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# Agricultural Libraries and Information Centres in China: Co-operation, Resource-sharing and Networking

Qiaoqiao Zhang

Vol 2.

Submitted for the degree of Doctor of Philosophy

Department of Information Science  
The City University  
London

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Agricultural Libraries and Information  
Centers in China: Co-operation,  
Resource-sharing and Networking

Q. Zhang

Volume 2

## Chapter 10

# Cost-effective-benefit Analysis—Generation of Alternatives

### 10.1 Introduction

As mentioned in Chapter Six, system alternatives can basically be grouped into three categories: manual, automated, and other technologies, such as photographic. In addition, because of the various approaches and degree that can be taken with automation, the automation alternative can be further divided into a number of options. Based on the cases reviewed and her knowledge, the author has tried to define three alternative programmes, i.e. manual, semi-computerised and computerised, and identified the means and resources needed for different programmes in the design of those network functions.

But which alternative is most cost-effective or feasible to the circumstance of the network needs a careful diagnosis. While admitted not easy to do correctly, a cost/benefit analysis can provide fundamental information on which to base a decision concerning the most cost-effective alternative for any networks. Lancaster pointed out

“.....An automated system may be judged cost-effective if it performs either at the same level of effectiveness as the manual system, but at reduced costs, or at a higher level of effectiveness at a cost comparable to that of the manual system. Unfortunately, the situation usually is not this simple. Frequently the automated system provides capacities that are almost impossible for the manual system to provide. Thus an important element in the evaluation will be some form of cost-benefit analysis involving identification of the benefits associated with the automated system. If the automated system is more expensive than manual system, the question then is whether the system benefits outweigh the costs. In the long run, the objectives of automation should be to increase the capability and/or

effectiveness of the library, and ultimately, to increase accessibility/exposure per dollar of expenditure.”(p273)

Cost-benefits analysis in this research involves cost study and benefit identification and assessment. The first section in this chapter will attempt to describe the cost analysis for four functions and second section is dedicated to the identification of benefits. Finally the information from both sources will all aid the cost benefit analysis by Analytical Hierarchy Process (AHP).

Cost analysis is the basic mode of study which provides information for other descriptive and analytical methods including cost/benefit analysis.

Unfortunately, it is difficult to compare manual and automated systems on the basis of cost alone. Although it is relatively easy to derive costs for an existing manual system, it can be rather difficult to accurately predict the costs of a projected automated system. Once the automated system is installed, however, accurate cost figures can be derived from its operation; but these cost figures may not be strictly comparable with the costs figures for the manual system, because the new system may have changed the method of operation and/or the range and scope of services offered. Thus one might be comparing the costs of two different systems, one providing greater benefits than the other. Another problem is that, once an automated system is installed, it is likely that no good cost or efficiency figures will be found for the manual system it replaced.

In this project, attempts are made to work out least total cost. The least total cost methodology consider all of the cost to network to acquire and to maintain the system over a five-to seven year period. (Matthews, 1981)

Most benefits of the four functions and benefits of computerised functions and computerised network as a whole can be identified based on the objectives they intend to achieve. Some of benefits can be quantified and some not. It is suggested that in a cost/benefit analysis, benefits needs to be quantified into money value if possible (Matthews, 1981). For those benefits which can not be quantified, qualitative analysis is required.

The cost-benefits analysis in this research, is based on AHP process. The reasons why the author does not use cost and benefit data directly from the two sources mentioned above can be stated as follows:

1. Cost data derived from the cost analysis are based on many assumptions. Without further confirmation, it is unsafe to draw any strong conclusions;
2. Cost figure may be unreliable in such a rapidly changing market and rapidly changing technologies;
3. Many benefits, especially those derived from user services, are difficult to be quantified.

AHP is a robust device which has a good tolerance of gross data and can generalise the data in alternatives. AHP can avoid or at least buffer the difficulties existed in some conventional

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

cost/benefit analysis. Claimed as a new logic for organising complexity and measuring priorities, AHP allows one to achieve a powerful economy of thought by bring all the factors together in a hierarchical decomposition of the system, with the objectives functions represented in the higher levels and structure represented in the lower levels. One uses judgements or other data to make careful quantified tradeoffs among the relevant criteria. This sets out an accurate assessment of an overall position.

In the process, we prioritise the alternatives according to their benefits and costs. To do this, we need to look at the alternatives in terms of what purpose they fulfil and how strongly and also in terms of what it would cost to bring about these alternatives. (Saaty, 1980)

Therefore, cost analysis, identification of benefits by quantification and qualitative assessment all assist in 1) setting priorities for the elements (benefits or cost elements) in each level of the hierarchy according to their impact on the criteria or objectives of the next higher-level; 2) structuring multi-person, multi-criteria, multi-time period problems with uncertainty and risk hierarchically.

The whole procedures of cost-benefit analysis can be illustrated in Figure 10.1.

When analysing cost requirement for purchase in CA, analytical resource allocation approach is used to meet four effectiveness criteria (reasonable targets). This aims at working out an overall network costs for acquisitions of stock and illustrating the usefulness of analytical solutions derived from the mathematical models. Since the actual purchase cost of network stock will remain the same between the alternative programmes, in other words, the computerisation will not affect the actual purchases of stock, therefore, the result of the cost determination for purchase will not be taken into account in the AHP process.

### 10.2 Cost Analysis for Network Functions

As it is mentioned before, cost analysis is the primary stage in assessing basic costs. Cost analysis can be carried out and its data presented in a variety of ways. As Lancaster (1977) mentioned, a complete cost analysis of a particular operation will involve:

1. The identification, perhaps by flowcharting, of all the detailed steps involved in the operation.
2. The identification of all equipment used in each step.
3. The calculation of unit costs for each step, sampled over a reasonable time period, and based on accurate production statistics, costs of staff time, and costs of equipment utilisation.

No matter from whose viewpoints, designers' or managers' or librarians', the network costs can be categorised as:

