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Strategy for Development of

Information Technology in Agricultural Research (ITAR)

August 1999

The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development

in cooperation with

isnar International Service for National Agricultural Research

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TABLE OF CONTENTS

1. INTRODUCTION 1

1.1 THE NATIONAL COMMITMENT TO IM/IT 1
1.2 PCARRD LEADERSHIP IN IM/IT 2
1.3 THE PCARRD REQUEST TO ISNAR 2

2. THE STRATEGY DEVELOPMENT PROCESS 3

2.1 TEAM MEMBERS 3
2.2 VISITS TO RESEARCH ORGANIZATIONS 3
2.3 VISITS TO IM/IT SPECIALISTS 3

3. BACKGROUND 4

3.1 A COMPLEX ORGANIZATIONAL ENVIRONMENT 4
3.2 MINIMAL SPREAD OF NEW IT OUTSIDE METROPOLITAN AREAS 5
3.3 MISUNDERSTANDING OF IT DEVELOPMENT ISSUES AND POTENTIALS 5
3.3.1 that IT development will be "free" 5
3.3.2 that new IT will "manage itself" 5
3.3.3 that new IT will be a "quick fix" for management and scientific problems 6
3.4 THE CURRENT IM/IT SITUATION IN PCARRD 6
3.4.1 Process 6
3.4.2 Hardware 7
3.4.3 Software 7

4. SOFTWARE POLICY 8

4.1 OFFICE APPLICATIONS 8
4.2 MANAGEMENT APPLICATIONS 9
4.2.1 Financial Resources 9
4.2.2 Human Resources 10
4.2.3 Physical Resources 11
4.2.4 Student Records 11
4.2.5 Correspondence Logging 11
4.2.6 Links Between Management Applications 12
4.3 RESEARCH APPLICATIONS 12
4.4 LIBRARY APPLICATIONS 12
4.5 A NOTE ON LOCAL PROGRAMMING 13
4.6 THE POTENTIAL FOR "KILLER APPS" 14

5. HARDWARE POLICY 16

6. NETWORK DEVELOPMENT POLICY 17

6.1 THREE LEVELS 17
6.1.1 Inside the Campus (LAN) 17
6.1.2 Between the Campus and Manila (WAN) 17
6.1.3 Between the Campus and the World (Internet) 17
6.2 SITE PLANNING 18
6.2.1 IT: Hardware/Software 18
6.2.2 Local Area Network(s) 19
6.3 IT: TELECOMS OPTIONS 19
6.3.1 Many ISPs 19
6.3.2 One ISP 20
6.3.3 An Independent Network 20

7. HUMAN RESOURCES FOR IM/IT 21

7.1 ATTITUDES AND BEHAVIORS 21
7.1.1 Openness 21
7.1.2 Awarenes 21
7.1.3 Skills 21
7.2 TRAINING ACTIONS 22
7.2.1 Awareness Training For Senior Managers 22
7.2.2 Skills Training for IT Specialists 24
7.2.3 Applications Training for Scientists 25
7.2.4 Certificates and rewards 25
7.3 RELATIONSHIP BETWEEN TRAINING AND TECHNOLOGY 26
7.4 TRAINING MANAGEMENT 26

8. THE ROLE OF PCARRD 27

8.1 MANDATE 27
8.1.1 Advice 27
8.1.2 Support 27
8.1.3 Training 28
8.2 PRIORITIES 28
8.3 ACTIVITIES 28
8.3.1 RDMIS 28
8.3.2 RETRES 29
8.3.3 Service 29

9. PCARRD IT CHOICES 30

9.1 A CHANGE OF DIRECTION 30
9.1.1 No More "Big Iron" Machines 30
9.1.2 No More "Proprietary Software" Solutions 31
9.2 A COMMITMENT TO SUSTAINABILITY 31
9.2.1 Hardware Replacement 31
9.2.2 Software Licensing 31
9.2.3 Career Planning For IT Professionals 32
9.3 PARTICIPATORY PLANNING 32

10. WHAT TO DO NEXT? 33

10.1 MISD REVIEW 33
10.1.1 Draft TOR 33
10.1.2 Personnel 33
10.1.3 Timing and Resources Required 33
10.2 NEW TASK CENTERS WITHIN PCARRD 34
10.2.1 PC and Software Support 34
10.2.2 Network Management 34
10.2.3 IM/IT Training 34
10.3 SITE PLANNING 34
10.4 A "DEMONSTRATION SITE" (DS) PROGRAM 34

11. HOW MUCH WILL IT ALL COST? 36

12. SUMMARY: PRIORITIES AND ACTIONS 38

13. ACRONYMS 39

14. INDEX 40

1. Introduction

1.1 The National Commitment to IM/IT[1]

The National Agriculture and Resources Research and Development Network (NARRDN) in the Philippines is one of the largest in Asia. It consists of more than 175 organizations[2] and more than 4800 graduate-level scientists,[3] spread out over more than 7100 islands in a country extending more than 1800 kilometers from north to south. A major management challenge for the NARRDN in the remainder of the 1990s will be to mold its vast and dispersed resources into an even more efficient whole.

One of the most effective tools for doing so can be improved information. President Ramos has identified the accelerated introduction of new information technology as a top national priority. In 1994, he included the following policy statement in his address to the Philippine Telecommunications Summit:

> "The telecommunications industry is one of those foundations on which our economic launching pad rests. Without it, we are doomed to insularity and stagnation... My administration, therefore, has committed itself to support the growth of the telecommunications industry to unite our country and people closer together—and then bring the Philippines on-line with the rest of the world... We cannot put development on hold."[4]

But he has also recognized that information technology by itself is not enough.

> "Many terms have been used to describe the closing years of the 20th century. It has been called the information age, the computer age, the cybernetic age. All these terms refer to products and processes—that is, to information and to the way it is gathered and delivered to users. But what this obsession with information sometimes obscures is the fact that information by itself is meaningless until and unless it is transformed...Knowledge must be useful—but to be truly useful, knowledge must be shared. This, by itself, has become a discipline that governments and civil servants all over the world are having to learn quickly."[5]

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1 Information Management / Information Technology.

2 Gapasin, Dely P., *Decentralizing Agricultural Research Management: The Case of the Regional Consortia in the Philippines*, The Hague, ISNAR (The International Service for National Agricultural Research), 1990, p.17.

3 Pardey, Philip G. and Johannes Roseboom report the presence of 2438 FTE (full-time equivalent) researchers in 1985. *ISNAR Agricultural Research Indicator Series*, Cambridge, Cambridge University Press, 1989, p.360. Dely P. Gapasin indicates a higher number of actual research personnel in place for the same year. Her figures are 553 PhDs, 1564 MScs, and 2780 BScs. Personal communication, February 1988.

4 Closing Address of H.E. President Fidel V. Ramos, Philippine Telecommunications Summit '94, Shangri-La Hotel, Makati City, November 23, 1994—http://is.eunet.ch/astarte/pbo/bbs/agenda/7-body.html

5 Launching of Andersen Consulting's Global Knowledge Network for the Government Industry, Shangri-La Hotel, Makati City, June 7, 1995—http://is.eunet.ch/astarte/pbo/bbs/agenda/6-body.html

1.2 PCARRD[6] Leadership in IM/IT

PCARRD has a long and significant history in IM. In the late 1970s, it was one of the first public organizations in Southeast Asia to recognize the importance of information as both a management and a scientific resource. Its Management Information Services Division (MISD) has been a leader in the collection, aggregation, and dissemination of agricultural research data throughout the country. Its computer operations have been much admired and commented on throughout the ASEAN region. The MISD has created several national databases on various aspects of Philippine agricultural research, and has issued numerous publications.

1.3 The PCARRD Request to ISNAR[7]

In late 1994, PCARRD asked ISNAR to assist in formulating a new strategy for IM/IT development in the NARRDN. The objective of the strategy was to provide a framework within which specific proposals and programs could later be identified, formulated, funded, and implemented. ISNAR had experience in such a task, as it had just completed a similar exercise in India in cooperation with the ICAR.[8]

The impetus for the PCARRD request came from a recognition that IM and IT are *very* rapidly changing fields. Approaches that might have been appropriate 20, 10, or even 5 years ago may no longer be so. PCARRD recognizes that it must modernize its IM/IT operations. The Executive Director of PCARRD has referred to "the clamor for the effective use of information in decision-making in agriculture and natural resources".[9] A draft "conceptual framework" for IM at PCARRD notes the following objective: "to develop and maintain information systems and databases that would improve the administrative capacity of PCARRD and the regional consortia in managing R and D".[10]

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6 The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development.

7 The International Service for National Agricultural Research. ISNAR is one of 16 centers in the Consultative Group on International Agricultural Research (CGIAR). Its mandate is to work with NARS on issues of agricultural research policy, organization, and management. Its headquarters are in The Hague, The Netherlands.

8 The Indian Council of Agricultural Research.

9 Dar, William D., "Regional Information Management for Sustainable Agri-Industrialization", message delivered during the launching of the WESVARRDEC One-Stop Information Shop, 11 May 1995, Iloilo City, quoted *in Reshaping The National Agriculture and Natural Resources R&D System*, Los Baños, PCARRD (Philippine Council for Agriculture, Forestry and Natural Resources Research and Development), 1995, p.78.

10 The Management Information Services Division (PCARRD), *A Conceptual Framework for the Information Management Program of PCARRD*, Los Baños, photocopy, no date. p.2.

2. The Strategy Development Process

2.1 Team Members

The joint PCARRD/ISNAR team that was set up to develop the strategy consisted of five persons, plus (*ex-officio*) the Director of the PCARRD MISD.[11]

* The team leader: Dr. Byron Mook[12]
* An international IT manager: Mr. Marco van den Berg[13]
* A senior agricultural scientist: Dr. Felino Lansigan[14]
* A senior manager from a regional consortium: Dr. William Medrano[15]
* A senior government official with responsibilities in IT policy: Mr. Glenn L. Sipin[16]

2.2 Visits to Research Organizations

The team began with visits to regional consortia.[17] These visits lasted two-three days each and had the following objectives:

a) To analyze existing IM in the regions.
b) To gather detail about computer and telecoms technology in place there.
c) To develop a list of management and technical issues that the NARRDN will have to face in the course of IT development.

2.3 Visits to IM/IT Specialists

Following the consortia visits, the team spent one week[18] in-and-around Manila in meetings with IT and network specialists. These meetings had two objectives.

a) To analyze the suitability of existing networks for NARRDN use.
b) To come to conclusions about the resources and timing required for a concentrated program of IM/IT development.

