors that affect leadership effectiveness. These contingency theories tried to isolate critical situational variables that help managers to lead effectively (Robbins, 1991).
stress that leaders must define the mission (purpose) of the enterprise and it becomes their responsibility to choose and to protect the mission’s distinctive value and "to create a social structure which embodies it" (Selznick, 1957). On these grounds it becomes conceivable that the cooperative behavior of organizational participants (not only the educated staff) were the result of, and formed around the new organizational value infused by the former provincial chief medical officer.

(2) Participation of Educated Officers: While the provincial staff were the leader’s closest and strongest supporters, the young physicians extended their roles considerably. Both groups became the main engines propelling the project. The PR15’s anonymous leader,\textsuperscript{12} considered that leaders in the various organizational segments must be bred as the most critical success factor. In addition to one-on-one leadership commonly described in the literature (and above), French (1990) points out that team leadership is another form. This form characterizes a team consisting of a formal leader and subordinates among whom leadership is shared. Besides emergence of new individual leaders, PR15

\textsuperscript{12}This interview was conducted in December 1990.
featured such teams at provincial and, to a lesser extent, district levels.

The breeding of "second-stage" leadership appears as a key factor in PR15's success. Secondary leaders emerged through the organizational acceptance of their potential and expertise. Thus, they became entrusted and their discharge of energy positively affected the organization. Weinberg (1986) suggests that most consistently effective technical leaders believe in innovation and empower people by the value they place on doing things in a better way. Importantly, in the PR15 case, secondary leadership lasted and sustained the mission long after the top management was changed.

(3) Instrumental Features: PR15's Ten Files assisted the field operations of health workers. Village-level health officers used them to identify for whom services should be provided. The provincial and district level monitored program implementation by coverage and comparative incidence figures. Unlike the conventional system, they led, rather than followed, the operations. In the latter case, operations could have been carried out even without
data inputs, thus, it was considered a burden rather than an instrument.

Izzo (1987) maintains that information is nonproduct and the information system is a means rather than an end by itself. He argues for a system that solves the corporate's problems and helps achieve its goals. PRI5 seemed to hinge upon this concept. They did not aim to produce information for its own sake. But health officers were prodded to achieve a "full-coverage" performance. Thus, the information system improvement policy would likely result in greater accomplishment of organizational goals and more services delivered to the target population. The policy also had negative side-effects. It created a great pressure to achieve on lower-level officers. One might argue that the project proceeded too fast and that full participation occurred predominantly at the upper levels.

(4) Quality Control: While the conventional system stressed the minimizing of calculation error, the more effective system emphasized factual data. The spot-check surveys generated an awareness among health officers that data quality had been monitored and could be validated. Furthermore, it provided a means to assess other relevant
information not captured by the reporting system, such as service utilization and health impacts. In addition, computerization appeared as a promising data processing and quality control tool. Finally, the ultimate consequence of good quality control was an increased confidence in the system. Such a confidence appeared critically essential for the organization to use its data assertively.

(5) Interinstitutional Communication: Feedback was one part of this feature. The two-way vertical flow substantiated the meaningfulness of reports. It could be seen as an adjunct to quality control mechanisms. Moreover, it could lead to appropriate, timely actions that positively affected emerging problems, such as preventing an outbreak of a disease and providing continuing care. Horizontal communication also appeared to be important to an effective system. It helped to update the data. Continual cross-checking helped reduce erroneous records (e.g. duplicates) and the tracing of critical cases (e.g., perinatal and maternal deaths) became possible. Finally, it enhanced better cooperation and understanding between and among the various units. In PR15,
radio transmission and the referral system appeared to be effective communication modes.

(6) **Other Systems:** "Other systems" include regulations and operations (systems) external but closely related to the information system. Most are those for which the information system is supposed to provide support and some are those for enhancing the information system. The more critical ones include resource allocations, transactional regulations, personnel issues, and intersectoral cooperation. The reported outbreak of dengue hemorrhagic fever in a PR4 district illustrated that even though a sensitive surveillance system was reportedly established, problems with resource allocation and delivery, and transactional regulations deterred effective and timely remedial actions.

Based on his experience in PR15, the PR15's anonymous leader stressed the necessity of improving these "other systems."

13 He related that major obstacles often arose from centrally structured regulation, and that these constraints prevented utilization of the improved data

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13 He was interviewed in November, 1990.
system to its full potential, as well as hindered the locally conducted project. He reported another concrete example where the PHO was short of per diem for local officers to visit community health volunteers and had to obtain the money from a nonformal system.