- (a) service costs or system cost

Figure 10.1: Procedures of Cost/Benefits Analysis

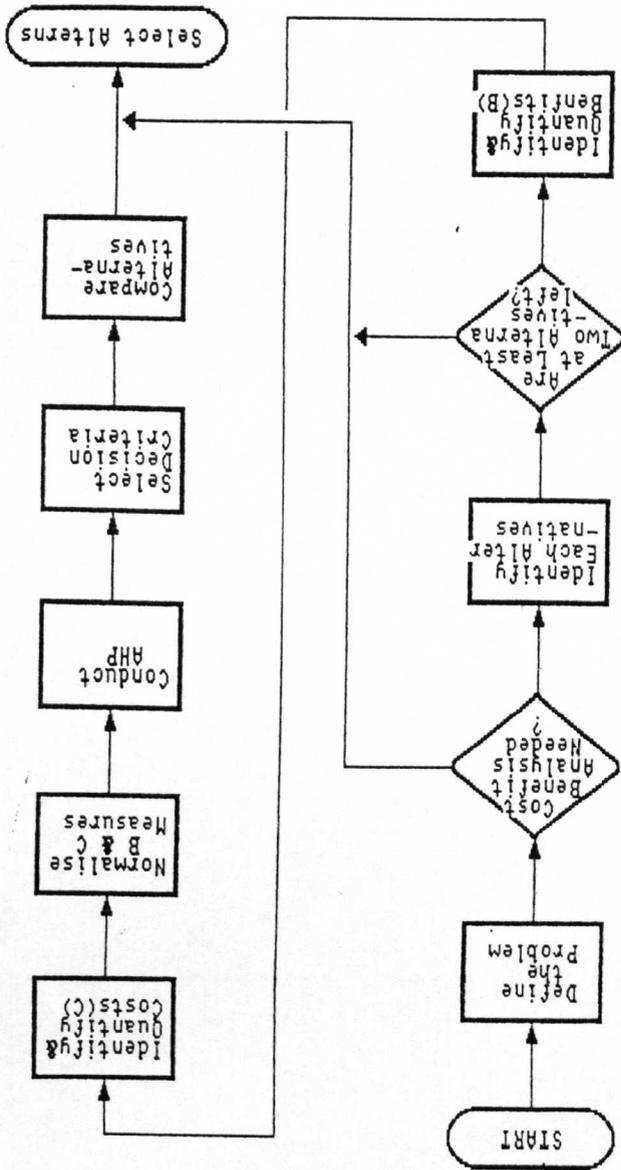
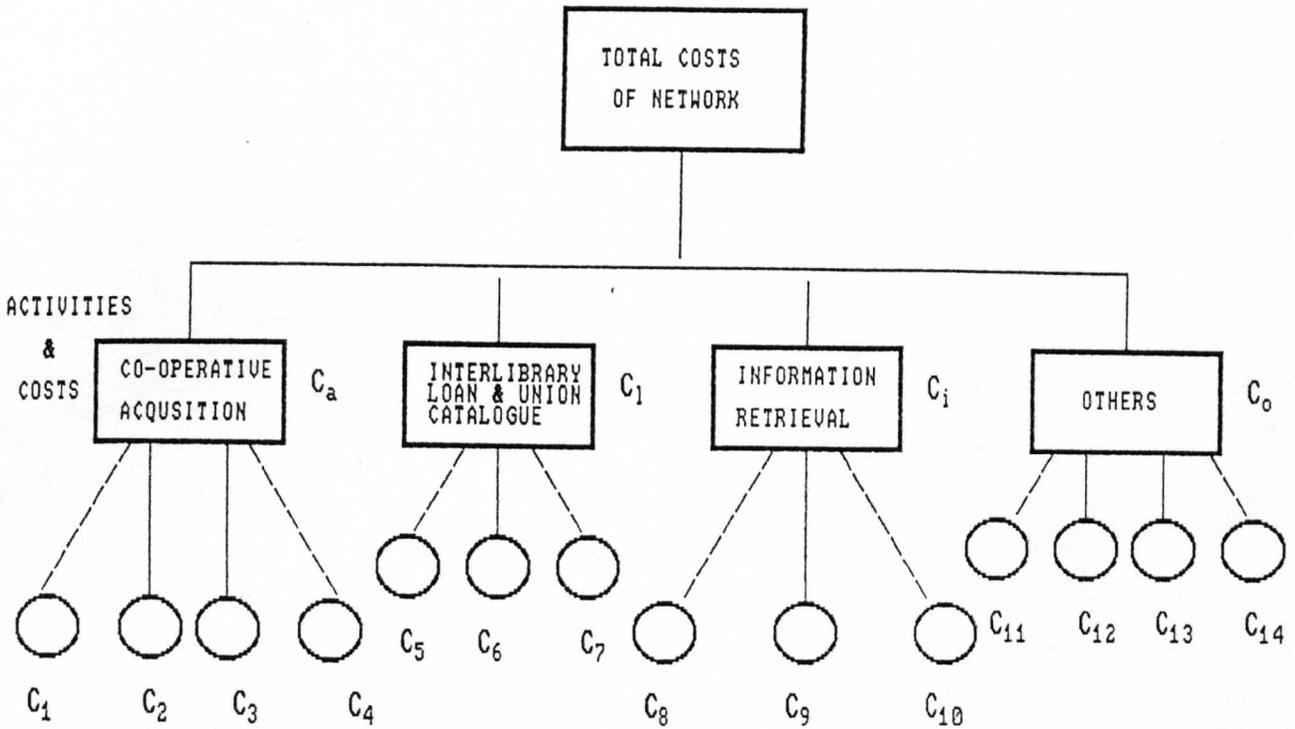


Figure 10.2: Structure of Costs for Network Activities



(b) unit costs

The service or system costs are useful to illustrate how much a given activity is costing. Unit costs usually can be calculated after the determination of service or system costs.

Since this research has mainly focused on the design and planning of the four major functions, the costs involved in the four functions will be of major concern here as well. The other network costs will be categorised as the other costs, which covers the costs involved in other network functions, such as training program. Figure 10.2 illustrates the total network function costs. And the costs of the four functions can be further divided into the costs involved in network system, participating libraries and users etc.

For planning purpose, it is useful to compare the total costs of different possible systems. For system designers and managers, the costs of day-to-day operations need to be compared. For example, for ILL, requesting libraries need to know the comparative costs of using alternative supply sources and different requesting methods. Finally, supply sources need to know the comparative costs of different methods of handling requests and supplying items, as well as to study their own efficiency of operation.

Not all costs will be incurred with each automation option. It is, therefore, necessary to make a check-list of cost elements and enter the figures for each option. By adding up all of the costs that might be incurred over a five- or seven-year period, the true cost of the options can be determined. The check-list should include:

a. Data processing Personnel

- b. Central site processing equipment
- c. Data storage
- d. Terminals
- e. Telecommunication hardware
- f. Software
- g. Installation and training
- i. Conversion of records
- j. Telecommunications
- k. Maintenance
- l. Supplies
- m. Use fees
- n. Personnel costs

Elements b through i on the check-list are one-time costs; the rest are recurring costs. (Boss, 1982)

Based on the above check-list, we, therefore, will be able to work out the least total costs. As it is mentioned before, the least total cost methodology considers all of the cost to network to acquire and to maintain the system over a five-to seven year period.

### 10.2.1 Cost Analysis for CA

#### Overview

As we all know, the network functions of communication; ILL, including delivery; and interlibrary reference will place an additional costs into the already overburdened budget. This cost must be alleviated in other ways, and one of the more impactive methods of alleviation is to reduce the costs of acquisitions (without reducing the total resources) by introducing a CA program.

As in all simplified models, there are flaws in the representation. The savings in acquisition costs may be offset by costs incurred in servicing ILL. Furthermore, the impact of such buying policies on the publishing industry would no doubt affect the cost of books acquired at higher levels of the network. (Williams, 1981)

#### Cost Components of CA

When analysing the components of costs for CA, several classifications can be adopted. But no matter what classification we decide to use, the full cost of co-operative acquisition includes not only the purchase, but the staff costs of communication, selection and acquisition.

According to the classification of variable and fixed costs, we can work out such a list for the network being designed:

#### I Variable Cost

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

### A) Acquisition & Subscription

#### (a) Book Purchase

- Chinese
- Foreign

#### (b) Periodical Subscription:

- Chinese
- Foreign

#### (c) Others(including other forms& media)

Total Purchase Cost

### B) Processing:

#### (a) Technical Services

#### (b) Co-ordinating discussion and meeting

#### (c) Collection Assessment

#### (d) Selection and Assignment

#### (e) Others

Total Processing Cost

Total Acquisition Cost

## II. Fix Cost

### A) Administration

#### (a) Network Management

#### (b) Individual Library Management related to CA

### B) Maintenance

### C) Imputed Cost

Total Fixed Cost

## Determination of Costs for CA (Purchase Costs)

As far as the cost-effectiveness of CA (purchase only) is concerned, the costs involved in assuring certain level of effectiveness measures can be divided into the cost requirements for four criteria measures.

Based on the effectiveness criteria for CA defined in the preceding chapter and the above division, we can determine the total costs for network acquisition in the light of cost-effectiveness. That is to say, if we devise a network acquisition policy, which assure a reasonable satisfactory degree of user, we therefore, are able to work out the cost requirement of the acquisition.

Figure 10.3 shows the flow of cost determination. The determination can be illustrated by explaining the procedures of quantification of some values. Appendix E goes into the details.

The total cost of purchase, therefore, can be estimated simply by multiplying the total number of items (including overlaps and duplications) by average price.