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11 Ms. Renelle Maligalig.

12 Senior Program Officer, ISNAR. Former Director of Information Management Services at ISNAR, and leader of the ICAR/ISNAR information strategy development team.

13 Head, Computer Services, International Center for Research on Agro-Forestry (ICRAF).

14 SARP Coordinator, International Rice Research Institute (IRRI) and Faculty Member, University of the Philippines at Los Baños (UPLB).

15 Director of Research, Isabela State University (ISU) and Consortium Coordinator, Cagayan Valley Agriculture and Resources Research and Development (CVARRD).

16 Deputy Executive Director, Philippine Council for Advanced Science and Technology Research and Development.

17 HARRDEC (Highland Agriculture and Resources Research and Development Consortium), March 4-6, 1996. CLARRDEC (Central Luzon Agriculture and Resources Research and Development Consortium), March 11-12, 1996. NOMCARRD (Northern Mindanao Consortium for Agriculture and Resources Research and Development), March 14-16, 1996.

18 March 18-22, 1996.

3. Background

The team quickly became aware of four features of the NARRDN which will affect both the IM/IT strategy and prospects for implementing it. In the order presented below, these four are: a complex organization environment; the minimal spread of new IT outside metropolitan areas; a widespread misunderstanding of IT development issues and potentials; and PCARRD moves toward decentralization of its own IM/IT operations.

3.1 A Complex Organizational Environment

The lead public agency for the development of IT in the Philippines is the Department of Science and Technology (DOST). By Executive Order,[19] DOST is charged with providing "central direction, leadership and coordination of (national) scientific and technological efforts" and with formulating and implementing "policies, plans, programs and projects for the development of science and technology".[20]

As regards agricultural research, PCARRD operates as a Sectoral Planning Council under DOST. It is responsible "for formulating policies, plans, programs, projects and strategies for S&T development; for programming and allocating funds; for monitoring of research and development projects; and for generating external funds" in agricultural research.[21] Two PCARRD programs are most important in the context of IM/IT development.[22]

a) Establishment and management of a national network of centers of excellence for the various research and development programs in crops, livestock, forestry, farm resources and systems, and socioeconomic research.
b) Establishment of a repository for research information in crops, livestock, forestry and farm resources and systems, and socio-economics.

The complexity of agricultural research management in the Philippines arises because neither DOST nor PCARRD has line authority over most of the organizations that actually do research. Instead, that responsibility lies with numerous other government departments, agencies, and universities. Research institutes and organizations located outside Manila report to their parent departments on matters of personnel, finance, and facilities. Coordination occurs at the national level through PCARRD and/or through the Bureau of Agricultural Research (Department of Agriculture), and/or at the regional level through 14 research and development consortia.

The number of organizations involved is large. In 1986, the NARRDN consisted of 108 agencies.[23] By 1989, this number had grown to 181.[24] Or, using another basis for calculation, it had been 289 in 1988 including agricultural colleges and universities.[25]

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19 No. 128.

20 Mandate (April 24, 1996) - http://www.dost.gov.ph/DOST/Mandate.html

21 Organizational Structure (April 24, 1996) - http://www.dost.gov.ph/DOST/Organization.html

22 Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (April 24, 1996) - http://www.dost.gov.ph/DOST/PCARRD/PCARRD.html

23 Gapasin, D.P., and C.A. Magboo, "The National Research and Development Network", in *Information Bulletin 13*, PCARRD, Los Baños, 1986, cited in Dely P. Gapasin, *Decentralizing Agricultural Research Management: The Case of the Regional Consortia in the Philippines*, The Hague, ISNAR (The International Service for National Agricultural Research), 1990, p.5.

24 Gapasin, D.P., and M.V. Lorica, "The Regional Research and Development Consortia in Agriculture, Forestry, Fisheries and Natural Resources", in *Information Bulletin 18*, PCARRD, Los Baños, 1989, cited in Dely P. Gapasin, *Decentralizing Agricultural Research Management: The Case of the Regional Consortia in the Philippines*, The Hague, ISNAR (The International Service for National Agricultural Research), 1990, p.17.

3.2 Minimal Spread of New IT Outside Metropolitan Areas

The major non-commercial Internet Service Provider (ISP) in the Philippines is PHnet.[26] It was established three years ago under the auspices of DOST and today has approximately 50 members. Most are organizations involved in education, research, and development. Preferred members (c.10) are connected to a port in a PHnet main router in Manila via 64 kpbs leased lines. Associate members can get connected by using either slower leased lines or dial-up connections via the nodes of preferred members.[27] Several public organizations have provided funds to PHnet in exchange for multi-year connectivity agreements.

At the present time, eight of the ten backbone nodes are at universities, including *all* nodes outside Manila (c.5). The result is that a regional office of a government department, or a member agency of a regional research and development consortium, or even PCARRD headquarters itself must go through a university if it wants to get connected to PHnet.

In addition to PHnet, c.40 other ISPs have opened for business. More are appearing each month, a direct result of government policy to deregulate the national telecommunications sector. All are located either in Metro Manila or in other urban areas (e.g., Cebu, Davao). The team believes that there will be considerable consolidation of these ISPs in the near future, and that existing telecom vendors will play a major role in this process. There is some indication that initial moves toward amalgamation are already taking place.

3.3 Misunderstanding of IT Development Issues and Potentials

Most research managers, scientists, and agricultural educators are not well informed about IM/IT issues. Most have not had any opportunity to learn what various IT components might cost, how they might be managed, and - most important - what benefits they might bring. Such a lack of knowledge is not surprising. Most individuals have little or no experience with personal computers, and many research organizations do not have regular telephone service. Team members repeatedly discovered four major misperceptions about the implications of the emerging "information revolution" for agricultural research.

3.3.1 THAT IT DEVELOPMENT WILL BE "FREE"

Research officials often reported that they did not have funds for significant computer or telecommunications purchases, and that they would therefore have to depend on "outside" sources. Usually they named these sources as the government, politicians (e.g., congressmen), or foreign donor organizations. The idea that a college, institute, or regional office might have to earmark a percentage of its annual budget for IM/IT was regarded as "unrealistic".

3.3.2 THAT NEW IT WILL "MANAGE ITSELF"

Most officials were quick to admit that they had not thought much about the personnel and organizational resources that they might have to allocate for IM. Once again, they hoped that

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25 Asian Development Bank, *Agricultural Research in the Asian and Pacific Region: Current Situation and Outlook*, ADB Staff Working Paper, Manila, Asian Development Bank, 1988, cited in William D. Dar, *System Support and Funding of Agricultural Research and Its Impact on Scientific Growth and Development of Agriculture in the Southeast Asian Region*, paper delivered at the Expert Consultation on NARS Vision Towards Future Challenges and Opportunities for Sustained and Enhanced Productivity and Food Security in the Asia-Pacific Region, Los Baños, 1994.

26 http://www.dost.gov.ph/DOST/DOSTMIS/PHNET/Phnet.html

27 http://www.dost.gov.ph/DOST/DOSTMIS/PHNET/membership.html

"outside" sources would provide funds and that the government would sanction new positions. As for the organization of IM operations within organizations, most managers said that they would welcome (and require) outside "consultants" who could tell them what they had to do.

3.3.3 THAT NEW IT WILL BE A "QUICK FIX" FOR MANAGEMENT AND SCIENTIFIC PROBLEMS

The idea that there is more to IT/IM than pushing a button has not been much discussed.

* "If we had computers, we would be able to manage our finances better".
* "If we had the Internet, we would be able to do better research".
* "If we had the Internet, we would not have to maintain our own library, because we would have immediate access to research libraries around the world".[28]

3.4 The Current IM/IT Situation in PCARRD

PCARRD began its information program in the 1970s in an era of mainframe computers. Even ten years ago, organizations that wanted to develop databases and to disseminate information from those databases had few IT choices. PCs were only just beginning to appear. Early IDRC[29] support to PCAR,[30] including the supply of a minicomputer and IM/IT expertise, were important inputs that have shaped the evolution of the entire PCARRD information program.

One word describes the approach which this program has taken to IM/IT issues. That word is "centralization". The team does not use it here in a critical sense, but rather as a simple description of a philosophy, a technical orientation, and a management style. Centralization of IM/IT operations was probably inevitable for PCARRD in the 1980s and early 1990s, though it would not be today. This preference for centralization has come about in three important ways.

3.4.1 PROCESS

Over the years, most data have been gathered and information disseminated in more-or-less the following sequence:

a) PCARRD identifies data requirements.
b) Research organizations provide these data to Los Baños.
c) PCARRD aggregates and analyzes the data.
d) PCARRD publishes reports.

The primary client for these reports has been PCARRD itself. Organizations outside Los Baños have usually had little influence on data content and report formats. Most have not been able to access directly the databases that PCARRD has created, and have therefore had

28 In fact, while several on-line catalogs are currently available over the Internet, this material is usually limited to indices and sometimes abstracts. As accessibility improves and better data become available, the trade-off is likely to be that users will be required to pay.

29 The International Development Research Center, Canada. IDRC has been a leader in supporting the development of agricultural information in Asia, Africa, and Latin America.

30 The Philippine Council for Agricultural Research (now PCARRD).

little choice but to accept the outputs that PCARRD has provided. Many have judged some of these outputs to have been considerably more useful than others.[31]

3.4.2 HARDWARE

PCARRD has built its IT infrastructure around a series of minicomputers. This configuration has had the following three general characteristics:

* An Altos or AT&T mini in the basement of the PCARRD HQ building.
* Connections to a dumb terminal throughout the building.
* No connections to users outside.

3.4.3 SOFTWARE

The use of minicomputers has made it almost essential that PCARRD get into programming. Over the years, it has had to write much of its own software and/or has had to write adaptations to existing software. There have been five major results of this orientation.

a) The software has been available for use only on the PCARRD mini(s) and connected in-house terminals.
b) Only MISD staff have been able to modify it.
c) Written documentation has been weak.
d) PCARRD has left itself vulnerable to the departure of its key programmers (e.g., to the private sector).
e) Research managers and staff outside PCARRD HQ have had no access to the in-house databases.

In 1996, PCARRD is taking important steps to change its IM/IT directions. The simple fact that it has asked ISNAR to assist in the development of an IM/IT strategy is perhaps the best evidence of such open-mindedness. It is listening to the demands of research managers and scientists throughout the NARRDN for access to both national and international information. It is rethinking its orientation toward minicomputers. It is encouraging research organizations around the country to acquire PCs. Finally, it is taking a lead in exploring national and international networking possibilities.