After the coverage goal is attained, a quest for quality services responsive to local needs would be impossible without a decentralized decision-making and resource allocation system. For example, if morbidity data points to a locally emerging health problem for which there is no existing responsible central unit, the province needs to find its own resources if it is to respond to the problem. The province needs to find both personnel and materials for the project "at its own expense." Under current regulations, resources are centrally earmarked and a planning cycle normally takes a few years for a provincial request to be acknowledged. These regulations restrict the feasibility of local planning and responsiveness to local problems, albeit the attainment of accurate, timely and problem-solving data. Further, in the case where a province successfully handles the problem, no central unit exists to recognize such an incidental achievement.
A way to ameliorate this organizational and regulatory slippage is decentralization at least to the provincial level. Smith et al (1988) contend that adequate decentralization of resource management and planning responsibility is a prerequisite for the local health system to play the role of mediator between local needs and national policy. Vaughan (1990) also supports a decentralization by reviewing experiences in several developed and developing countries and further suggests that a decentralization policy needs a strengthened health planning capacity and possible reorganization at the headquarters level (i.e., the MOPH itself).

Policy Recommendations

The recommendations that follow are based on the above discussion. During preliminary interview, the most discussed policy matter related to the future direction of the MOPH's health information system. Currently, innovative provinces, recognizing the inadequacies, have changed their systems even though the MOPH still maintains a centralized system structure. Thus, MOPH should facilitate positive provincial changes but, at the same time, conserve the essential coherence that constitutes the corporate system. The evidence shown by this study suggests that to effectively improve the provincial systems will require appropriate central interventions. So, instead of focusing on the operational
detail of provincial information systems, recommendations are proposed at the policy level. The following strategies for improving the effectiveness of provincial health information systems are suggested for consideration by the Ministry of Public Health (MOPH):

1. The MOPH should establish a corporate value that health information assists the management, and thus it is valued.

As in the PR15 case, the infused corporate value created a common purpose for everyone of the organizational participants. This common ideology became the pivot to which all officers held their beliefs and which guided their behavior. However, it was initiated by, and depended upon, one particular leader. If MOPH needs an improved information system, this value will need to be infused throughout the hierarchical organization. To clearly establish such a value, the MOPH’s top management must declare a commitment. Potential projects, including the periodic presentation of provincial health status information, emphases on provincial-level quality of information (such as monthly executive summaries), and data-based resource allocations should be implemented. The main point is that two-way communication channels should be set up so that MOPH top management can regularly interact with provinces on the grounds of concise and meaningful data presentations.
Corporate goals for provincial information systems should be established.

This study suggests that even at the local level, different organizational constituencies saw different pictures of the systems. To attain successful and sustainable implementation requires further commitment by critical users. Thus, the MOPH's goals should be derived from provincial contributions. A set of common goals provides a common direction, rather than detailed configuration, to which the development of provincial systems will be adhered. Corporate goals should blend together national policies and major provincial needs yet allow for local variation. MOPH's leadership should urge provinces to first establish their own goals. Provincial goals should look to the future and aim at assisting the organization solve its problems and improve its operations rather than be confined to the information system for its own sake. Thus, provinces should consider: (1) management demands; (2) operational demands; (3) community demands; and, (4) national policies and plans. Goals should be ambitious yet potentially attainable, and existing obstacles (such as current regulations, resource management) should be identified. Major common attributes of the provinces' goals then will constitute the basis of the MOPH's corporate goals. A bridge between central and provincial
needs should then be made. This mechanism will result in more committed corporate goals which point to a common direction for future provincial system improvement projects. The resulting system architecture ought to be congruent with corporate missions. Technological aspects should be secondary. Nonetheless, MOPH's leadership should facilitate provincial attempts to realize corporate and provincial goals and help reduce the identified constraints. Finally, the MOPH should provide technical and technological assistance in pursuit of these goals.

(3) Human resources should be considered a primary component of the system and thus system improvement should emphasize the development of human components.

Local health officers (or system users) are those who implement, maintain and improve the provincial systems. This study, however, shows that different user groups might perceive the system differently. Thus interventions should be customized to suit targeted personnel. Though the study identifies some predicting attributes, it appears more practical to target activities by position, based on the identified
For senior provincial and district chief health officers, status should be affirmed and their supervisory roles should remain accountable. They should be guided in the area of concise and practical interpretation of data. Young, educated staff and community hospital directors who showed dissatisfaction with system management should become more involved in planning and implementation. The PR15 case presented a good example of how their expertise could contribute to the improvement of the project. However, role conflicts between line and staff officers should be prevented. Finally, subdistrict officers who expressed a relative satisfaction with management structure, but who were strongly disappointed with other system components, should be assisted in terms of instrumental and data processing aspects of the systems.