Figure 10.3: Flowchart of Cost Determination for CA

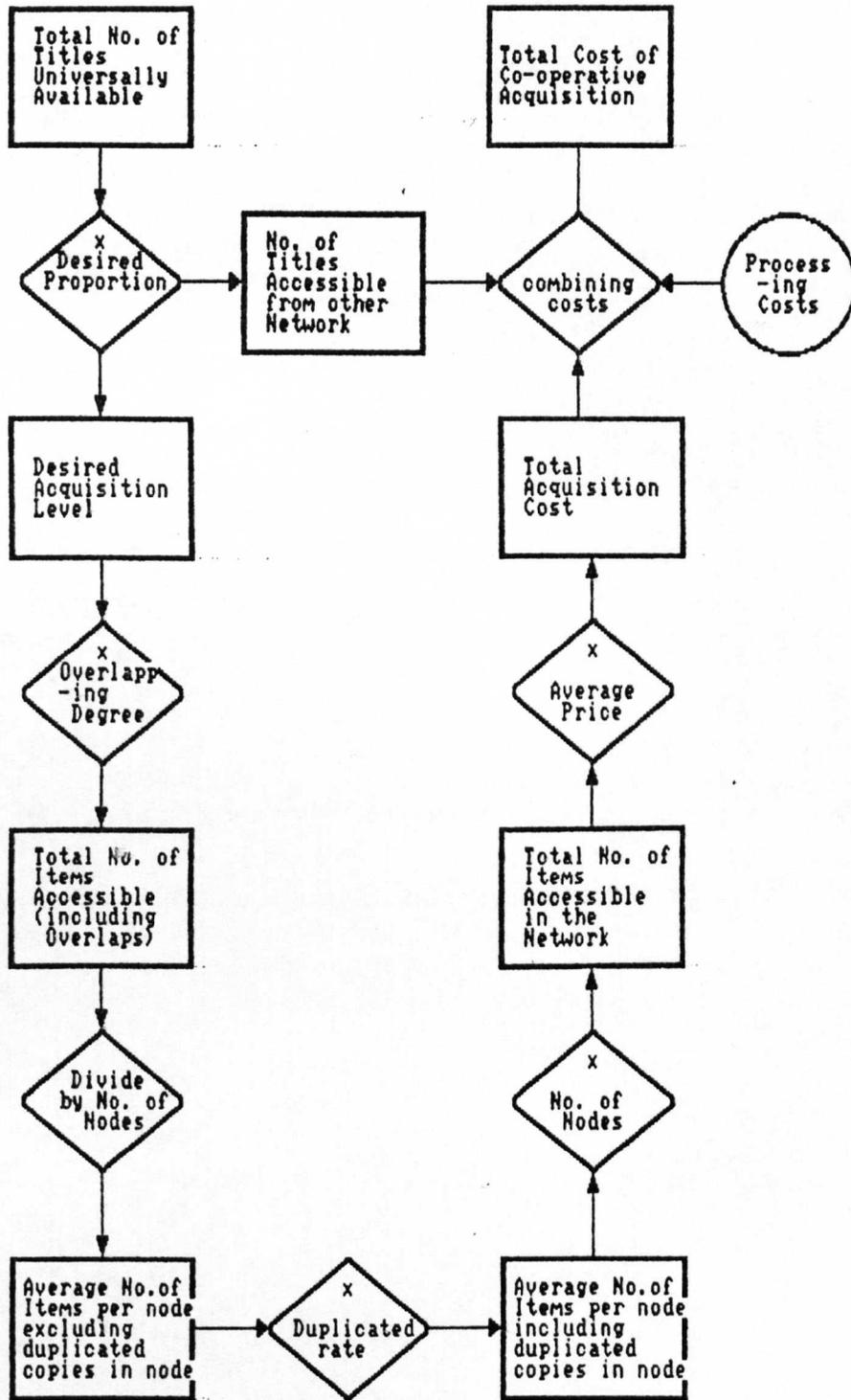


Table 10.1: Cost Requirement of Forms &amp; Languages

Performance Criteria	Decision Variables	Chinese Books	Foreign Books	Chinese Periodical	Foreign Periodical	Total
Material Accessibility	Total Number of Titles	3,135.0	96,250.0	4,851.3	190,400.0	294,636.3
Interlibrary Loan(outside)	Total Number of Titles	97.5	6,562.5	0	3,440.0	11,511.0
Geographical Accessibility	Overlapping Degree	15,048.0	177,100.5	56,196.8	32,300.0	280,644.8
Local Availability	Duplicated Degree	5,964.0	8,624.0	--	--	14,588.0
Sub-total		24,147.0	281,974.0	61,048.1	222,700	589,869.1 excluding ILL
Total			306,121		283,748.1	601,380.1

Annexe 10.2 summarises the costs for four criteria measures of CA for different forms, which is important for the trade-offs among those criteria measures. Based on the above tables, we therefore can further sum up the total cost requirement for the four criteria despite of the forms (Table 10.1). It shows the cost requirement and the proportion of the total.

Table 10.2 shows the summary of the cost requirement for both different languages and forms irrespective of the four criteria. We can see that an overwhelming majority of budget will have to be allocated to acquire and subscribe foreign materials because of the high price of foreign materials. Figure 10.4 illustrates the ratio of cost requirement between

- (a) Book : Periodical
- (b) Chinese : Foreign
- (c) Chinese Book (CB) : Foreign Book (FB) : Chinese Periodicals(CP) : Foreign Periodicals

The rank of cost requirement can be seen as follows:

$$FB > FP > CP > CB$$

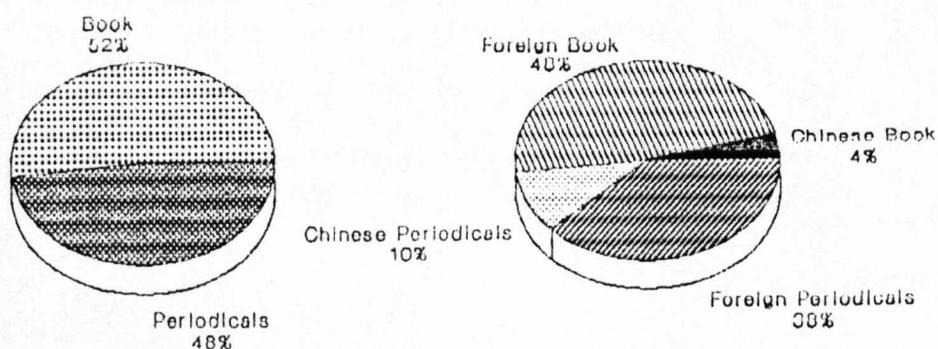
If we review the acquisition situation of those libraries in 1987, we can summarise the costs in Table 10.3. The cost data presented is a sum of the data collected from 28 libraries. Again Figure 10.5 gives an illustrative picture of the acquisition costs.

10. Cost-effective-benefit Analysis—Generation of Alternatives

Table 10.2: Total Cost Requirement  
(Agricultural Science)

ACTIVITIES (EFFECTIVENESS)	BUDGET REQUIREMENT ( $R_{ij}$ )	PROPORTION OF TOTAL ( $R_{ij}/R_i$ )
MATERIAL ACCESSIBILITY	294,636.3	0.4899
INTERLIBRARY LOAN FROM OUTSIDE	11,511.0	0.0191
GEOGRAPHICAL ACCESSIBILITY	280,644.8	0.4667
PROBABILITY OF DISSATISFACTION	14,588.0	0.0243
Total	601,380.1	1.0000