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31 Two recent steps toward decentralization have been the introduction of “one-stop-information-shops and the development of a regionally-oriented “agricultural research management information system”. The latter - called ARMIS - has been initiated by PCARRD with IDRC support, piloted in two consortia in 1994, and is now reported to have at least some presence in “all regions”. The Director of the PCARRD MISD evaluates its progress as follows: “This year, all regions have the information system. We are experiencing ‘delivery pains’ but little by little the regional MIS units are becoming acquainted with the technology and are showing promise in the management of their own data. . .One of the main objectives of (ARMIS) is to enable the NARRDN to participate in data collection and management so that their R&D activities are attuned to regional needs.” (Personal Communication, January 1997).

4. Software Policy

PCARRD does not have a clear policy on software. Its reasons for not having one are understandable and valid. Any central directive in favor of legal software would be difficult to enforce in an environment in which piracy continues to be rampant.

But the hidden costs of such a hands-off attitude have been high and will get higher. Some organizations have written their own basic administrative applications, but many of these programs do not run well. Others find themselves stuck with old software (e.g., Wordstar and Lotus 123-for-DOS), which should have been phased out years ago but which have by now become almost "public goods". Many managers and scientists do not know which software to use for which tasks. The team heard on several occasions that an organization had a "fully automated system" in place (e.g., for personnel, or for student records), while in fact this "system" was being implemented using Wordstar or Lotus 123-for-DOS.

The team believes that 1996 is a good time for PCARRD to change its policy on software. There are at least three strong arguments for doing so.

a) New hardware usually comes bundled with legal software of the buyer's choice. As a result, the marginal cost of setting standards and going legal at the time of widespread PC purchases will be manageable.
b) The introduction of new hardware (e.g., PCs) without standard software can lead to anarchy. If some research organizations use Word while others use Word Perfect, or if some use Excel while others use Quattro, data sharing within the NARRDN will be difficult.
c) Dependence on pirated software weakens management. Neither DOST nor PCARRD will be able to exploit fully the potentials of IT development if they cannot hold their constituent organizations to certain data standards. Standard financial reports will be impossible, for example, if DOST and PCARRD have not made it possible for organizations to acquire the software necessary to produce those reports.

PCARRD efforts to standardize and legalize software will focus on four areas: office applications, administration, research, and libraries.

4.1 Office Applications

There are three arguments for standard office software.

a) Data sharing.
b) Training and support. The introduction of new software will be *much* easier if IM/IT professionals have a limited number of packages to deal with.
c) Cost. Not only for initial purchases but also for upgrades. National organizations like DOST and PCARRD are large potential clients, well placed to make multi-year purchase-and-upgrade deals with software suppliers. The market favors the buyers.

Only six common type of programs are required.

Spreadsheet	For basic financial data at both organization and project levels.
Database	For data on human and physical resources, as well as for certain types of research data.
Word Processor	For reports and letters. This software will ideally be able to import data easily from the two programs above.
Graphics	For the creation of presentations, both written (in reports) and oral (including slides and overheads).
Virus Checker	For the protection of the PC against viruses. Eventually a network application.
Data Compression Utility	For both backup and file transfer.

4.2 Management Applications

Perhaps the most important early use of new IT will be for "management information". The following table lists the subjects usually covered by a Management Information System (left column) and the uses to which this information is usually put (top row). The words in italics in the cells are functions addressed by an MIS.

SUBJECTS FOR INFO/ USES FOR INFO	**Planning/Programming**	**Monitoring/Evaluation**
Research (Projects)	Annual Workplans	Impact Assessment
Financial Resources (Money)	Budgeting	Accounting, Auditing
Human Resources (People)	Recruitment, Career Planning	Performance Appraisal
Physical Resources (Things)	Procurement Planning	Inventory, Stock Control

4.2.1 FINANCIAL RESOURCES

The management of money is perhaps the biggest challenge facing any research manager. Governments require research organizations to be systematic in their allocation of funds (budgeting) as well as in their use of funds (accounting). Managers are usually asked to prepare annual plans and to submit annual reports of expenditure.

Much of this work is done now with pencil and paper. Even though national and regional organizations demand many data in standard formats, no one has yet been able to adapt most of these formats for computers. The result is that cross-organizational comparisons and aggregations are difficult. A manager at the consortium level cannot easily get an overview of budgets and expenditures in different agencies, and a manager at PCARRD cannot easily get an overview of the NARRDN as a whole.

Nevertheless, computerization of finance is beginning. The team found many organizations that did have at least part of their budgeting and accounting operations computerized. But the most striking characteristic of the software being used was that it had often been written by staff. Locally developed payroll programs were common.

DOST and PCARRD will make three software decisions as they try to harness new IT for financial management.

a) The selection of a standard PC-based package for use in smaller research organizations. An off-the-shelf spreadsheet program will probably be best.
b) The development of standard PC-based formats ("templates") for most common financial management tasks and reports. These templates will be created for use with the standard spreadsheet application.
c) The selection of standard packages for the most common organization-wide financial tasks. Obvious examples include payroll, general ledger, and accounts payable. The first step in this process will be the formulation of clear specifications as to what is required.[32] Only when such specifications have been agreed on will a decision be made as to whether an existing, commercially available package is suitable. If it is not, then DOST and PCARRD will commission the development of software which is custom-made for research organizations.

4.2.2 HUMAN RESOURCES

After money, people are the most important resource for the NARRDN. Yet the team found that many research organizations pay little systematic attention to the management of their human resources. It is actually the exceptional organization which plans its recruitment on a regular basis. Very few have training or career plans. The evaluation of personnel is often a formalized, bureaucratic, and not very useful process.

Good information is a prerequisite for good (human resources) management. Yet most organizations maintain only fragmentary information on their personnel. Who are these people? How many of them are there, what are they working on, what are their training needs, and what decisions regarding careers and postings will management be likely to have to make in the years ahead?

In almost all organizations that the team visited, someone had made a start on the computerization of personnel records. Many such efforts were creative, but the recurring problem was software. A database on human resources will ideally use a database program. A word processor (e.g., Wordstar for DOS) or a spreadsheet (e.g., 123 for DOS) are not likely to give the best results.

The challenges for DOST and PCARRD regarding software for human resources management are almost identical to those for financial management.

a) The selection of a standard PC-based package for use in smaller research organizations. An off-the-shelf database program will be best.
b) The development of standard PC-based templates for most common human resources management tasks and reports. These templates will be created for use with the standard database application.
c) The selection of standard packages for the most common organization-wide tasks. Obvious examples include time planning, time reporting, and reports of achievements.

For both financial and human resources management, DOST and PCARRD must be sure that software chosen can be used to prepare reports in government-approved formats.

32 These specifications will depend, in turn, on the existence of a clear "Chart of Accounts".

4.2.3 PHYSICAL RESOURCES

Labs/Land are the third leg of the three-legged resource stool. Most organizations which the team visited kept reasonably systematic records of their physical resources. Managers were usually able to say how much land they had and/or what major types of equipment were available.

But the rationale for such record-keeping is most often administrative rather than managerial. Directors say that they need good records on which to base required reports, but they also admit that records protect them against the misuse of physical resources. Most place more emphasis on inventory and stock control (see the above table) than on procurement planning.

Software to manage physical resources is generally straightforward. For most organizations, a simple database or set of databases will do. An asset management system will contain data on the acquisition of each item, its original value, its depreciated value, its location, the individual responsible for maintaining it, and specific maintenance requirements.

4.2.4 STUDENT RECORDS

The management of student records is obviously a function limited to colleges and universities. The team visited several such organizations. *All* had made at least a start on the computerization of such data, and some had useful systems up-and-running. But the dominant characteristic of the software being used was the same as that for financial resources: i.e., it had been written locally by staff.

Several programs exist which have been designed specifically for the maintenance of student records. Admittedly most of them have been developed in North America and many are expensive. But there is a strong case that DOST, PCARRD, and perhaps CHED[33] should look at them. Three conditions will have to be met for a program to receive serious consideration.

a) It will have to be flexible enough to meet national requirements.
b) Its price will have to be negotiable.
c) Its vendor will have to offer an attractive training and support package.

4.2.5 CORRESPONDENCE LOGGING

This subject is the lowest priority of the five in this section, but one for which early planning is necessary. The objective of a correspondence logging system is control. Managers want to be sure that both they and their subordinates deal with orders and requests promptly. All letters coming into the organization are to be logged, assigned for action, monitored, and all responses and other outgoing letters are also to be logged.

At least the following three conditions must be met before it makes sense for management to put much money into computerization of this function.

a) Volume of correspondence. An organization must deal with more correspondence than a single senior manager or small group of senior managers can keep track of.
b) Delegation. This senior management group must already be assigning responsibility for action on correspondence to a wide group of subordinates.
c) Structure. The organization must have a unit responsible for files and archives (to implement the correspondence logging system).

33 Commission on Higher Education.

At the present time, there are very few NARRDN organizations which meet these criteria. PCARRD is one, as are many of the state colleges and universities. But there will be more. The argument for beginning now with computerization of correspondence logging is simply one of getting a "head start". More PCs in an organization will mean more people exchanging letters (and faxes and emails), and therefore more need for conscious and deliberate IM.

The first step will be the most challenging. Managers must specify precisely what they want in and out of the correspondence log database. What fields are to be included? For each field, what data choices will be allowed? What will be the links between fields? Will some fields be dependent on others? What types of outputs will be required?

And, perhaps most important, what will be the relationship between this database and others noted in this section (i.e., information on financial resources, human resources, physical resources, and student records)?

4.2.6 LINKS BETWEEN MANAGEMENT APPLICATIONS

The last question, immediately above, is a natural transition to a theme often neglected in IM/IT strategies. The links are obvious between data on financial, human, and physical resources, even student records, and certainly the paperwork (or digital work) necessary to manage all of them together. But too often an organization designs an IM/IT system for one administrative application in isolation from systems for others.

The challenge and *opportunity* for DOST and PCARRD comes from the fact that most organizations in the NARRDN are still in the early stages of IT development. Software standards for administrative applications can still be discussed and agreed on. But the danger is that IT is developing fast and time is passing. Unless such standards are decided on quickly, the NARRDN may find itself in a situation of different organizations taking different (and perhaps incompatible) software routes.

4.3 Research Applications

The team found very few scientists making much use of PCs. Insofar as some are doing so, most of the software they use falls in the category of "office applications". They write their reports in word processors (usually Wordstar) and aggregate their data in spreadsheets (usually Lotus 123-for-DOS). Very few use databases to manage what are often large datasets on crops. soils, weather, and farmer socio-economic conditions. Only some of the bigger organizations use software specifically designed for research.