Health officers should be encouraged to develop their knowledge and skills. Currently some provinces do not assist local officers in attaining continued education, possibly because of a fear of personnel shortages. Indeed, such shortages would be temporary and could be ameliorated by proactive health work-force planning.

Although the delineations between the three clusters were not distinct, they do provide crude estimates about the compositions of user groups from which these practical recommendations were translated into.
PR15 illustrated that educated officers could significantly induce positive changes provided they were allowed to discharge their potential and expertise. Not only the provincial level, but also the district, are in need of knowledgeable and capable officers. In fact, the case study found that district health offices were priority units and that most needed strengthening. District cooperating committees should be encouraged to work together, learn from each other and to share responsibilities. One way to move in this direction is to combine the hospital and DHO data as the district data. MOPH should provide appropriate training courses for certain kinds of special skills, such as program management, computer competency, epidemiology, demography, and research methodology. High priority should be placed on provincial and district-level personnel and the curricula should be customized to respond to the needs of specific groups as described above. Finally, MOPH should reconsider the roles and development of community health workers as part of the development of corporate goals regarding provincial information systems.
(4) Leadership should be an important criterion in the appointment of provincial chief medical officers. PR15 showed that management leadership initiated and facilitated project implementation. However, a critical and essential role of provincial leaders is that they mediate between ideology (or policy) and actual implementation, no matter whether the ideology or policy belongs to their own or the central organization. To realize national policies, PHOs need effective leaders. Thus, among other capabilities, leadership should be a major criterion for their appointment. Provincial chief medical officers ought to possess both job-oriented and people-oriented skills, as well as those of cultivating second-stage leadership within organizations. Further, they need to be soundly knowledgeable on how health data can help in dealing with health problems and have a broad perspective of technology. An alternative intervention, which might yield more immediate results, is leadership training for current provincial chief medical officers.

(5) Decentralized management should be made a reality. This study found that decentralization is likely essential to make better use of health data, as well as to effectively implement an improvement project. Centrally structured regulations prevented the uses of health data from attaining its maximum potential worth.
Decentralization at least to the provincial level enables the local data system to lead to appropriate and timely actions.

Currently, decentralization has reportedly been a concept mostly talked about but rarely transformed into concrete practice. Decentralization, especially of resource management and program planning, should be emphasized. Local planning should supplement existing central planning. Local plans should include not only operational, but also strategic elements. Not only centrally provided resources, but justifications to reallocate local resources, should also be done at the provincial level. For example, mobilization from local "earning institutions," such as general and community hospitals, to subsidized "nonearning" community-based programs should be encouraged. Strategic planning based on local data will warrant that health programs be responsive to the community's needs rather than only to fulfill central approval.

Although the existing planning mechanism which involves mainly annual budgetary appropriation has been advocated as "bottom-up" type, actual practices exhibit yet a high degree of central structuredness. The conventional planning cycle also takes two years to complete.
The central responsibility should include the standard establishment, coordination, technical support and quality control of health data.

PR15 illustrated that quality control was a major feature that led to satisfactory data accuracy and confidence in the system. It made the subunits become meticulous about their data quality. MOPH should demand that quality control mechanisms be built into all provincial systems. Periodic spot-check surveys should be conducted by MOPH, possibly in association with external organizations. Provided a system standard was attained, comparisons among subunits could become possible. By the same token, MOPH should maintain a national standard of quality for provincial figures to relate. Finally, the organizationally accepted standard and quality control will urge provinces to improve their substandard systems. However, the standard should be restricted to data accuracy and a minimal centrally needed data set that allows for peripheral flexibility. The case study illustrated that provinces are in need of technical supports. Finally, a central authority is needed to establish coordination among central agencies to alleviate redundancy at peripheral levels. The critical step that enables MOPH to effectively perform these responsibilities is to establish the technical maturity and credibility of the Health Information Center.
(7) **Provincial systems should consider the major "success" features.**

These features, described earlier, include: participatory implementation, instrumental features, interinstitutional communication, strengthening of the district coordinating committee, quality control, interface with the community, and verifiable data sources. Attention should also be paid to minimizing role conflicts among participants. Municipality data should be separated from those of rural areas. One way to accelerate the widespread improvement of provincial capabilities is to learn from the experiences of innovative provinces. MOPH should facilitate transfers of experience among more and less innovative provincial systems.