Figure 10.4: Ratio of Cost Requirement



10. Cost-effective-benefit Analysis—Generation of Alternatives

Figure 10.5: Acquisition Costs in 1987

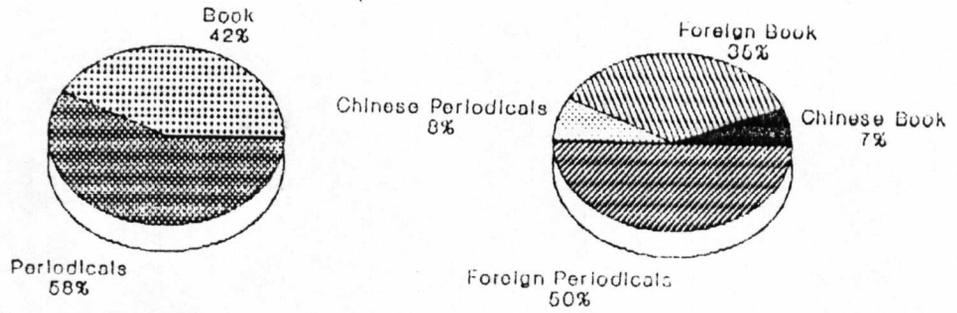
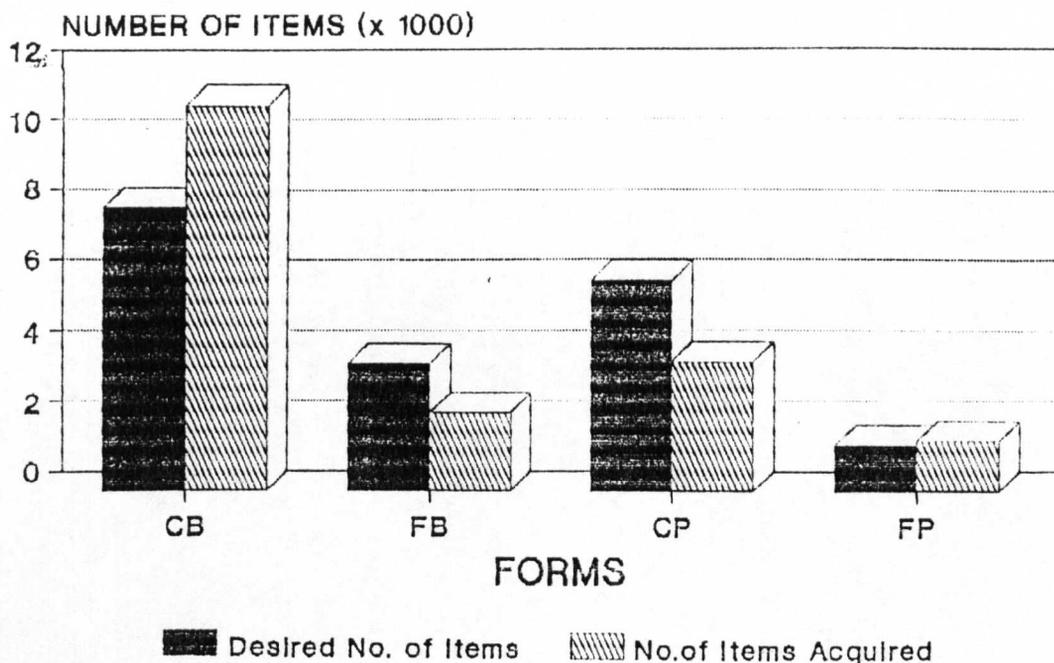


Table 10.3: Summary of Acquisition Costs in 1987

	CB	FB	CP	FP	Total
Total Stock	800,599	111,859	13,942	3,120	929,520
Total Agri. Stock	174,459	30,530	3,699	1,439	210,127
Proportion	21.8%	27.3%			22.6%
New Acquisition in 1987	73,196	7,163			
New Agri. Acquisition in 1987	10,977	2,374			
Proportion	24.0%	33.1%			
Growth Rate*	12.7%	10.9%			
Growth Rate**	12.5%	11.2%			

Figure 10.6: Optimum Allocation of Budget



By comparison, we can find that there exists some different pattern between two sets of costs. For instance, the cost for foreign periodicals ranked first in the latter case (i.e. actual acquisition in 1987) and the cost for periodicals were more than the estimated cost requirement. But one pattern which remains stable is the ratio between Chinese and Foreign material irrespective of the forms. Figure 10.6 & Figure 10.7 illustrate the comparison between reasonable number of items and number of items acquired in 1987 by those libraries and cost comparison between those two as well.

The reasons why the estimated cost requirement for foreign book is becoming superior to that for foreign periodicals may be explained as follows:

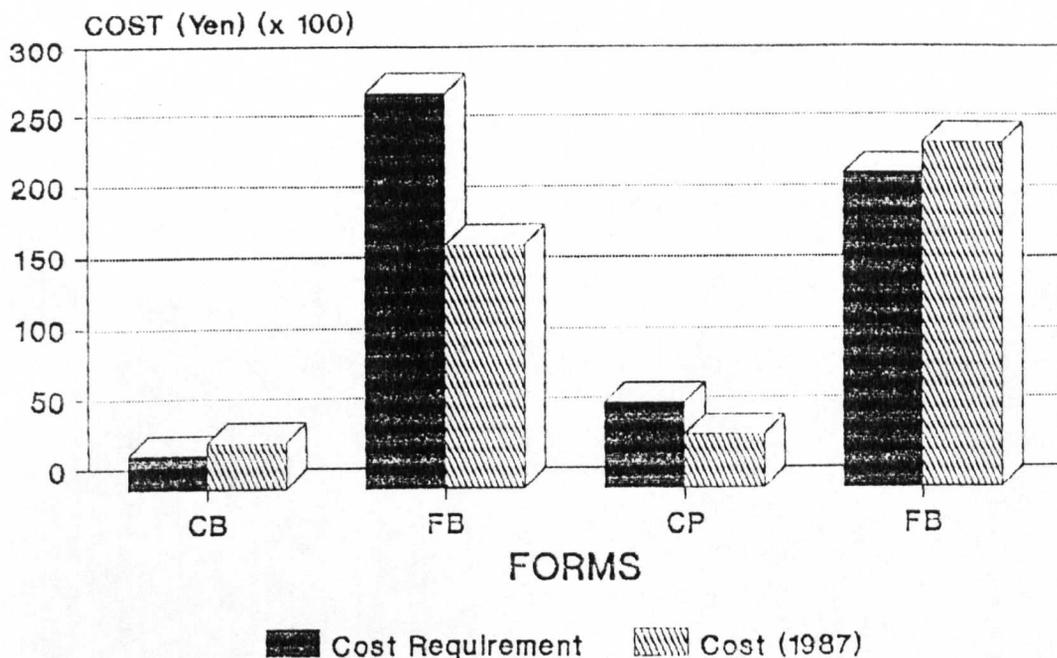
- (a) The annual output of book (unique titles) is higher than that for periodicals;
- (b) "Non-duplicated" (Duplicated rate=1.00) and almost "Non-overlapped" (Overlapping degree=1.04) policy is planned to be adopted for foreign periodicals but not for foreign books (DR=1.03, OD=2.84 resp.) in the network design and planning.

#### Determination of Operating Costs and Least Total Cost at three Programmes

The operating costs of CA can be divided into at least two types:

- (a) those incurred in the local library
- (b) those incurred in the network system

Figure 10.7: Actual Acquisition Budget in 1987



But the proportion of the costs incurred in both sites varies with the alternative programmes since the structure of acquisition systems and proportions of the tasks involved in both sites vary.

No matter the acquisition systems in local libraries are manual or computerised, the basic functions of an acquisition system are similar for most types of library, which include 1) receiving recommendations of items to be purchased and establishing that the items are already on order, 2) preparing order notes to be sent to booksellers, maintaining a file of records of items on order or in process, 3) generating claims to be sent to the bookseller for items not received, 4) maintaining the accounts, and 5) accessioning the items on arrival in the library and keeping statistics.

As it is mentioned in Chapter Eight, the computerisation of acquisitions system includes

- (a) Development of in-house program, which can be run in batch mode on the main-frame computer of the library's parent organisation;
- (b) Establishment of processing centre, equipped with computers, performing the functions in a centralised mode;
- (c) On-line accesses to network system, publishers or booksellers.

Here the review of Table 6.4 is needed. It lists the means and equipment used in each steps for three programmes.