Several scientists asked for recommendations about standard statistical packages. There are several good ones on the market in use by agricultural researchers in North America and Western Europe. Just as with *all* other types of applications, PCARRD has an important role in providing recommendations to the constituent parts of the NARRDN. The starting point is that PCARRD itself needs to keep abreast with current software developments. A new unit charged with "Hardware and Software Support" could perform this function.[34]

4.4 Library Applications

The computerization of library catalogs is a prerequisite for the improved exchange of scientific information. Almost every research organization in the NARRDN has at least a

[34] Sections 8.1.1, 8.1.2, and 10.2.1.

small library, but almost none make significant use of new IT. Very few have more than one-two PCs. The only exceptions are larger libraries at some of the state colleges and universities.

The jobs to be done fall into two categories: document identification and document access. A scientist planning new research wants to be able to answer the following two sets of questions *quickly*.

a) What work on the subject has already been done or is in progress? By whom, where, and when? How have the results of the work been written up: in books, articles, and/or reports? (IDENTIFICATION)
b) Where are these documents? How can I get copies of them? (ACCESS)

The tasks to be performed to answer these questions fall into five categories.

* *Procurement and storage.* Of books, journals, abstracts, reports, papers, and various types of "gray literature".
* *Indexing and cataloging.* Electronic search tools that users both inside and outside the organization can use.
* *Dissemination of tables of contents, current awareness bulletins, etc.*
* *Delivery of documents.*
* *Synthesis and review of documents on single subjects.* Bibliographies, review articles, etc.

The challenge for IM/IT professionals in answering the questions and performing the tasks is to take advantage of initiatives in progress elsewhere. For example, the College of Science Library at UP[35] is using TINLIB, a commercially available "library automation" package. Several organizations are committed to CDS-ISIS, developed by UNESCO.[36] CHED is reportedly creating a database of research completed in tertiary-level education institutions. The team also heard of plans for a "Union Catalog", a document abstracting service, and a document photocopying service.

In these early days, DOST, PCARRD, and CHED need to insist not only on computerization but also on standard software. A recurring theme in this strategy. If different libraries use different packages, they will obviously not be able to exchange information. The easiest and safest decision in 1996 is to go for CDS-ISIS for at least the smaller libraries. This software is free, it runs on simple PCs, and there is a large worldwide user community. The choice of software for use in bigger libraries and for aggregating data from smaller ones is still an open question. TINLIB is obviously one option,[37] but there are many others.

4.5 A Note on Local Programming

As noted, the team found several organizations in which local staff had attempted some of their own software programming. There are several important disadvantages to such an approach.

35 University of the Philippines.

36 An alternative to CDS-ISIS is PC-MINISIS (from IDRC, Canada). This new software is a follow-up to the MINISIS which ran on Hewlett-Packard 3000 minicomputers.

37 The team heard that the conversion of CDS-ISIS data into TINLIB format(s) was possible, but it was not able to collect details.

a) Time. While computer professionals may enjoy programming, new software almost always has bugs. The effort and patience required by both IT professionals and users to get a new application running properly is likely to be substantial.
b) Continuity. The market for IT professionals is growing in the Philippines. A young person with programming experience is quite likely to stay in the public sector only briefly, and then to move on to a better paid job in the private sector. If (s)he leaves without software bugs fully eradicated, and/or without having written full documentation, and/or without having trained follow-up support personnel, the organization will have difficulty. The team heard of several such cases.
c) Economies of scale. If each organization develops and uses unique software, there are few possibilities for savings on additional procurement (upgrades), inter-organizational training, or support.

4.6 The Potential for "Killer Apps"

This phrase is used by IT professionals to describe a software application that is so useful and powerful that it grabs an overwhelming market share. The use of the phrase in this strategy is somewhat different...

DOST, PCARRD, and CHED have the opportunity to commission, appoint and prescribe a limited number of software packages. The main reason why they should do so is standardization (as noted several times above). Although the effect will be to create at least short-term monopolies for these products in the NARRDN, the pluses far outweigh the minuses. The table on the following page shows those particular packages which the team thinks that the government might consider as "killer apps".[38]

An important assumption is that PCs throughout the NARRDN will be running either Windows 3.1, Windows 95, or Windows NT. The team makes this assumption in spite of two findings: first, that most PCs in the NARRDN are, at present, still running DOS, and second, that most such PCs are based on 8086 or 286 processors not suitable for running Graphical User Interfaces (like Windows) anyway. The logic behind the recommendation for a move to Windows is that DOS is disappearing. Windows is well on the way to becoming a world standard. Most major software developers have stopped work on their DOS-based products altogether.

38 The team believes that the basic philosophy regarding software should be: "if you can buy it, don't develop it". At the same time, it is well aware that the requirements for management information particularly may be so specific that off-the-shelf software will not be appropriate. Colleges and universities clearly have unique MIS needs. One particularly promising trial that the team heard about is a joint effort between the Institute of Computer Sciences (ICS) at UPLB and the Camarines Sur State Agricultural College (CSSAC). ICS has developed software which integrates financial, personnel, inventory, and student record information, and CSSAC is testing it.

General Category	Specific Category	Options
Office[39]	Spreadsheet	Microsoft Excel Corel Quattro Lotus 1-2-3
	Database	Microsoft Access Borland Paradox Lotus Approach
	Word Processor	Microsoft Word Corel WordPerfect Lotus WordPro
	Graphics	Microsoft Powerpoint Corel Lotus Freelance
	Virus Checking	Norton Anti-Virus McAfee Anti-Virus
	Data Compression	PKZip WinZip
Management	Payroll	???
	Accounts	???
	Personnel	(The Database Program Selected Above)
	Physical Assets	(The Database Program Selected Above)
	Student Records	???
	Correspondence	(The Database Program Selected Above)
Research	Statistics	???
Library	Small Libraries Big Libraries	CDS-ISIS TINLIB

39 DOST and PCARRD will have three choices in deciding on office applications. (1) Separate programs. One spreadsheet, one database, and one word processor, not necessarily all from the same manufacturer. (2) One "suite" of programs (including a spreadsheet, database, and word processor) from the same manufacturer. The advantage of a "suite" is that all components have the same "look and feel", are therefore easier to learn, and are designed to work together. (3) One "integrated" program (including spreadsheet, database, and word processing modules). This option is the simplest one. Instead of 3-4 programs, there is only one, and the modules are even more tightly integrated with each other than are the components of a "suite".

5. Hardware Policy

Rapid developments in software have necessitated complementary changes in hardware.[40] Windows 3.1 will not run on a PC with a 8086 processor, and only with great difficulty on a PC with a 286 processor. These machines were standards in the Philippines throughout the 1980s and early 1990s, but both are now almost out of production. Even PCs with 386 processors are now considered marginal entry-level hardware.

PCARRD obviously cannot recommend that all outdated machines be replaced overnight. But it can assist institutes, colleges, and universities to develop regular replacement schedules. Hardware acquired today will most likely have a useful life of 4-5 years. The challenge will be to agree on plans under which 20%-25% of hardware at each NARRDN site is turned over annually.

PCs purchased in 1996 will meet the following minimum standards.

Processor	**Pentium 133**
Memory (RAM)	16MB
Hard Disk Capacity	400 MB
Monitor	15", Color

40 Or, from the opposite perspective, rapid developments in hardware have made complementary changes in software possible.

6. Network Development Policy

6.1 Three Levels

Computers in the NARRDN can be interconnected on three levels: inside an institute campus (a LAN, Local Area Network), between an institute campus and Manila (a WAN, Wide Area Network), and between an institute campus and the world (the Internet, a Global Network).

6.1.1 INSIDE THE CAMPUS (LAN)

In the last 3-5 years, the cost of establishing a LAN has dropped significantly. Actual expenditure per site is mainly dependent on the cost of wiring, which in turn depends on physical layout (e.g., number of buildings and distances between them). Total expenditure can be as low as US$150 per PC in the case of some relatively compact campuses,. All major operating systems for PCs now have networking capabilities built in, as do the new PC versions of most major applications.

LANs are also becoming much easier to use. Individuals and groups spread over an entire campus can now share information immediately. The most visible immediate payoff is usually internal campus email. Another is the exchange of "management information". For example, project managers throughout the site can have instantaneous access to *current* financial information on activities for which they are responsible. They need not ask for updates, since the LAN server holds only one networked version of the relevant file. Access to sensitive files can be regulated by security rules and procedures.

The team recognizes that not all organizations will be able to set up LANs immediately. It therefore urges DOST and PCARRD to consider the establishment of a series of "Demonstration Sites" around the country, which can act as focal points for training and support. The concept of such sites is discussed below.[41]

6.1.2 BETWEEN THE CAMPUS AND MANILA (WAN)

A WAN connects LANs. The traditional means of making such connections is via telephone lines. If the volume of traffic to and from a single LAN at a single site is low, a normal phone line may be sufficient. An organization which uses its WAN connection mainly for email will usually not need more capacity, at least at the beginning.

As traffic volume increases, however, a leased phone line is much to be preferred. Leased lines are faster, have bigger capacities, and are always available. Scientists who wish to access bibliographic databases stored on computers in Los Baños or Manila will need this additional capability. Financial managers who want to receive budget data from Los Baños or Manila, and to send accounting data there, will also need it. The cost of leased lines can be expected to fall as the telecom sector is deregulated and demand increases.

6.1.3 BETWEEN THE CAMPUS AND THE WORLD (INTERNET)

A connection between a LAN and the Internet can be implemented in one of two ways.

a) By connecting the LAN directly to an Internet Service Provider (e.g., PHnet).
b) By connecting a number of LANs to a central location (e.g., a Network Operations Center, or NOC), which in turn is connected to the Internet.

41 Section 10.4.

Both options have pluses and minuses. In general, however, the team prefers option "b". One of the major benefits of this alternative is that the line connecting the LAN to the NOC can be used for *voice* as well as data. Whenever a manager or scientist wants to email or *phone* someone anywhere on the national network, (s)he can. The team believes that such an investment makes sense in both ease of use and economic terms. A leased line is always open, and since it is paid for on a monthly or quarterly basis, additional phone calls or emails do not incur incremental charges. In the Philippines, where the traditional phone service is often unreliable, such a system will bring obvious benefits.

6.2 Site Planning

Each institute, college, and university will require its own site-specific IM/IT plan. This plan will cover software and hardware,[42] in addition to local area and wide area networking. The logic behind the need for each organization in the NARRDN to have its own IM/IT plan is that each one is different on at least the following five dimensions:

* *Size (Personnel).* Number of staff and/or students.
* *Size (Physical).* Number of buildings and distance between them.
* *Existing IT Infrastructure.* PCs, software, telephones, LAN.
* *Location.* Ease of connecting to an ISP.
* *Management Commitment.* Budget and personnel available for IT development.