(8) **Computerization should be encouraged.**

The study found that computerization was a promising instrument that helped reduce processing error and enhanced processing efficiency. Further, data could be generated in more disaggregated forms. This facilitated the identification of problem areas, reporting, presentation, and timely and meaningful feedback. The MOPH should provide technical support as well as guidance, especially with respect to system compatibility and data integration.
Major Deficiencies of Current Systems

Though PR15 featured a more effective information system, it still incorporated certain deficiencies. The following inadequacies were restricted to community-based programs. Deficiencies in other organizational aspects were not presented. The three weaker areas below were also found in PR4 and likely were common to other provinces since they arose from existing organizational structures and long-time functions.

(1) Municipality Data. PR15 had an innovative way of handling data (especially population data) for outlaying (rural) areas but the municipality data had not yet been touched. It appeared doubtful, at this point, whether the Ten Files system would be appropriate to the municipality which is quite different in terms of social and economic characteristics.

(2) Morbidity Data. The PR15 system emphasized service coverage and epidemiological surveillance. However, epidemiological data about conditions other than the diseases under surveillance were still embedded. The case study illustrated two examples (air pollution generated by a lignite generator plant and teenage abortions - Chapter V) showing that the existing reporting system did not
present local problems unless they were among the items appearing on the centrally structured reports. Hospital (and occasional survey) morbidity data should be more considered to disclose local health problems and respective risk groups. Morbidity data should lead to strategic planning (still inapparent even in PR15).

(3) **Intersectoral Cooperation.** Cooperation among local organizations with respect to both data exchange and activities were limited. This appeared due to the organizational structure of each organization. Currently, first-priority cooperation should be among the general hospital, the provincial health office, and the MOI municipality.

**Methodological Problems and Future Study**

The literature review suggests that this study applied, for the first time, the measure of user satisfaction survey and organizational analysis (through field study) to examine health information systems in Thailand. The researcher experienced some major methodological problems as follows:

(1) **Selection Biases:** The selection of information system users was based on the positions which the preliminary interview indicated and were closely involved with the process and outputs of the
information systems. Therefore, though they expectedly reflected the systems' functioning from firsthand perspectives, they would unlikely represent the views of general system users. At the same time, due to the fact that the selected positions included decision-makers and immediate operators, their opinions and behaviors should have a greater influence on the systems than the rest of the users. Another kind of selection bias was that only certain portions of the organizations were assessed. The case study emphasized the data systems managed only by officers handling the four community-based programs.

(2) Subject Behavior: Pedhazur and Schmelkin (1991) point out that not only does the subject's background (e.g., gender, race, education, experience, personality, attitudes towards scientific inquiry, motivation, anxiety), affect his or her perception of the study and his or her role in it, but so do a myriad of other factors associated with the setting and the researcher (e.g., whether a treatment is administered individually or in a group; the status, personality, and behavior of the researcher; the instructions; the nature of the task). The survey
was administered top-down via MOPH's hierarchical authority in order to boost anticipated low response rates. The perceived authority inevitably influenced the thinking of respondents. The researcher tried to minimize the effect with certain trade-offs, such as dropping participant identification from the questionnaires and addressing sensitive issues with indirect questions. The survey assumed that questionnaire administration would be comparable across the provinces and levels but this might not have happened in all circumstances. Further, the study setting was within a government organization so respondents might possess a tendency to respond as if they were good officers. Expectedly, some would also be inclined to become "apprehensive subjects" (Rosenberg 1969). Finally, cultural practices played a constraining role in conducting the interviews. It was not possible to ask identical questions to senior and young interviewees. For example, the researcher had to discard the data interpretation test when interviewing senior top administrators. Research findings both of the survey and, presumably to a greater extent in the case study, incorporated these subject-related artifacts.
(3) **Instruments:** Several weaknesses were found in the instruments, especially the questionnaires. The three equivalent sets provided more specific questions as to contexts but a trade-off was the imperfect comparability. A single pretest appeared inadequate, resulting in a number of ambiguous wordings. Satisfaction domains were considered too broad. Some were of minor concern, albeit verified by experts and practitioners, whereas others were considered critical, but all of the items were equally weighted. The broadness of the domains made the questionnaire lengthy. To keep it practical, only a few sensitive items were assessed with multiple questions. This resulted in disputable reliability of the instruments.

This dissertation proposes that user satisfaction assessment is a sensible and practical method for future research provided that the methodological flaws described above be corrected. MOPH may periodically use the viewpoints of users at large in evaluating the system in addition to other measures of quality control. In-depth case studies will provide more meaningful findings to comprehend specific systems.
This dissertation proposes several potential determinants of system effectiveness, namely; leadership, participation, instrumentality, extent of communication, quality control, automation, and decentralized management. Automation, municipality data, and existing databases will be issues urgently in need of research support. Another of interesting areas to focus on is the role of health data in strategic planning. Future studies ought also to consider other specific features of the organization beyond community-based programs, such as, resource management, hospital data requirements, intersectoral cooperation, and human resource development.