In a network environment, computerisation in CA operation will involve in computerisation of local library acquisition procedures first, then that of network acquisition

system. Unfortunately, as it is mentioned before, it is extremely difficult to accurately predict the costs of a computerised system. Nevertheless, attempts need to be made to get some rough cost figures of the system. It has been recognised that the cost of acquisition system can be further summarised as five elements: (i) labour, (ii) equipment, (iii) consumables, (iv) computer time, and (v) system maintenance.

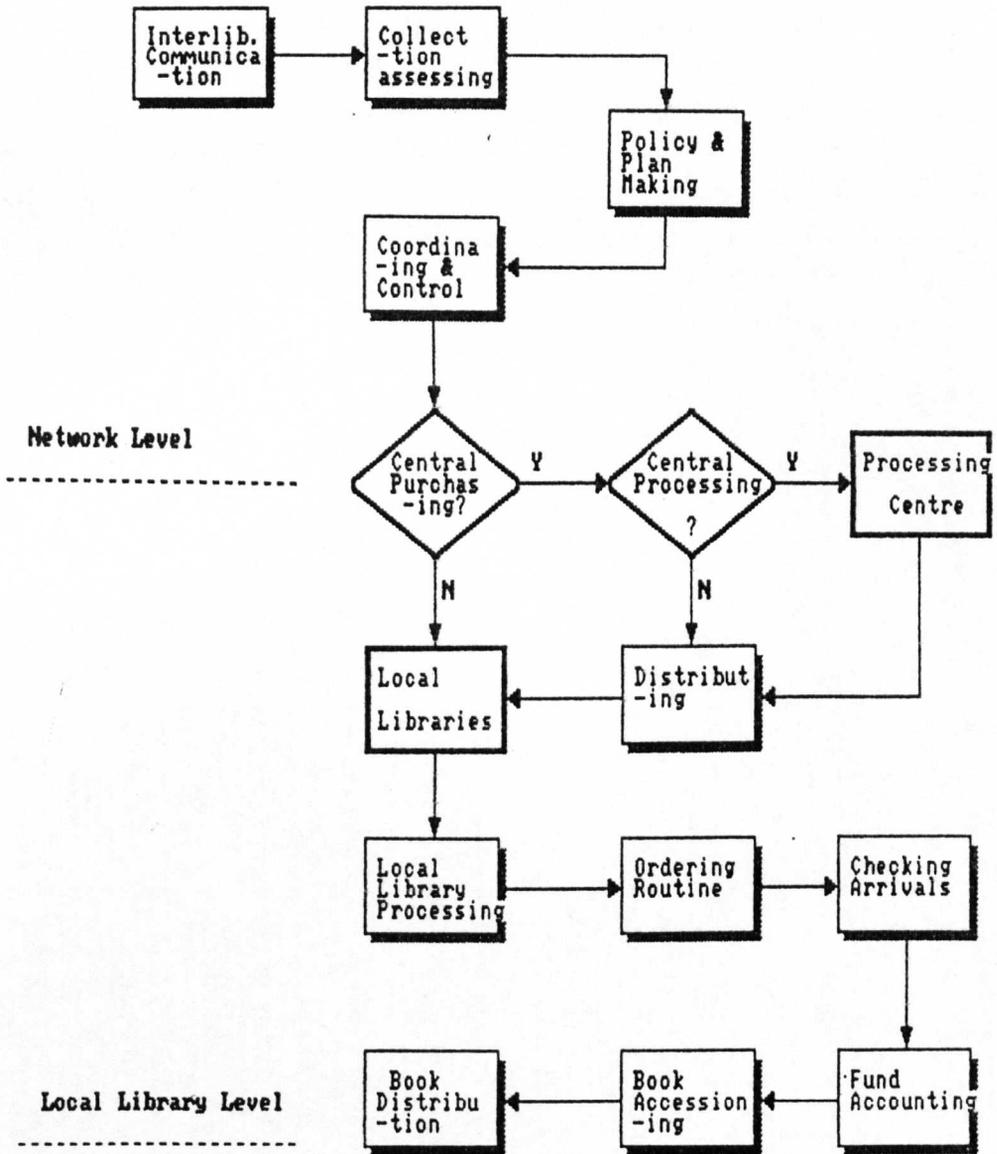
As we all know, acquisition is regarded as one of the activities in technical services. Technical services are concerned mostly with inputs to the library. While the output of acquisition manifested to the user is stock (collection). The procedures of CA can be flowcharted at both local library level and network level (Figure 10.8).

As it is mentioned, labour cost is important in the determination of operating costs. To gather the data related, a diary exercise was conducted over a period of two weeks (1.11.87—15.11.87) in ZAU. The diary exercise was preceded by an analysis and codification of the actual tasks done by each member of staff involved in any acquisition process. Annexe 10.2 shows the time duration of acquisition function per unit order in each staff grade and labour cost of unit cost for ZAU.

No equivalent data can be collected for comparison since almost none of the libraries' acquisition system in China has been automated. Nevertheless, there tends to be some reduction of personnel in automated (computerised) acquisition systems, which is envisaged on the basis of western cases. Annexe 10.3 presents the number of staff involved in acquisitions in the three programmes, which does not include the staff involved in co-ordination and management of CA programmes. The reduction of labour seems not dramatic in the computerised systems for some additional work will usually be done to make full use of the capability of computers. As we know, it is extremely difficult to acquire just enough computer capability to speed up work done manually without also acquiring capabilities that far exceed the minimal needs. Since many of these "extra" features are highly desirable, libraries tend to use them. The cost of performing a single task may be reduced, but total operating cost may rise because more work is being done. This fact has caused the difficulties in comparison of costs only between manual and computerised systems.

Based on the above identification of cost components, the author, therefore, is able to work out the detailed least total cost. In the calculation, annual hardware maintenance normally costs up to 5% of the initial purchase price of a piece of equipment. Thus the maintenance costs will be calculated under this assumption. The results of calculation can be listed as follows:

Figure 10.8: Procedures of CA



10. Cost-effective-benefit Analysis—Generation of Alternatives

**Program One**

	Yuan
<i>One-time Purchase:</i>	
Typewriters	
(18 Chinese, 300 Yuan each	5,400
& 14 English, 200 Yuan each)	<u>2,800</u>
	8,200
 <i>Annual Fees:</i>	
Maintenance	375
Stationery	1,500
Personnel Cost (Annual Salary + 1/2 Overheads)	<u>124,766</u>
	126,641
 Total Annual Fees × 7	 886,487
Estimated total Set-up & Operating Costs for 7 Years	894,687
Average Yearly Costs (7 Years)	127,812.4

(Unit cost for 36,500 orders per year = 3.50 Yuan)

**Program Two**

	Yuan
<i>One-time Purchase:</i>	
<i>Hardwares:</i>	
Discs	5,000
Terminals (5) (4,000 each)	20,000
Printers (2) (7,000 each)	14,000
Softwares	15,000
Personnel Costs for set-up	<u>7,900</u>
	61,920
 <i>Annual Fees:</i>	
<i>Computer time:</i>	
Estimated computer time spent on acquisition work	365 hrs
annually (network-wide)	
Cost of computer time (100.00 Yuan per hr)	36,500
Cost of computer time per unit order (i.e. $Y36504 \div 36504$ )	1.00
Maintenance	1,750
Personnel Costs	109,080
Stationery	<u>1,000</u>
	148,330
 Total Annual Fees × 7	 1,038,310
Estimated Total Setting-up & Operating Costs for 7 Years	1,100,230
Average Yearly Costs (7 Years)	157,175.7

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

(Unit Cost = 4.31 Yuan)

### Program Three:

	Yuan
<i>One-time Purchases:</i>	
Hardwares	
Computer (CPU, Discs)	100,000
Terminals (28)	112,000
Printers (28)	196,000
Softwares	50,000
Telecommunication Interface	14,000
Personnel Costs for set-up (3)	11,880
	<hr/> 483,880
 <i>Annual Fees:</i>	
Maintenance	19,750
Telecom Charge	5,000
Stationery	1,000
Personnel Costs	98,352
	<hr/> 124,102
 Total Annual Fees × 7	 868,714
Estimated Total Setting-up & Operating Costs for 7 Years	1,352,594
Average Yearly Costs (7)	193,227.7

(Unit Cost = 5.29 Yuan)

### 10.2.2 Cost Analysis for ILL & UC

#### Overview

Costs for processing ILL requests are generally influenced by the following variables:

- (a) Size of the network—number of demands per year, size of staff, and volumes in total collection;
- (b) Centralised or decentralised collection;
- (c) Standards of service;
- (d) Processing time per request;
- (e) Technological support, and
- (f) Salary scales.