The team believes that such planning can be carried out in roughly the following sequence:

a) PCARRD will take the lead in developing a small number of general plans.
b) It will then indicate to each organization in the NARRDN which general plan might best be used as a basis for more specific plans.
c) And finally, it will offer support to each site during this more detailed planning process. Such support may take the form of expertise from Los Baños and/or referrals to other sources of expertise.

6.2.1 IT: HARDWARE/SOFTWARE

The team believes that the top hardware priority for most organizations is the acquisition of PCs. Without more powerful machines on more user desks, a LAN will have little to connect. The minimum processor standard for any new PC will be a Pentium 133. Insofar as older, "legacy" PCs are connected to LANs at all, they should run on nothing less than 486 processors. Such older PCs can be upgraded to use operating systems that have built-in networking.[43]

As for a standard network operating system, the best choice will be one "native" to the OSs in use on end user PCs.[44] Specifically, the team is not in favor of third-party protocols such as those used by Novell and Lantastic OSs.[45] At small sites, simple peer-to-peer networking will be sufficient while larger sites will need network servers. In both cases, the emphasis in planning and system design will be on systems which require a minimum amount of training and support.

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42 Sections 4 and 5.

43 Windows for Workgroups or Windows 95.

44 The term "native" has two general definitions. One is "from the same vendor", and the other is "which runs in non-emulation mode".

45 IPX/SPX, etc.

In addition, the team thinks that all LANs, WANs, and Internet connectivity must be based on TCP/IP.[46] An organization that uses TCP/IP will be able to develop an Intranet using the large number of application protocols available on the Internet. One of the first uses of such an Intranet is likely to be the development of an internal, local web site.

6.2.2 LOCAL AREA NETWORK(S)

Two variables will have most influence on the shape of a LAN at a particular site. First is the number of buildings at the site and second is the distance between them.

a) Single building. An organization in a single building can install a LAN easily and cheaply. The only items required are network boards in each PC and cables connecting them. In large buildings with many PCs, some additional hardware to create a network "hub" with a server may be required.
b) Multiple buildings. Most organizations in the NARRDN fall into this category. The biggest challenge for them in creating a LAN will be to balance considerations of technology, cost, and inclusiveness. The most appropriate cable technology currently available is fiber optics. It is not susceptible to electrical interference, but installation costs are higher than some other alternatives.[47] Many organizations will probably decide to install fiber optic connections between a limited number of buildings at the beginning, and to plan for further connections later as more funds become available.

6.3 IT: Telecoms Options

Analysis of telecom options begins with three facts.

a) The ISP business in the Philippines is booming.[48]
b) Most ISPs are based in metropolitan areas and have limited geographic coverage.
c) Leased (telephone) lines are expensive and sometimes hard to obtain.

6.3.1 MANY ISPS

In such a situation, the most logical policy for PCARRD might be to allow each organization in the NARRDN to make its own ISP deal. A site in Mindanao, for example, could evaluate the prices and performance of competing ISPs and make its own decision. PCARRD could help with the initial identification of local ISPs and the development of selection criteria.

Such a policy seems attractive on paper. It clearly fits with government policies on deregulation and decentralization. It might be appropriate if the only serious use of the ISP was for email. But if interactive connections (e.g., database access) are also planned, then this option is not desirable. The reason is that not all ISPs are interconnected in the Philippines. For example:

a) A research site in Mindanao wants to connect to a research site in Los Baños. The former has a contract with ISP "A", but the latter has one with ISP "B".
b) The request from Mindanao may therefore have to travel over the international line of ISP "A" to the United States, where it will be switched to the international line of ISP "B" for transmission back to Los Baños.

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46 Transport Control Protocol / Internet Protocol. TCP/IP is used on the entire Internet.

47 For example, wireless technology is developing rapidly, though it still suffers from lack of capacity (i.e., bandwidth).

48 Section 3.2.

Such a scenario is not a technical problem, *ideally*. Exotic and complicated patterns of information flow are common on the Internet. But the reality is that the international lines of most ISPs are congested, and a request traveling on the above route will be likely to have unacceptable delays or to fail completely.

6.3.2 ONE ISP

An obvious second alternative is for PCARRD to mandate that all organizations in the NARRDN connect to the same ISP. Such an option has two advantages.

a) Traffic within the Philippines will not have to be routed over potentially congested international lines.
b) PCARRD and NARRDN organizations can presumably negotiate a significant price discount, based on number of members and volume of traffic.

The disadvantage, however, is that no ISP today has the country-wide coverage which the NARRDN requires. PHnet perhaps comes closest, and the government has a commitment to it.[49] In such a situation, the team believes that DOST and PCARRD might well consider the following two options:

* To encourage PHnet to become a national ISP on its own.
* To encourage PHnet to become the leader of a group of interconnected ISPs.[50]

6.3.3 AN INDEPENDENT NETWORK

In this scenario, the NARRDN would bypass ISPs altogether and would create its own independent network. In fact, it would become its own ISP. Such a choice has obvious technical advantages, but the team believes that the costs far outweigh the benefits.

On the benefit side, such a network would function far better than any alternative, since it would carry only agricultural research traffic. On the cost side, however, it would require leased lines, equipment, and (most important) IT managerial skill. The costs of establishing and maintaining such a network would be very high.

49 Section 3.2.

50 This second option may be the most practical one, given the fact that PHnet is in the process of rethinking its role as an independent ISP. One of the options under consideration is that it should sell its international gateway, while another is that it should become more involved in connection-oriented consultancy and content-development.

7. Human Resources for IM/IT

Good IM requires people who are open, aware, and skilled. A major challenge for DOST and PCARRD in the next five years will be to ensure that such individuals assume leadership roles in IM/IT development.

7.1 Attitudes and Behaviors

7.1.1 OPENNESS

The issue here is one of sharing information. Most research organizations in the Philippines *and elsewhere* are characterized by at least moderate "cultures of secrecy". Many scientists are reluctant to announce detailed research plans, to report on data, or to disseminate preliminary findings for discussion. The root cause is usually a "publish or perish" syndrome. Scientists are justifiably worried that others may "steal" their research ideas.

Scientists often told team members that they wanted access to the Internet, for two reasons. First, they said that they wanted access to citations and articles not available in their local libraries. Second, they wanted to be able to get information about research in progress in other organizations.[51] But when pressed, *very few* said that they were keen on putting out their own designs, data, and progress reports for others to see.

This issue is related to a basic one of data standards. "Standards" here means not only IM/IT compatibility but also quality. On the one hand, unreliable or invalid data will remain unreliable/invalid no matter what IM/IT is used. But on the other hand, the presence of data which meets agreed standards may be an incentive for scientists to share. The team believes that PCARRD has an important role in developing these standards, not only for data exchange but also for data collection and analysis.

7.1.2 AWARENESS

As noted above, most managers and scientists have had little experience with IT. The primary reason has been lack of infrastructure. Most research organizations have few PCs. Those PCs that are available are often old, and software is both outdated and undocumented. The team found very few LANs and very few modems. If telephone connections existed at all, they were usually unreliable.

In such environments, it is not surprising that managers and scientists are mostly unaware of what computers and telecommunications can do. Their perceptions (and demands) are inevitably shaped by hi-tech articles in newspapers and presentations on television. The daily print and visual media are full of stories about networks and the Internet. Many researchers therefore seem to feel that they are being left behind by a revolution they do not understand.

7.1.3 SKILLS

Very few research personnel have computer or telecommunications skills. There are three reasons for this. The first is the lack of infrastructure. The second are status issues ("PCs are for secretaries"). The third is a preference for putting whatever infrastructure there is to work on administrative tasks.

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51 In 1995-96, PCARRD began a pilot program to address these two concerns. With the permission of CAB International, it copied some CABI databases from CD-ROMs to floppy disks, which it then distributed to the regional consortia. Personal Communication, January 1999.

These three reasons are inter-related and are problems in organizations *everywhere*. The team found few research organizations in which senior- or even middle-level personnel were using computers. Whatever IT existed was mainly in the hands of younger and clerical staffs. The main use was word processing, though some individuals were making attempts to computerize personnel records and/or accounts.

7.2 Training Actions

In light of the above three considerations, the *highest* priority for PCARRD in IM/IT is to take the lead in a crash program of human resources development. Without managers and scientists who are open, aware, and skilled, the injection of technology is certain to bring fewer benefits than expected. The goal is "an information culture" in Philippines agricultural research. What are the first steps?

The training component of a successful strategy will deal with each of the cells in the following table: In the rows are three distinct target groups, and in the columns are two distinct objectives. All cells are important, but the number which the team has placed in each represents a first attempt at priority-setting. A #1 is the highest priority and a #3 the lowest.

	Awareness	**Skills**
Managers	1	3
Scientists	3	2
IT Specialists	2	1

7.2.1 AWARENESS TRAINING FOR SENIOR MANAGERS

How to train senior people? There are basically two approaches. The first is to bring technology to them, and the second is to bring them to technology.

7.2.1.1 A Mobile IM/IT Show

The most innovative approach will be for PCARRD to acquire a small van, fill it with the latest IT, including an Internet connection via a portable VSAT[52] earth station, and to take it to where research is. Primary venues for such visits will be consortia, research institutes, colleges, and universities. The van will spend up to a week at each site. During this time, scientists and managers will be invited to surf the Internet, receive introductions to software packages which they can use for institutional and research management, and – most important – have as much "hands-on" time as they want. The pluses and minuses of such a "van" idea are obvious.

7.2.1.1.1 PLUSES

a) Scientists, managers, support staff, and students will be able to see that new IT actually does work *in their environments*.
b) They will be able to set their own schedules and avoid the IM/IT overload which attendance at a more formal "course" might bring.
c) They will be able to co-opt on the spot those other managers and scientists whom they might want to involve in further IM/IT development.

52 Very Small Aperture Terminal.

7.2.1.1.2 MINUSES

a) PCARRD will have to set up a small team to organize and publicize the van visits, as well as to handle organizational problems.
b) At some locations, the van-based IT might not work as well as expected. In the case of such "failures", managerial doubts and hesitations about IT development might actually increase rather than decrease.
c) The fact that a van is "on campus" might give some managers an excuse for procrastinating, or even for avoiding it altogether due to "pressing commitments".