Finally, this dissertation would like to suggest the following research hypotheses for future academic investigation:

1. Provincial leadership is associated with a high achievement of national objectives and responsiveness to local needs;
2. Higher quality outputs are associated with a greater confidence in the system, more assertive uses of data and a greater demand for management decentralization;
3. Effective systems are associated with participatory management, and participation is mandatory for effective and sustainable systems;
(4) Existing health data on health status and health services in urban (municipal) areas is not associated with respective data assessed by health surveys but the association is significant in the countryside;

(5) Higher levels of intersectoral cooperations are associated with greater systems effectiveness and higher extent of strategic planning.

Final Conclusion

This dissertation started with a preliminary situational assessment indicating that there had been concerns of inadequacies in current health information systems. Movements had taken place both at the Ministry and the peripheries. The study found that users rated themselves somewhat dissatisfied with the northern provincial systems. The study identified three distinct users groups, as well as meaningful predictors of group membership and models which yielded fair prediction powers.

Survey found that provincial system satisfaction was considered intrinsic to system management and not dependent on organizational structure and selected environmental factors. Field evaluation of two selected provincial systems converged with survey results both in direction and patterns. PR15 and PR4, the more and less effective systems respectively,
featured characteristics not included in the survey. These characteristics were considered potential determinants of system function and outcomes.

Based on the findings of the study, this dissertation proposes the following recommendations for MOPH's policy-makers as strategies for improving provincial health information systems. Major recommendations include: (1) commitment by MOPH's top management expressed as a corporate value; (2) future-oriented corporate goals derived from provincial contribution; (3) emphases on human components of the systems; (4) leadership enhancements; (5) decentralization of resource management and planning responsibilities; (6) technical maturity and credibility of the Health Information Center with quality-related roles; and, (7) appropriate technology.
APPENDIX I
CHARACTERISTICS OF NORTHERN PROVINCES

Table A.2.1
Geo-political Profiles of the 17 Northern Provinces

<table>
<thead>
<tr>
<th>PROVINCES</th>
<th>AREA Sq. km.</th>
<th>POPULATION (thousands)</th>
<th>NO. OF DISTRICTS</th>
<th>NO. OF SUBDISTRICTS</th>
<th>NO. OF VILLAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR1</td>
<td>4,531</td>
<td>554</td>
<td>8</td>
<td>82</td>
<td>664</td>
</tr>
<tr>
<td>PR2</td>
<td>7,839</td>
<td>456</td>
<td>9</td>
<td>67</td>
<td>492</td>
</tr>
<tr>
<td>PR3</td>
<td>6,730</td>
<td>301</td>
<td>7 (1)</td>
<td>65</td>
<td>519</td>
</tr>
<tr>
<td>PR4</td>
<td>6,596</td>
<td>589</td>
<td>9</td>
<td>83</td>
<td>658</td>
</tr>
<tr>
<td>PR5</td>
<td>6,539</td>
<td>491</td>
<td>7 (1)</td>
<td>65</td>
<td>497</td>
</tr>
<tr>
<td>PR6</td>
<td>16,407</td>
<td>346</td>
<td>8</td>
<td>56</td>
<td>447</td>
</tr>
<tr>
<td>PR7</td>
<td>12,681</td>
<td>170</td>
<td>5 (2)</td>
<td>42</td>
<td>353</td>
</tr>
<tr>
<td>PR8</td>
<td>11,678</td>
<td>1,028</td>
<td>12 (1)</td>
<td>112</td>
<td>1,192</td>
</tr>
<tr>
<td>PR9</td>
<td>11,472</td>
<td>441</td>
<td>8 (4)</td>
<td>88</td>
<td>728</td>
</tr>
<tr>
<td>PR10</td>
<td>10,815</td>
<td>776</td>
<td>9</td>
<td>88</td>
<td>843</td>
</tr>
<tr>
<td>PR11</td>
<td>4,506</td>
<td>415</td>
<td>5 (2)</td>
<td>49</td>
<td>456</td>
</tr>
<tr>
<td>PR12</td>
<td>9,598</td>
<td>1,081</td>
<td>12</td>
<td>121</td>
<td>1,185</td>
</tr>
<tr>
<td>PR13</td>
<td>20,107</td>
<td>1,361</td>
<td>19 (3)</td>
<td>192</td>
<td>1,629</td>
</tr>
<tr>
<td>PR14</td>
<td>6,335</td>
<td>498</td>
<td>7</td>
<td>58</td>
<td>637</td>
</tr>
<tr>
<td>PR15</td>
<td>12,534</td>
<td>764</td>
<td>12 (1)</td>
<td>92</td>
<td>701</td>
</tr>
<tr>
<td>PR16</td>
<td>8,608</td>
<td>658</td>
<td>7</td>
<td>70</td>
<td>707</td>
</tr>
<tr>
<td>PR17</td>
<td>12,668</td>
<td>943</td>
<td>9 (2)</td>
<td>106</td>
<td>1,074</td>
</tr>
</tbody>
</table>

Sources: Health Statistics Division, Ministry of Public Health (1989 figures).