Perhaps even more than with success rate and turnaround time, cost as a performance criterion is subject to varying interpretation and the peculiarities of local circumstances. Differences in local policies, personnel involved in ILL, methods and procedures employed, the nature of the material borrowed and loaned, and a variety of other factors

directly influence the results of ILL cost studies. The widely varying answers to the questions of "What to measure?" and "How to measure it?", have resulted in cost studies of ILL that seldom have relevance beyond the narrowly defined local environment. Because of the methodological flaws, there are frequently serious questions regarding even that limited use of the results of costs studies.

Central to any cost analysis is the determination of what costs are going to be included as "relevant." Organisations, left to their own devices, will seldom arrive at the same conclusions regarding the relevance of specific cost elements to be included in a cost study.

## Components of Costs

### I. Different Types of Costs for ILL

It is essential to distinguish different types of costs for ILL and document delivery.

According to PGI-UNSIST's classification (1987), the costs may be:

*Direct:* the costs incurred directly in ILL and document supply transaction, excluding capital costs (such as acquisitions) and indirect or overhead costs (such as accommodation and management). They should include consumables (such as paper for photocopying), depreciation on machinery, and possible depreciation on stock (to allow wear and tear caused by document supply).

*Total:* the full costs, including overheads and indirect costs. In the case of ILL and document supply, total costs would include the acquisition of material to meet demand, an element of senior management costs (e.g. a portion of the librarian's salary would be attributed to document supply), accommodation overheads, and so on.

Distinction also has to be made between:

*Visible Costs:* the costs of forms, postage, paper, etc. and

*Hidden Costs:* in particular the time of staff who are employed anyway and who devote some of their time to ILL and document supply.

It may be useful to divide Direct costs into Visible and Hidden costs. Visible costs are much easier to calculate.

Finally, it is useful to distinguish between

*Fixed Costs*, such as accommodation, equipment and stock; and

*Running costs*, such as telephone, postage, etc.

### II. The Calculation of Costs

When calculating costs, distinction needs to be made between

*Service or system costs:* the costs (usually annual costs) of the system or service, whether direct or total; and

*Unit costs:* the cost per unit transaction. The "unit" may be a request, a completed transaction, or a fulfilled request: the last is the most meaningful measure and the best for comparative purposes.

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

In calculating unit costs per completed transaction or per fulfilled request, all costs, whether direct or total, including those incurred for unfulfilled requests and uncompleted transactions, have of course to be taken into account. It may also be worth calculating separately the unit costs per fulfilled request and per unfulfilled request using only those costs directly incurred in filling or not filling requests. If, for example, the cost of unfulfilled request is good deal higher than of a fulfilled request, this may suggest that acquisition should be extended.

Cost may be broken down into:

- Costs to the requesting library
- Costs to the supply source
- Costs to any central unit responsible for planning and management
- Costs to the system or nation

In calculating total costs, care must be taken in cases where the supply source passes some or all of its costs on to requesting libraries, since some of the same costs are then incurred by both and these must not be counted twice.

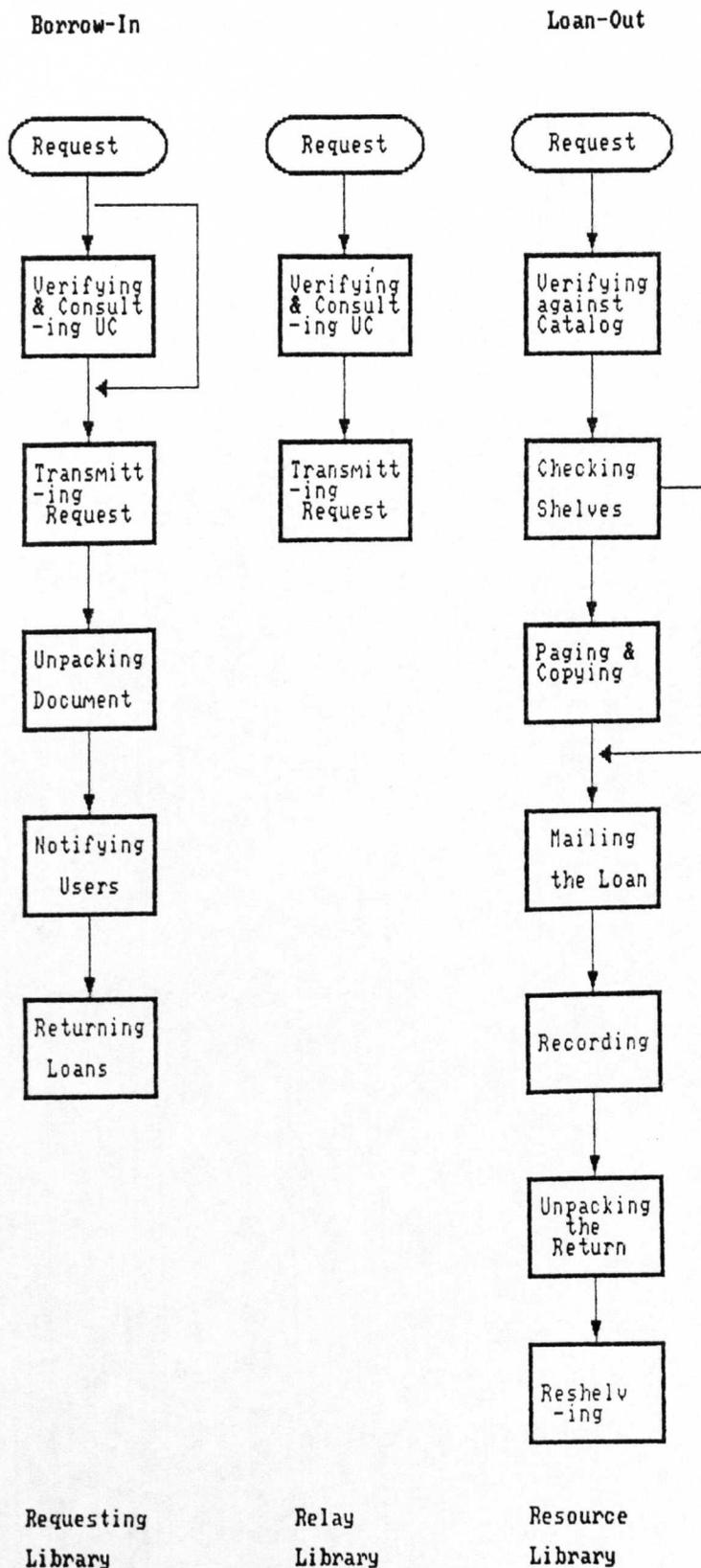
### Determination of Unit Cost of ILL in three Programmes

To determine the unit cost of ILL, it is essential to identify the processing cost both incurred in local library and network system. One important component in determining unit cost is labour cost, which requires the identification of the task of ILL transaction. The tasks of ILL in request library, resources library and relay library can be identified by flowcharting the procedures (Figure 10.9). A library can be either request or resource or relay library, which depends on the nature of the request, i.e. local request, or ILL request. But one trend is that the bigger the library is, the more likely resource library it is. As it is mentioned before, cost analysis is perhaps the most undeveloped area in all of librarianship and information science. It has been neglected because it is difficult, at least with the methods generally in use for measuring labour costs.