The costs of such a project will be manageable.[53] The best approach for PCARRD will probably be to give out a contract for the van itself, for its IT contents, and for the IM/IT resource people to go with it. PCARRD personnel can then focus on management and on the planning of follow-up.

One of the biggest arguments in favor is public relations. Since the approach is innovative, PCARRD will reinforce its position as an organization which is hands-on and concerned with development at the "rice roots".

7.2.1.2 Executive Boot Camps

A more conventional approach to building IM/IT awareness among senior managers will be through *off-site* training. The problem is time commitments. Many managers already receive so many invitations to seminars and courses that they may well decide to miss one on a subject they know little about. The invitation will therefore have to be so distinctive that managers will feel that they cannot afford not to come. The relative financial costs of such training will be high, but they will be a small percentage of the absolute costs of hardware and software procurement later.

7.2.1.2.1 ESSENTIAL FEATURES

a) This training will be held in an unusual place. The best choice will probably be a resort reasonably far from Manila and Los Baños.
b) There will be few lectures. The focus will instead be "hands-on" and there will be considerable opportunity for one-to-one questions and answers.
c) Invitations will come from both DOST and PCARRD. The tone will be that this training is very important, intensive, limited to select participants,[54] and mandatory.
d) There will not be more than 8-10 participants per course.
e) The duration of each course will be 3-4 days.

The most efficient way for PCARRD to organize such events will be, again, to contract most of them out. A contracting organization will be responsible for the supply and maintenance of hardware and software (including Internet connections), as well as for provision of a lead

53 Section 11.

54 For example, college and university presidents, institute directors, heads of regional offices, and consortium coordinators.

trainer.[55] PCARRD personnel will therefore be left free to focus on training logistics and on the planning of follow-up.

7.2.2 SKILLS TRAINING FOR IT SPECIALISTS

The training for IT specialists will be more conventional. The target group will be those persons in each research organization who have day-to-day responsibility for computers, networks, and telecommunications. The objective will be to assist them in the development of skills necessary to manage new technology. The emphasis will be on (at least) the following three themes:

7.2.2.1 Planning

Good IT management depends on the existence of an IT plan, but the team found few organizations which had one. One of the most important first steps in the IT development process will be for each consortium, research institute, and college or university to develop its own.[56] Each such plan will be different. There is no single set of IT "solutions" which can apply to organizations throughout the country. Training in planning will focus on the following questions:

a) Models. What are the strengths and weaknesses of IT plans which have been developed in other organizations, both in the Philippines and outside?
b) Process. Which managers and scientists should be involved in development of an IT plan for a specific organization?
c) Coverage. What subjects should be included?
d) Interconnections. How should a plan developed in one organization fit with plans developed elsewhere?

7.2.2.2 Operations

Once hardware and software specified in the plan are in place, the challenge is management. Training for IT specialists will deal with IM operations on three levels.

a) The individual PC.
b) The local area network within the organization.
c) The wide area network connecting the organization to the outside world.

Training for IT specialists will be carried out by a combination of external agencies and PCARRD personnel. PCARRD will contribute more to some subjects than to others. It has had little experience with on-site IT planning, for example, but considerably more with the management of databases and LANs. An obvious candidate for partnership in such training will be PHnet. PHnet has already developed and is running a course for "systems administrators", which it might well be interested in broadening to include additional planning and management subjects. A third partner in delivering the training could well be one of the universities belonging to PHnet.

This training is likely to have a "rolling" format. IT specialists need to upgrade their skills constantly in a field which is changing so fast. The best approach is probably therefore a one-week introductory course, followed within six months by an intermediate course, followed

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55 Several types of organizations might be suitable as contractors. One is public sector IM/IT organizations (e.g., PHnet). Another is colleges and universities with IM/IT experience (e.g., De La Salle). Another is private sector IM/IT training organizations.

56 Section 6.2.

within another six months by an advanced-cum-refresher course. For IT specialists at smaller and less complicated sites particularly, PCARRD can supplement formal training with PC- and video-based materials.

7.2.2. User Support

Improved planning, management, and technology will make no difference if the managers and scientists for whom the IT exists are not happy. Training here will focus on three different types of user support services.

a) Getting started. How can users best be introduced to new software packages?
b) Help desk(s). Where can users turn when they have hardware or software problems?
c) Applications support. Who can assist users in moving beyond the basics of standard software?

For smaller sites in particular, an efficient approach to the organization of support can be the designation of a "Local Product Specialist". This individual may be a middle-level staff member whose main responsibilities are not in IM/IT at all. A good example can be a secretary who has become an in-house "expert" on word-processing software. "Local Product Specialists" can be rewarded both in salary terms and with attendance at special software courses.

At most larger sites, management will need to set up a formal "help desk". This function can be performed either by an internal IT specialist or it can be contracted out.[57] In future, as Internet connections become more widely used, users will be able to access considerable "help" and "support" information (as well as product "fixes") on-line.

7.2.3 APPLICATIONS TRAINING FOR SCIENTISTS

This training will be related directly to the conduct of research. The objective will be to have scientists make better use of particular types of software packages. Most such training will occur at the level of the consortium, research institute, college or university. It will usually be organized by the resident IT specialists. Four types of software are likely to receive most attention.

* *Word Processing and Spreadsheets.* (For report writing and project management).
* *Databases.* (For organization of research data).
* *Statistics packages.* (For data analysis).
* *Topic-specific applications.* (For geographic information, simulations, modeling, etc.).

7.2.4 CERTIFICATES AND REWARDS

The team believes that all the above training, whether formal or informal, on-site or off, should ideally be related to the career prospects of participants. Two strategies are important. One is to grant participants certificates on completion of their "courses", and the other is to take these certificates into account in the allocation of new posts and further opportunities. Training without rewards is not likely to be either attractive to potential participants or of the highest quality.

57 In the latter case, the logical contractor will be a company representing the software products which need to be supported.

7.3 Relationship between Training and Technology

Just as technology without people will be a waste of resources, so will people without technology. The HRD development program outlined above must be coupled with a program of technology introduction, so that people who have been trained can apply what they have learned *immediately*. A major problem with a lot of "computer training" is that people learn new skills, which they then forget immediately when they return to work environments lacking appropriate hardware and/or software.

A precondition for training, therefore, is that there be funds available for follow-up acquisition of technology. For each senior manager who attends one of the "boot camps" or who spends more than a nominal amount of time at the "mobile show", a minimum technology package must be available.

a) Hardware.[58]
b) Software. Windows 95, plus a simple integrated applications package containing word processing, spreadsheet, and database modules.[59]

But there will be strings attached. If possible, each manager who receives this package will have to agree to keep the machine in his/her own office (rather than sending it to another part of the organization) and—more important—to submit semi-annual reports for three years as to how the machine is being used. PCARRD will devise standard formats for such reports. The purpose of attaching such strings is to encourage managers to remain committed to IT use.

A similar set of preconditions and strings will exist for each IT specialist who receives formal training. Here the minimum hardware/software configuration for his/her own use will be more powerful, and additional machines may be included to provide the nucleus of a local area network (if one does not exist already). Once again, however, a critical part of the bargain will be that the trainee will be required to submit periodic progress reports. For PCARRD, these reports will become the basis for continuous monitoring of IM/IT issues throughout the NARRDN, as well as for planning for future development.

7.4 Training Management

Such a wide-ranging HRD program will have to be managed. Who will take the lead? The obvious candidate is PCARRD, though the MISD at the present time does not have either the experience or personnel to do so. The list of jobs required to be done is long and includes planning, contracting, logistical support, hardware and software procurement, follow-up, as well as participation in training itself.

An important question is whether PCARRD wants to take on such a program. If the answer is "yes", it will have to think about either adding to or recasting its MISD. Some of the options for doing so are discussed immediately below.[60]

58 Section 5.

59 Probably Microsoft WORKS FOR WINDOWS 95.

60 Section 8.

8. The Role of PCARRD

PCARRD has been a leader in IM/IT development in Asian agricultural research.[61] The challenge which it faces now is to build on its successes. The team believes that adaptation to the rapid development of IT requires that it give attention to the following three IM/IT subjects: its mandate, its priorities, and its particular portfolio of activities.

8.1 Mandate

The broad lines of change in IT over the past five years can be summarized under three main headings.

a) The dominance of PCs. Many PCs available today are more powerful than minis of 3-4 years ago. The line between PCs and minis is becoming blurred, and organizations establishing LANs are increasingly using powerful PCs as servers.
b) The explosion of telecommunications technologies. In September 1995, the Economist magazine noted that the "...death of distance as a determinant of the cost of communications will probably be the single most important economic force shaping society in the first half of the next century. It will alter, in ways that are only dimly imaginable, decisions about where people live and work; concepts of national borders...Its effects will be as pervasive as those of the discovery of electricity."[62]
c) The emergence of the Internet. Even 2-3 years ago, very few people or organizations were predicting how fast the Internet would grow. Even Microsoft missed the first wave, and is now having to put vast resources into a "catch up" effort.

How do such changes effect the PCARRD mandate in IT? In one phrase: "power to the users". The combination of more powerful PCs, more and better telecom facilities, and access to the Internet means that users will decide on their own information needs. An organization like PCARRD will no longer have a comparative advantage in collecting data, organizing them at a central place (on mini-computers), and disseminating processed information in hard copy.

What will users want from PCARRD? Not finished information "products", because they will create their own, but rather information "services".

Specifically, at least the following three types of service:

8.1.1 ADVICE

The team was often asked for recommendations on hardware, software, and telecom. Managers wanted help in making decisions about hardware procurement. Managers, scientists, and even information professionals requested suggestions about new software. Everyone asked about "getting connected" to the Internet, but few knew what their options were.

8.1.2 SUPPORT

Support. Whom to buy from and how to organize after-sales support? An entrepreneurial organization, particularly one in a position to organize volume procurement, can usually get

61 Section 1.2.

62 "The death of distance", in *The Economist*, September 30, 1995.

large discounts. For hardware, such discounts can take the forms of lower prices and/or service agreements. For software, both lower prices and guaranteed upgrades.

8.1.3 TRAINING

Training. A related issue, discussed above.[63] If well organized, training in IM/IT for managers, scientists, and IT professionals can produce large economies of scale. Obvious opportunities exist for standard courses, standard materials, and a pool of continuing trainers.