Notes:

* Figures were as of December 1989, except numbers of districts and subdistricts were the 1990 mid-year figures.

** The parenthesis showed the number of "mini-districts." They usually were small remote areas which were politically governed by separated public administrative units equivalent to districts. Every district had a community hospital situated but there might be none in a mini-district.
### Table A.2.2
Provincial Health Facilities

<table>
<thead>
<tr>
<th>PROVINCES</th>
<th>GENERAL HOSPITAL</th>
<th>COMMUNITY HOSPITALS</th>
<th>HEALTH CENTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90-BED</td>
<td>60-BED</td>
</tr>
<tr>
<td>PR1</td>
<td>1 (1)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>PR2</td>
<td>2 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR3</td>
<td>1 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR4</td>
<td>3 (2)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>PR5</td>
<td>5 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR6</td>
<td>2 (2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR7</td>
<td>2 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR8</td>
<td>5 (1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>PR9</td>
<td>2 (1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>PR10</td>
<td>5 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR11</td>
<td>1 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR12</td>
<td>8 (1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>PR13</td>
<td>15 (1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>PR14</td>
<td>2 (2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR15</td>
<td>5 (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PR16</td>
<td>3 (1)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PR17</td>
<td>1 (1)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Source:** Health Statistics and Rural Health Divisions, Ministry of Public Health (1989 figures).

**Note:**

* The figures were the total numbers. Numbers of provincial hospitals (or equivalent) were given in parentheses. Besides MOPH's general hospitals, ones run by other ministries as well as private hospitals could be found. However, MOPH's hospitals were normally much larger and provided more facilities. For example, PR15 had a 750-bed provincial hospital while the total number of hospital beds (excluding those of community hospitals) amounted to 990. PR4 had two MOPH's general hospitals providing 475-bed facilities. The two situated in two communities about 25 kilometers apart. The only private hospital in PR4 housed 8 beds. The regional average size of a private hospital was 50 beds.
APPENDIX II

QUESTIONNAIRES

Acknowledgement to respondents

This questionnaire attempts to collect the opinions of health officers at the provincial, district, and subdistrict levels on the health data system that the respondents work with in their daily operations. These opinions of administrators, implementers and other associates will be essential for understanding the strong and weak points of provincial data systems. The study results will be presented to central policy-makers.

The presentation of the findings will be as aggregated figures and perspectives, not individual responses. This study will neither positively nor negatively affect the respondents but will be of great value to the improvement of your health data systems.

Instruction for Completing the Questionnaire

(1) Please answer immediately upon receipt of the questionnaire;
(2) It will take you approximately 15 to 20 minutes to complete;
(3) You do not have to write your name on the questionnaire, but please answer the questions by yourself;
(4) Almost all questions contain multiple choices for which you are to mark a cross (X), but a few require filling in the blank space;
(5) Please read each question thoroughly and choose your best choice;
(6) When you finish you may enclose the questionnaire in an envelope;
(7) Return your response to the person who gave it to you on the first occasion (otherwise you might forget it).

THANK YOU.
QUESTIONNAIRE
YOUR OPINIONS ON THE IMPLEMENTATION
OF THE PROVINCIAL HEALTH DATA SYSTEM

SECTION 1
Please give us some information about yourself. (Your information will be available only for this study.)

1. Your present position is:
   ( ) A provincial chief medical officer
   ( ) A deputy
   ( ) A section head
   ( ) A data processing officer or a computer operator

2. You have assumed this particular position in this province, as well as in other provinces, for ...... years.

3. Your age is ...... .

4. You are .... . ( ) male ( ) female.

5. How developed is this province in your estimation?
   ( ) Developed ( ) Somewhat developed
   ( ) Somewhat undeveloped ( ) Undeveloped
   ( ) Very undeveloped

6. Your education is (possibly more than one choice chosen)
   ( ) M.D. ( ) Bachelor
   ( ) Master ( ) Medical Specialty
   ( ) Certificate ( ) Others .............