An attempt was made to work out unit cost for request and resource library by different transmission means, i.e. mail, telephone and telefacsimile. The data was collected by the following:

1. Random Time Sampling in ZAAS for mail transmission;
2. Published Data; and
3. Assumptions.

Figure 10.9: Procedures of ILL Transaction in Request, Relay & Resource Libraries



## 10. Cost-effective-benefit Analysis—Generation of Alternatives

Random Time Sampling was carried out by asking the staff to fill in a time sheet for two weeks (Annexe 10.4). Then time slip were assembled and the number of observations for each task during the observation period were counted and totalled. The percentage of that person's total time spent on each task was calculated.

The effective daily wage was calculated for each staff by dividing his annual salary by 224 working days per year. The average daily cost for each tasks was calculated.

Estimated material and equipment costs was derived by the survey and other cases.

Fringe benefits unit cost was calculated as 5% of direct wages. Overhead was added in the effective daily wage. The total unit cost then equalled the sum of the labour, materials, fringe, and overhead unit costs.

In Chapter Eight, the definitions of ILL-UC services in three programmes have been given and the means adopted, equipment and resources incurred have been identified. Here the following summary of assumption are made for the convenience of cost analysis in both request library and resource library.

### *Borrow-In*

#### 1. Channel—Transmission Mode

- Mail or Telephone or Telefacsimile

#### 2. Process ( See Figure 10.7)

- Whole process completed by Library Staff; or
- Part of the process done by users themselves

#### 3. UC is available and in the forms of either printed, or microform or MARC forms.

#### 4. Only request on original documents and photocopies are considered.

#### 5. Two other costs must be considered, i.e. staff costs in relaying the requests and recalling users.

### *Loan-Out*

#### 1. Channel Only mailing of photocopies or original document is considered

#### 2. Process ( See Figure 10.7)

#### 3. The principle of "First-coming, First served", i.e. equal priority to ILL users and local users will be adopted, and ILL requests will wait in the queue if the item is not available at the moment of entering.

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

Based on the above summary of assumptions, the results of unit costs for request library, via three different transmission means can be presented in Annexe 10.5 (a,b,c) and results of unit cost for resource library to supply ILL by mail can be presented in Annexe 10.5 (d). The unit cost for satisfying an ILL request is the sum of unit cost for borrow-in and loan-out.

Therefore, the total cost of ILL transaction will largely depend on the total number of request.

A cost comparison between three different transmission means was thought useful. Thus an attempt was made to compare labour time, average turn-around time, transmission cost per request, accuracy, reliability of transmission mode of those three mode (Annexe 10.6)

### Cost Components of UC

In the network, two types of UC are thought to be priorities, i.e. Union lists of periodicals (both Chinese and Foreign) and Union Catalogue for Foreign Publications.

Two major types of costs can be identified in a UC system:

1. Setting-up Cost, and
2. Consulting Costs

Setting-up costs include the following:

1) Manpower; 2) Materials; 3) Equipment and 4) Communication in the processes of cataloguing, compilation, production and maintenance of UC.

The detailed components of costs can be listed as follows:

#### *Staff Time (Labour Cost)*

##### Activities in

- cataloguing
- compiling
- printing or microfilming
- up-dating
- co-ordinating & organising

#### *Material & Equipment*

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

- cards or paper or films
- typewriters
- microform camera & other facilities
- microform reader
- computer & printer etc.

The actual items involved depend on the programme chosen. The author was not able to gather the data to derive unit cost per item catalogued during her survey. But some interview were made to find out rough costs of existing UC and the amount of funds allocated to some UC planned (including number of personnel involved and costs for printing in each cases). These data help the author calculate the total estimated costs of UC. Since it is difficult to distract the UC system costs from ILL system costs, the author decides to merge the costs together and emphasis that the major usage of UC system is to assist ILL transaction. It is noteworthy that the UC mainly dedicated to ILL tends to be simpler, in terms of compilation and entry arrangement.

The following section attempts to work out set-up cost, annual fees and finally average yearly costs of ILL-UC system in three alternative programmes.

### Total Costs of ILL-UC System in Three Programmes

The possible costs have been identified in different ILL-UC systems. And thus the calculation can be done as follows:

#### Program One

	Yuan
<i>One-time Purchase:</i>	
Photocopier (20) (5,000 each, but 10% Used for ILL)	10,000
Personnel Cost for UC set-up(5)	16,920
Costs of UC Production (printed or card)	10,000
	<u>36,920</u>
<i>Annual Fees:</i>	
Maintenance	5,000
Postage Charge	700
Personnel Costs (10.7)	36,208.8
Stationery	1,000
	<u>46,328.8</u>

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

Total Annual Fees × 7	324,301.6
Estimated Total Set-up & Operating Cost for 7 Years	361,221.6
Average Yearly Costs (7 Years)	51,603.1

### Program Two

	Yuan
<i>One time Purchase:</i>	
Computer time for UC set-up (300 Hours)	30,000
Photocopier (20) (10% used for ILL)	10,000
Discs	5,000
Terminals (5)	20,000
Printers (2)	14,000
Microfilm Readers (14) (200 for each)	7,000
Microform Camera (1)	10,000
Microfilms	2,000
Software	15,000
Telephone facilities	5,000
Personnel for UC set-up (3)	11,304
	129,304

<i>Annual Fees</i>	
Computer Time for UC up-dating (15)	1,500
Maintenance	3,550
Postage Charge	500
Personnel Costs (8)	27,072
Telephone Charges	500
Stationery	1,000
	34,122

Total Annual Fees × 7	238,854
Estimated Total Set-up & Operating Costs for 7 Years	368,158
Average Yearly Costs (7 Years)	52,597

### Program Three

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

	Yuan
<i>One-time Purchase:</i>	
Photocopier (20) (10% used for ILL)	10,000
Computer (CPU+Discs)	100,000
Terminals (28)	112,000
Printers (28)	196,000
Softwares	5,000
Telecom Interface	14,000
Telefacsimile (2)	10,000
Personnel Costs for UC Set-up (4)	14,688
	<u>461,688</u>
 <i>Annual Fees:</i>	
Maintenance	22,100
Telecom Charge	5,000
Stationery	1,000
Personnel Costs (6)	22,032
	<u>50,132</u>
 Total Annual Fees × 7	 350,924
Estimated Total Set-up & Operating Costs for 7 Years	812,612
Average Annual Costs (7 Years)	116,087.4

### 10.2.3 Cost Analysis for IR System

#### Overview

The cost of an IR service can be measured in terms of input of resources (funds). Under cost we need to consider both the costs that are relative fixed—for example, equipment purchase or rental for IR, developmental costs, costs involved in acquisition and indexing of present database—and the costs that are relative variable. Variable costs are of two kinds;

1. The variable cost that is a function of the number of transactions;
2. The variable cost that is a function of alternative modes of operating the system.

As mentioned earlier, one barrier to the application of cost-effectiveness or cost-benefit analysis to information systems is that the realistic costing procedures for products and services are generally lacking. We must cost the operations of a system in same meaningful way if we are to be able to measure economic improvements in tangible terms.

Elchesen (1978) tries to make a cost-effectiveness comparison of manual and on-line retrospective bibliographic searching. In the costs determination, he breaks the costs down into the following components:

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

1. *Labour*: Searcher and clerical salaries and over-head.
2. *Information*: Subscriptions to abstracting-indexing publications; data base connect-time charges.
3. *Reproduction*: photocopying; material; off-line citation printing.
4. *Equipment*: Photocopier, terminal, acoustic coupler lease/purchase/amortisation.
5. *Space*: Maintenance of physical space for publications and equipment.
6. *Telecommunication*: Carrier charges for on-line access.

According to Echesen's conclusion, On-line searching is generally faster, less expensive, and more effective than equivalent manual searching. Approximately five on-line searches may be conducted in the two hours required to perform a single manual search. A typical on-line search against one data base, cost approximate \$26, as opposed to over \$30 for the corresponding manual search... The average cost per relevant citation was less for on-line searches (\$0.65) than for manual searches (\$0.86).