8.2 Priorities

In such an environment, the team believes that PCARRD will need to think carefully about its IM/IT priorities. The team wants to stimulate a process of internal discussion and debate, rather than to present a series of firm recommendations. In order to do so, it has formulated the following questions:

a) Should PCARRD continue to maintain all its existing databases? Who are the main users for each one? In 3-5 years, is this pattern of use likely to have changed?
b) Should PCARRD continue to develop software for these databases? What are the comparative costs of in-house "programming" vs. Buying and adapting commercially available software?
c) Should the MISD get more involved in providing IM/IT advice, support, and training to NARRDN users? If so, what might be the personnel and budgetary implications of commitment to such activities?
d) Should PCARRD attempt to prescribe hardware and software standards, with a view both to encouraging exchange of information and to making possible the national aggregation of critical data?

8.3 Activities

8.3.1 RDMIS[64]

This database is perhaps the most valuable one which PCARRD operates. It has considerable potential for becoming an important resource for DOST, for PCARRD itself, for the DA, as well as for managers at institutes, colleges, and universities. The most pressing current issue is that it is being operated on an outdated hardware platform with unnecessarily complex software. One team member who was critical of this hardware/software combination said that "PCARRD does not have such heavy-duty data requirements".

The team believes that at least the following four changes in RDMIS might be considered:

a) Software. A change to a database program that will run on PCs. Users outside Los Baños can then get outputs from the database themselves, without going through PCARRD.
b) Content. A reduction in the number and complexity of fields.
c) Inputs. A simplification of procedures. PCARRD might provide users with standard *input* templates (forms). Data could then be transferred to Los Baños either electronically or by floppy disk.

63 Section 7.

64 Research and Development Management Information System.

d) Outputs. The development of standard *report* templates, to be made available to users throughout the NARRDN.

8.3.2 RETRES[65]

The team questions whether PCARRD should continue with this database. In its present form, the emphasis on citations and abstracts is similar to what a user might expect from a more conventional library (e.g., at UPLB). As the automation of library and documentation services within the UP system progresses, the comparative advantage of PCARRD in maintaining this kind of database will become debatable.

The way forward may be for PCARRD and UPLB to agree on a division of labor regarding RETRES-type operations. The broad lines of such an agreement might be that PCARRD would have a major role in determining content, while UPLB would have a major role in managing technology. Specifically...

a) Information needs assessment (PCARRD)
b) Development of bibliographies on selected research subjects (PCARRD and UPLB)
c) Preparation of selected abstracts (PCARRD)
d) Creation of appropriate databases to manage these bibliographies and abstracts (UPLB)
e) Management and dissemination of these databases to scientists in the NARRDN (UPLB)

8.3.3 SERVICE[66]

The team envisions the MISD providing more services and fewer products. In such a scenario, it might become a kind of "IM consulting firm" within PCARRD. Its expertise would lie in providing and organizing IM/IT advice, support, and training for clients both inside the organization, and—more important—outside. Whether PCARRD can get into such service activities within existing resources is a management question. The team does believe, however, that there is some scope for the reallocation of personnel and programmatic resources within the MISD.

65 Research Information Storage and Retrieval System.

66 Sections 8.1.1, 8.1.2, and 8.1.3.

9. PCARRD IT Choices

9.1 A Change of Direction

The team has briefly described the current IM/IT situation in PCARRD.[67] As the apex organization in the NARRDN, PCARRD has traditionally had a strong orientation toward "centralization" in both hardware and software. This preference has led to the acquisition of a series of minicomputers and development of a large-scale database management system.

The most important result has been a widening IM/IT gap between PCARRD and other members of the NARRDN. Most of the latter have not been able to afford the hardware, software, or human resources which might have made them effective users of PCARRD IM/IT services. Even more critical, many seem to believe that their IM/IT futures have little to do with those of PCARRD. Leaders in these organizations talk about PCs and shared databases, neither of which have ever figured prominently in PCARRD information programs.

Fortunately, new developments will allow PCARRD to close the IM/IT gap. Instead of "centralization", it is now in a position to take the lead in developing a new culture of "distributed" information services.[68] In this scenario, organizations throughout the NARRDN will use the same hardware and software platforms, though on different scales. Research managers and scientists throughout the NARRDN will be able to communicate easily both with PCARRD and with their peers in other consortia.

9.1.1 NO MORE "BIG IRON" MACHINES

The traditional argument for minicomputers was that only they could handle the large amounts of data that PCARRD wanted to manage. PCs were not up to the job. This logic had two parts. On the one hand, large agricultural research databases needed hardware capacity which PCs lacked (e.g., memory and storage), and on the other, they required software which PCs could not handle.

But nowadays these arguments are no longer valid. New database servers have been developed that are basically big PCs. These servers are available with massive amounts of memory and storage, at prices comparable to what much more modest PCs cost only 2-3 years ago.[69] New database software to run on these servers is available off-the-shelf and bug-free, often with capacities far beyond those of specially authored software. Most important, again, these servers are based on the *same* processor technology as PCs.

This last fact is critical for PCARRD. Managers and scientists throughout the NARRDN now have the possibility of using completely compatible hardware (and software). But to get to this point, not only will NARRDN members need guidance as to what hardware to buy, but PCARRD itself will have to move to NARRDN-compatible machines.

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67 Section 3.4.

68 In 1995, PCARRD launched its first trial of "Regional R&D Information Services" (RRDIS), including "One-Stop Information Shops" (OSIS). This pilot program was extended to all regional consortia in 1996-1997. Personal Communication, January 1999.

69 The list price in the United States of Pentium Pro 200 machine, with 128MB of memory and a 9GB hard disk is now under US$8000 (including monitor, CD-ROM, and software). Street prices and discounts based on quantity purchases can make the final figure much lower.

9.1.2 NO MORE "PROPRIETARY SOFTWARE" SOLUTIONS

Such a change in direction on hardware will require a similar change on software. PCARRD will no longer be able to invest in the development of software applications that only run on minis.

In fact, the team believes that PCARRD should be cautious about *all* software development efforts, for whatever hardware platform. Most IT professionals argue that an organization usually spends more on maintaining a piece of software than on developing it. In-house applications almost always have initial bugs, and support to users is more difficult when complete documentation is not available. For PCARRD, a reasonable policy might be to put the burden of proof on the MISD. If the IT professionals in the organization feel that they *do* need to develop software for a particular purpose, the burden of proof should be on them. They should be required to demonstrate that no "off-the-shelf" application is available or suitable.

In other words: *If It's For Sale, Don't Develop It*.

However, in those few cases when development does seem the way to go, the team strongly believes that PCARRD should adopt a "product independent" strategy. The best choice is the Open DataBase Connectivity (ODBC) standard, which will allow software developers to create applications that can be run using different database management systems (DBMS). Examples might range from a multi-user system on a database server (at PCARRD itself) to a single database on a single user machine (at an institute). The major benefit of such an approach is obviously that a DBMS software product can be scaled to user needs.

9.2 A Commitment to Sustainability

The team has noted several "misunderstandings" about IT development.[70] One was that IT development would be "free" and another was that new IT would "manage itself".

The team believes that PCARRD is well placed to take a lead in the NARRDN in demonstrating how such a misunderstanding can be corrected. Three subjects are of critical importance. To address them adequately, PCARRD will need to earmark in advance a fixed percentage of its annual budget for "IM/IT development".

9.2.1 HARDWARE REPLACEMENT

Most IT professionals assume that the price/performance ratio of computers and telecom equipment doubles every 18-24 months. For planning purposes in many organizations, this assumption means a 36-48 month replacement hardware replacement cycle.

In PCARRD, the goal is not "state-of-the-art" equipment for its own sake, but rather a continuous capacity to take advantage of worldwide information resources. As leader of the NARRDN, PCARRD must not only be up-to-date but must also be percieved as such. The team found that much of the computer equipment in PCARRD was significantly more than four years old.

9.2.2 SOFTWARE LICENSING

Even on newer machines, the team found mostly outdated software. Particularly outside Los Baños, this software was not only old, it was unlicensed. The Government of the Philippines

[70] Section 3.3.

supports international agreements on "intellectual property rights". Just as in the case of hardware, therefore, PCARRD should set an example for the rest of the NARRDN.[71]

9.2.3 CAREER PLANNING FOR IT PROFESSIONALS

Good IT professionals are in short supply in the Philippines. Demand is increasing rapidly, with the result that public organizations like PCARRD can expect a continuing "brain drain" to the private sector. For PCARRD management, the challenge will be to devise policies that will reduce this attrition as much as possible.[72]

The team believes that such a policy might have two parts.

a) Career Planning. IT professionals want to know what they can expect to be doing and where they can expect to be in 5-15 years. For most of the best people, career prospects limited to the MISD in Los Baños will not be sufficiently attractive to keep them.
b) Training. Part of a career plan for each individual should include regular training opportunities. The IM/IT field is developing so rapidly that specialists need to renew their skills every 18-24 months. One of the biggest incentives offered by private sector employers is the opportunity to travel to seminars and courses, both so that staff can upgrade skills and so that they can keep in contact with their IM/IT peers in other organizations.

9.3 Participatory Planning

The major clients for PCARRD activities in IM/IT are scientists. The team met several researchers outside Los Baños who voiced frustration at the IM/IT gap noted above. Particularly younger individuals, many of whom had studied outside the Philippines, felt that they were being slowly cut off from developments in their fields because of the lack of IT capabilities.

One way in which such individuals might be "won back" is to involve them in IM/IT planning for the NARRDN as a whole. To implement such an idea, the team believes that PCARRD management might consider formation of a national IM/IT advisory panel with heavy representation of scientists and IT professionals from outside Los Baños.

71 Introduction to Section 4.

72 Section 4.5, Point b.

10. What To Do Next?

10.1 MISD Review

This first task is critical. The team believes that the MISD as it exists at present will most likely not be able to sustain PCARRD leadership in IM/IT matters for the remainder of the 1990s. A thorough review of the mandate, activities, organization, resources, and even of the name of the division is therefore in order.

Such a review need not take a long time or involve many people. In this report, the strategy team wishes to get the process started by proposing a draft TOR, to recommend types of persons who might carry out the review, and to make some initial suggestions about timing and resources required.

10.1.1 DRAFT TOR

a) To examine the mandate of the MISD.
   - Why was the MISD created?
   - Has its mission changed over time, and if so, why?

b) To evaluate MISD priorities and activities.
   - How has the division set its priorities?
   - What have been the respective roles in this priority-setting process of PCARRD management, division staff, other PCARRD staff, and information users outside Los Baños (e.g., in institutes, colleges, and universities).
   - How has the division evaluated the impact of its activities?
   - How has its portfolio of activities been modified to reflect the changing needs of users?

c) To review the organization of the MISD.
   - Do the numbers and skills of existing personnel match the jobs to be done?
   - If the mandate and activities of the division are to be modified, what organizational changes will be required?

d) To evaluate current resources (financial, personnel) of the division, and to make recommendations about changes.

e) To consider whether the name of the division should be changed to reflect current and/or future activities.