7. During the past three years, did you attend some training on health information?
   ( ) Yes ( ) No

8. During the past three years, did you attend other trainings, even though not specific to but closely related to the area of health information?
   ( ) Yes ( ) No

16Four forms of questionnaires, "A," "B," "C" and "D", were used in the survey for provincial health officers, community hospital directors, district chief health officers, and subdistrict chief health officers, respectively. All forms contained the same content as presented below. However, there is a slight difference with respect to the context. A few specific questions were also included in each form as shown following Section One.
9. Estimate that the total training time amounted to in questions nos. 7 and 8 to be about .......
   ( ) Fewer than 7 days   ( ) 7 to 14 days
   ( ) 15 to 20 days       ( ) 21 to 30 days
   ( ) More than 30 days   ( ) No training

Questions specified for Form A (provincial health officers).
1. How many computers are installed in this provincial health office?
   _______ machines with hard drives; and
   _______ machines with only floppy drives.

Questions specified for Form B (community Hospital Directors).
1. How long have you been the community hospital director?
   _______ years.
2. What size is this hospital? _______ beds.
3. Do you have any personnel specializing in data processing and/or computers?
   ( ) Yes, _______ persons. ( ) No.
4. Do you have any computer installed in the hospital, and how many?
   ( ) Yes, _______ machines with hard drives;
   _______ machines with only floppy drives.
   ( ) No.

Questions specified for Form C (district chief health officers).
1. How many subdistricts and health centers are there in this district? ... 
2. How many personnel do you have in the office? ... 

Questions specified for Form D (subdistrict chief health officers).
1. How many health centers are there in this subdistrict? ... 
2. Is there a community hospital? ( ) Yes. ( ) No.

SECTION 2
The following questions will address the data processing you may be involved in. Please give your opinion on how much you agree with the contention in quotes.

1. "It is not difficult for a practitioner to understand the data processing mechanism."
   ( ) Strongly agree   ( ) Agree somewhat
   ( ) Somewhat disagree ( ) Strongly disagree
   [Note: The same set of choices are applied to other questions, lest given otherwise.]
2. "The content of the monthly report is hard to understand."
3. "At present, we still don't have succinct, readable, current documentation and instructions for report processing."
4. "Persons who did not attend any of the past trainings can process the data as well as those who underwent the training."
5. "Supervision by MOPH usually helps correct problems of the data system."
6. "Reporting forms and/or computer applications nowadays are easy to use and present little chance of making a mistake."
7. "The technical competency of data processing staff in this province is inadequate."

SECTION 3
The following questions describe operations of the data system. Please indicate the extent of your agreement with the quoted phrases.

1. "It is hard to tell what figures on a report are erroneous if they do not appear fully distinct, and the correction is usually chaotic."
2. Does this unit establish a fixed schedule for processing and submitting reports? ( ) Yes. ( ) No.
3. "Oftentimes it is hard to ensure that reporting meets the schedule."
4. "It is common to see data processing staff assist, give advice to, and cooperate with personnel of this unit."
5. "Unless one is a high-level administrator, it is hard to get data from the PHO."
6. "Anyone can come to see data available at this unit."
7. "To improve the provincial health information system, the provincial top-administration provides adequate resources and support related activities."
8. "Opinions of officers at your level have influence on the improvement of the provincial health information system."
9. "Overall, I have a good confidence in the provincial health reporting process with respect to its management, implementation and technical aspects."

SECTION 4
In the following questions, you will be asked about the contents of current reports and record keeping.

1. It is possible that local characteristics affect the collection and processing of population figures. What do you believe with respect to the accuracy of data in the following jurisdictions?
   1.1 Municipality (district center or subdistrict center).
       ( ) Accurate ( ) Somewhat accurate
       ( ) Somewhat inaccurate ( ) Inaccurate

   1.2 The most remote jurisdiction.

   1.3 The jurisdiction nearest to yours.
[Note: 1.2 and 1.3 are provided the same set of choices. The "jurisdiction" is specified to match the level of the respective set of questionnaires.]

2. "Figures collected by health officers, village health volunteers and from the Ministry of Interior's local records do not match acceptably."

3. "Data quality over the past three years has been, by and large, unchanged."

4. "Several data items which I need are not available on the current report."

5. "I can use data included in the monthly report for applications at my level."

6. "Though many things are recorded on the monthly report, it does not provide adequate information about really significant events."

7. "The time, labor force, and expense used for data processing could have been more beneficial to the community, had they been used for something else."

8. "The content of the job does not depend on the data."

9. "A spot-check survey will show the result that institutional population data agree with the actual counting of residents within this area."

**SECTION 5**

This section will address the appearance of existing forms and your handling of them. Please express your opinions about the forms you work on periodically.

1. "Existing forms are complicated to process."

2. "Much can be done to improve forms to enhance their use."

3. "The quantity of data items nowadays is not more than necessary."

4. "Reports could become more meaningful if the sequence of items is changed."

5. "Wording, vocabulary and phrases on the current reports are hard to understand."

6. "To add graphs to the existing report would augment its meaningfulness."

7. "At the present time, redundancy of forms is not a major problem at this level."

8. In the case that this province has been using or testing new forms for an expected replacement of the Ministry's existing forms, how much do you like the provincial forms?

   () Very positive   () Somewhat positive

   () Somewhat negative () Very negative

   () No provincial forms used

**SECTION 6 (THE LAST SECTION)**

Thank you for your enthusiastic completion of the previous five sections. This is the last one. It will ask your opinion on the utility of the current health information system with
respect to your task-related roles. It will also address your
decisional position to which your work relates.

1. "If a significant event takes place, I will normally be
acknowledged before it appears on the report."
2. "All data items are equally important."
3. "It is perplexing to identify which data items are
exceptionally important to the task."
4. "Just looking at the report, one can figure out problems
in the various jurisdictions without visiting the field."
5. "Solutions to local health problems normally come from
other means than looking up the report."
6. "Using figures as they appear on present reports to
identify target groups is not reasonable."
7. Currently, do you use some unofficial forms for use only
in your office? ( ) Yes. ( ) No.
8. "Provincial forms are not appropriate for use in your
locality."
9. "Your invented forms do not include new data items but
help your operations."
10. How do you operate with respect to the following
situations:
   10.1 Use the office budget;
       ( ) By your authority;
       ( ) By recommending to your superior and usually
(s)he agrees;
       ( ) By recommending to your superior but with
varied results;
       ( ) Not applicable.
10.2 Substitute responsibilities of subordinates;
10.3 Adjust operational plans;
10.4 Implement a special project with your unit's
resources.
[Note: The same set of choices is provided for each of
the four situations above.]
11. How much do you consider the authority you possess
relative to your responsibility?
   ( ) Much       ( ) Somewhat much
   ( ) Somewhat little ( ) Little.

Open space for other opinions and recommendations for
improving the provincial health information system (below).
APPENDIX III
OUTLINE OF INTERVIEW QUESTIONS
AND DISCUSSION IN CASE STUDY

The field study started with an interview of a deputy provincial chief health officer, head of planning section, and principal data processing staff about existing mechanisms of the provincial reporting system, as well as unique processes emerging over the past three years. These became basic subjects for discussion.

1. Would you rate how much you feel satisfied with the current provincial reporting system?
   [Each interviewee was provided with a rating sheet. Items to be rated included: ease of processing, factual data, timeliness, effects on job, cooperation of involved officers, and management support.]
   The respondent was asked to describe extreme-scored (highest satisfied and lowest satisfied) items.

2. Would you rate how much you feel dissatisfied with the current provincial reporting system?
   [A rating sheet was provided. Items to be rated included: redundancy, extent of detailed data, lack of needed data, data credibility, time-consuming procedures, incapability of providing alternatives to correct existing health problems, untimeliness, lack of data analysts, ineffective related functional mechanisms, lack of knowledge for using data.]
   Extreme-scored items were discussed.

3. What are your sources of data? From whom do you primarily acquire information?
   [List of personnel of different positions, from which data could be acquired, was given to be rated.]

4. What is your opinion about the population figures which you use? How do you obtain target group figures. How does each of the different figures affect you? How do you handle discrepancies between existing figures? What do you suggest in regards to population data, which might alleviate current problems?

5. This province has implemented certain activities with respect to the reporting system (such as epidemiological data presentation, spot-check survey, referral communication, supervision, interaction with village health volunteers, computerization). What is your role for these activities? What do you suggest to improve their implementation?
6. Would you give some comments on a report?
[A one-page report, containing a table, was presented. Items in the table included: location, infant mortality and perinatal death rates. The respondent was expected to give an interpretation and discuss implication.]

7. What do you consider as "success factors" for making up a successful system, that is, a system which you consider would be successful?
APPENDIX IV

SIMPLIFIED TEMPLATES
OF PR15'S FILE NOS. 1 AND 7
THE VILLAGE FILE NO. 7
Pregnant Women and Women after their Deliveries

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<th>No.</th>
<th>CARD NO.</th>
<th>FIVE-LAST NAME</th>
<th>ADDRESS</th>
<th>AGE</th>
<th>PRE-EMPLOY</th>
<th>MAN/EUR</th>
<th>ABORT-YES/NO</th>
<th>STILL-BIRTH-YEAR</th>
<th>HOSPITAL-PERIODE</th>
<th>LAST-M</th>
<th>EVAP-MONTHS</th>
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