10.1.2 PERSONNEL

Two persons will be sufficient for this review. Both can come from the Philippines. One could be an IM/IT-oriented scientist (i.e., a user) and one could be an IT professional (i.e., a collaborator). The list of organizations which might provide such individuals could include UPLB, UP Diliman, ASTI,[73] and even PHnet.

10.1.3 TIMING AND RESOURCES REQUIRED

The review could be finished within one week (including writing). Most of the work could take place in Los Baños, and expenses would therefore be minimal.

[73] Advanced Science and Technology Institute.

10.2 New Task Centers within PCARRD

In this strategy, the team does not want to pre-judge the outcomes of an MISD review team. It has presented several preliminary ideas above about new directions in mandate, priorities, and activities.[74] Here the intention is to translate some of these ideas into possible organizational changes.

The team believes that three new "task centers" are needed. One of the jobs of the review team will be to recommend whether staff for such units can be found within the current MISD, and/or within PCARRD, or whether at least a few new staff might have to be hired. Under the following three headings, the team notes briefly the main functions of each of these units:

10.2.1 PC AND SOFTWARE SUPPORT

a) To evaluate different brands and configurations of hardware (particularly PCs). Output: continuing recommendations to NARRDN members regarding purchases.
b) To evaluate software in terms of suitability for tasks described above.[75] Output: continuing recommendations to NARRDN members.
c) To negotiate purchase, licensing, and support agreements with hardware and software vendors.

10.2.2 NETWORK MANAGEMENT

As immediately above, except here for network hardware and software.

10.2.3 IM/IT TRAINING

To organize a Human Resources Development program, as outlined above.[76] This task will involve at least the following sub-tasks:

a) Consideration of the "Mobile IM/IT" idea.[77]
b) Identification of sites where more conventional training courses can be held on a continuing basis.
c) Identification of trainers, both from within the NARRDN and from outside.
d) Development of training materials.

10.3 Site Planning

The *first* task of the division, following the review, will be to organize the site planning exercises described above.[78]

10.4 A "Demonstration Site" (DS) Program

The basic idea of such a program is that intensive IM/IT work be done in a small number of NARRDN organizations. Perhaps 4-6. There will be two objectives.

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74 Section 8.
75 Section 4.
76 Section 7.
77 Section 7.2.1.1.
78 Section 6.2.

a) Research and Development (R&D). DOST and PCARRD could assist each DS to acquire a significant amount of new IT. This technology would then be used to create a campus-wide LAN, to establish Internet connections, to develop a basic MIS, and to automate the library. The goal would be to find out what works and what does not.
b) Education and Training (E&T). PCARRD would expect that each DS became an IM/IT hub, with responsibility for training managers and scientists from its region (and nearby regions).

The team feels that a DS program might have several benefits for PCARRD.

a) To publicize the PCARRD commitment to development of IM/IT throughout the NARRDN.
b) To provide partners for PCARRD in PC and software support, network management, and training.
c) To provide the core of a "special project proposal" which PCARRD might prepare for submission to international funding agencies.

If PCARRD decides to move forward with a DS program, a first step will be to prepare this project proposal.

11. How Much Will It All Cost?

The activities described and proposed in this strategy fall into five categories. The team has made an estimate of costs in each category. The following figures are approximate, and are intended to provide policy-makers at DOST and PCARRD with general orders of magnitude. For each activity with which DOST and PCARRD wish to proceed, a more detailed budget must be drawn up.

Budget Summary			
Total ($)			**3,068,000**
Total (Pesos)			**79,768,000**
Management at PCARRD HQ in Los Baños–Year #1	**Units**	**Rate**	**Total ($)**
Review of the MISD			
– Honoraria	10	50	500
– Per Diems	10	50	500
Staff and Operating Costs (not included)			
– PC and Software Support Unit			
– Network and Management Unit			
– IM/IT Training Unit			
Subtotal			***1,000***
PC Acquisition & LAN Development–Years #1–2	**Units**	**Rate**	**Total ($**
PCs	400	2,000	800,000
Standard PC Software	400	500	200,000
LAN Servers	50	5,000	250,000
LAN Servers	50	1,000	50,000
Subtotal			***1,300.000***
WAN/Internet Connectivity–Annual	**Units**		
ISP Subscriptions	150	7,500	1,125,000
Subtotal			***1,125,000***
Demonstration Sites (4)–Year #1	**Units**	**Rate**	**Total ($**
Hardware			
–PCs	100	2,000	200,000
–Standard PC Software	100	500	50,000
–LAN Servers	4	5,000	20,000
–LAN Software	4	1,000	4,000
Subtotal			***274,000***
Training–First Year	**Units**	**Rate**	**Total ($**
IM/IT Van			
– Contract for Implementing Organization			50,000
– Van			40,000
–PC Hardware and Software	6	2,500	15,000
– Portable VSAT			20,000
– Operating Costs			50,000
Executive Boot Camps (6)			
– Contract for Implementing Organization			50,000
– Travel and Hotel Costs	6	12,000	72,000
– Other Operating Costs	6	2,000	12,000
Skills Training for IT Specialists (3)			
– Contract for Implementing Organization			20,000
– Course Costs	3	10,000	30,000
– Other Operating Costs	3	3,000	9,000
Applications Training for Scientists (not included)			
Subtotal			***368,000***

In addition, the team calls special attention to Section 3.3.1. Organizations in the NARRDN must be prepared to set aside fixed percentages of their annual budget for IM/IT operating expenses (e.g., maintenance of existing equipment and updating of staff expertise), as well as for IM/IT capital investment (e.g., replacement of outdated equipment).

One team member has proposed three approaches to getting the whole process started. The common feature of each approach is that DOST, PCARRD, and CHED will work together. He suggests that they...

a. Request DBM to issue a directive to NARRDN agencies that they should allocate a specific percentage of their savings and/or income for IM/IT development; and/or
b. Request DBM[79] to make regular appropriations to NARRDN agencies specifically for IM/IT development; and/or
c. Request Congressmen to make allocations from their "Countryside Development Funds" for IM/IT development in the NARRDN agencies in their districts.

79 The Department of Management and Budget.

12. Summary: Priorities and Actions

i. A PCARRD evaluation of its IM/IT program and structure
   - Mandate and Priorities—Section 8.1, Section 8.2
   - Activities—Section 8.3
   - Hardware and Software—Section 9.1, Section 9.2
   - Personnel—Section 9.2.3
   - Participatory Planning—Section 9.3
   - Structure (MISD)—Section 10.1
   - New Task Centers—Section 10.2

ii. PCARRD leadership in development of IM/IT plans at each NARRDN site
   - Section 6.2
   - Section 10.3

iii. DOST leadership in development of a group of interconnected ISPs
   - Section 6.1.3
   - Section 6.3.2

iv. An intensive program of IM/IT development at selected "Demonstration Sites"
   - Section 6.1.1
   - Section 10.4

v. PCARRD leadership in a crash program of human resources development for IM/IT
   - Section 7.2
   - Section 7.2.1—For Senior Managers
   - Section 7.2.1.1—A Mobile IM/IT Show
   - Section 7.2.1.2—Executive Boot Camps
   - Section 7.2.2—For IT Specialists
   - Section 7.2.3—For Scientists
   - Section 7.3—A commitment to follow-up training with technology acquisition

vi. Adoption of a minimum set of standard PC-based software for use throughout the NARRDN
   - Section 4, Section 4.6
   - Section 4.1—General Office Use
   - Section 4.2—Management
   - Section 4.3—Research
   - Section 4.4—Libraries

vii. PCARRD commitment to IM/IT sustainability
   - Section 9.2

13. Acronyms

ARMIS	Agricultural Research Management Information System
ASTI	Advanced Science and Technology Institute
CHED	Commission on Higher Education
CLARRDEC	Central Luzon Agriculture and Resources Research and Development Consortium
CSSAC	Camarines Sur State Agricultural College
CVARRD	Cagayan Valley Agriculture and Resources Research and Development
DOST	Department of Science and Technology
HARRDEC	Highland Agriculture and Resources Research and Development Consortium
ICAR	Indian Council of Agricultural Research
ICRAF	International Center for Research on Agro-Forestry (CGIAR)
ICS	Institute of Computer Sciences
IDR	International Development Research Center (Canada)
IRRI	International Rice Research Institute (CGIAR)
ISNAR	International Service for National Agricultural Research
ISP	Internet Service Provider
LAN	Local Area Network
MIS	Management Information System
MISD	Management Information Services Division (PCARRD)
NARRDN	National Agriculture and Resources Research and Development Network
NOMCARRD	Northern Mindanao Consortium for Agriculture and Resources Research and Development
ODBC	Open DataBase Connectivity
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
Phnet	The Network of the “Philippine Network Foundation”
RDMIS	Research and Development Management Information System
RETRES	Research Information Storage and Retrieval System
UP	University of the Philippines
UPLB	University of the Philippines at Los Baños
WAN	Wide Area Network

14. Index

A

Advanced Science and Technology Institute (ASTI) 33
Agricultural Research Management Information System (ARMIS) 7
Asian Development Bank (ADB) 5

C

Cagayan Valley Agriculture & Resources Research & Development (CVARRD) 3
Camarines Sur State Agricultural College (CSSAC) 14
Central Luzon Agriculture and Resources Research & Development (CLARRDEC) 3
Commission on Higher Education (CHED) 11, 13, 14, 37

D

Dar, William D. 2, 5
De La Salle University 24
Department of Agriculture 4

G

Gapasin, Dely P. 1, 4, 5

H

Highland Agriculture and Resources Research and Development Consortium (HARRDEC) 3

I

Indian Council of Agricultural Research (ICAR) 2, 3
Institute of Computer Sciences at UPLB (ICS) 14
International Development Research Centre (IDRC, Canada) 6, 7, 13
Internet Service Provider 5, 18, 19, 20

L

Lorica, M.V. 5

M

Magboo, C.A. 4

N

Northern Mindanao Consortium for Agriculture & Resources Research & Development (NOMCARRD) 3

P

Pardey, Philip G. 1
PHnet, The Major Non-Commercial ISP 5, 17, 20, 23, 24, 33

R

Ramos, (President) Fidel 1
Research and Development Management Information System (RDMIS) 28
Research Information Storage and Retrieval System (RETRES) 29
Roseboom, Johannes 1

T

The Economist 27
TINLIB 13, 15

U

University 33
University of the Philippines 13, 29
University of the Philippines at Los Baños 3, 14, 29, 33