In her survey in China, the author had attempted to apply the similar methodology to data collection about the searching via CAB abstract journals, CAB database tapes and CAB on-line. Failing in the collection of those detailed data, the author tried to gather some data about average charges per search in respective searching and SDI modes (Annexe 10.7.).

### Least Total Costs for IR System

The total estimated costs of different alternative system are worked out under the same fashion as the other functions:

#### Program One

	Yuan
<i>One-time Purchase:</i>	
Typewriter (1 Chinese + 1 English)	500
Photocopier (1) (50% usage)	2,500
	<hr/>
	3,000
<i>Annual Fees:</i>	
Maintenance	150
Subscription to Printed Retrieval Tools (20 Chinese & 10 Foreign)	2,000
Personnel Costs (4)	14,112
Stationery	1,000
Postage	500
	<hr/>
	27,762

10. Cost-effective-benefit Analysis—Generation of Alternatives

Total Annual Fees × 7	194,334
Estimated Total Set-up & Operating Costs for 7 Years	197,334
Average Yearly Costs (7 Years)	51,603.1

**Program Two**

	Yuan
<i>One-time Purchase:</i>	
Computer Time for In-house Database Building (500 hrs)	50,000
Terminals(5)	20,000
Printers (2)	14,000
Discs	5,000
Software	20,000
Personnel Costs for Set-up (3)	11,304
	<u>120,304</u>
<i>Annual Fees:</i>	
Maintenance	4,250
Subscription to Databases	36,000
Personnel Costs (2)	5,616
Stationery	1,000
Postage	500
	<u>47,364</u>
Total Annual Fees × 7	331,562
Estimated Total Set-up & Operating Costs for 7 Years	451,866
Average Yearly Costs (7 Years)	64,552.3

**Program Three**

	Yuan
<i>One-time Purchase:</i>	
Computer (CPU+Hard Discs)	100,000
Terminals (28)	112,000
Printers (28)	196,000
Telecom Interfaces	14,000
Softwares	20,000
Personnel Costs for Set-up (3)	11,304
	<u>453,304</u>

## 10. Cost-effective-benefit Analysis—Generation of Alternatives

<i>Annual Fees:</i>	
Maintenance	22,100
Telecom Charge	5,000
Database Connection Time Charge	32,000
Stationery	1,000
Postage	500
Personnel Costs (2)	5,616
	<hr/>
	61,216
Total Annual Fees × 7	428,512
Estimated Total Set-up & Operating Costs for 7 Years	881,816
Average Yearly Costs (7 Years)	125,973.7

### 10.2.4 Least Total Network Costs

It is obvious that the initial investment for setting up a computerised system is rather high, especially that for the on-line system. But in a long run, computerised system cost can be reduced as the machine can be run for many years. And average yearly cost is not much higher than a manual system since less personnel costs are incurred. (\* The author believes that there are some reductions in staff time when the operation are computerised or more work can be done with similar number of staff). For example, the creation of acquisition file can be used for cataloguing, circulation etc. Another noticeable phenomenon is that the computer facilities can be shared between the functions and between the nodes. This is one great advantage of networking. And in returns, the computer system has facilitated the development of networks. We can see from from the table that if we automate one function only, the average yearly cost is much higher than that if we automate those functions together since the computer and other set-up costs can be shared (Table 10.4).

If we analysis the costs table, we can find that

1. Acquisition system has higher costs than others—different from other services, acquisition system involves the local libraries' acquisition operations. While local libraries' acquisition operation is a day- to-day technical processing, which requires certain staff time. The sum of such staff time in a network environment is much more than that for other services. If we only count the staff time involved in the communication, network-level management and processing, the cost can be much less.
2. The actual acquisition and purchase costs of stock is not included in aquisition system costs. The main reasons are two-fold: firstly this type of costs is irrelevant to whatever alternative programmes were defined before. Secondly, a dedicated amount of budget should be allocated to assure the acquisition and subscription of stock. As it is mentioned earlier, a cost-effectiveness comparison, i.e. trade-offs between different acquisition policies may be achieved by the formulations in Chapter Seven.
3. It should be pointed out that the cost data used are obtained from

10. Cost-effective-benefit Analysis—Generation of Alternatives

Table 10.4: Least Total Network Costs

	Program One		Program Two		Program Three	
	SET-UP COSTS	ANNUAL RUNNING COST	SET-UP COSTS	ANNUAL RUNNING COST	SET-UP COSTS	ANNUAL RUNNING COST
CA	8,200	126,641	61,920	148,330	483,800	124,102
		<u>127,812.4</u>		<u>157,175.7</u>		<u>193,227.7</u>
ILL-UC	36,920	46,328.8	129,304	34,122	461,688	50,132
		<u>51,603.1</u>		<u>52,597</u>		<u>116,087</u>
IR	3,000	27,762	116,304	43,116	453,304	61,216
		<u>28,190.6</u>		<u>59,730.9</u>		<u>125,973.7</u>
SHARED COSTS						
CA	8,200	126,641	38,500	147,360	230,680	112,792
		<u>127,812.4</u>		<u>152,860</u>		<u>145,746.3</u>
ILL-UC	36,920	46,328.8	65,904	32,552	176,288	35,362
		<u>51,603.1</u>		<u>41,966.9</u>		<u>60,546</u>
IR	3,000	27,762	89,104	43,506	157,904	46,446
		<u>28,190.6</u>		<u>56,235.1</u>		<u>69,003.7</u>

- Survey data
- Published data (from either Chinese sources or Foreign sources)
- Derivation from some other cases, and
- Some assumptions.

The high degree of accuracy may be questionable, but the author believes that most important cost components have been considered and there is no significant difference from the actual costs. Moreover, the tendency is right, i.e. computer-based system has higher one-time cost while manual system requires more staff time.

### 10.3 Identification of Effectiveness and Benefits Components

#### 10.3.1 Overview

It is recognised that networking and computerisation of networks are beneficial. To make a cost-benefit analysis, detailed benefits need to be identified. The main benefits of four individual functions to the whole network system and network users are identified and summarised under three categories, i.e. user benefits, participating library benefits and network system benefits (Table 10.5).

Now the author intends to focus on the comparison of benefits derived from the alternative programmes. Lancaster (1977) lists the major potential advantages of automating any kind of operation (Table 10.6).

And Lancaster (1977) further concluded that:

“ The most obvious among a number of possible quantitative considerations is the effect of automation on the number of transactions that can be handled in a specific time; another is its effect on the volume of use. Automated systems have the capability of increasing library and network use. Some possible ways of achieving this are:

1. Wide distribution of printed catalogues and bibliographies.
2. More efficient acquisition procedures.
3. More efficient catalogue procedures.
4. More access points in the machine catalogue, especially an on-line catalogue.
5. More effective use of the catalogue through more access points and built-in redundancy to compensate for common human errors.
6. Improved recordkeeping (e.g. by knowing where a particular copy is at any time)
7. Co-operative processing in acquisitions, cataloguing, etc., reduces unit costs and number of duplicates required, thus freeing more money for book collection and public services.”(285)

Table 10.5: Benefits of Networking

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**User Benefit:**

1. Increased Number of Actual Users
2. Increased Exposure of Material to Users
3. Speed of Document Delivery
4. Speed of Response Time for Literature Searching
5. Stimulation of Information Need by the services available
6. Increased Satisfaction Rate

**Participating Library Benefits:**

1. Reduced Duplication of Material, Labours and Resources
2. Expansion of Services without additional local Expenditures
3. Decrease of Bibliographic Access Time

**System Benefits:**

1. Increased Material Accessibility
2. Increased Fill Rate
3. Reduced Duplication
4. Expansion of Services

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Table 10.6: Possible Benefits in Automation

1. Improve productivity	6. Increase range & depth of service
2. Reduce staff	7. Facilitate co-operation
3. Improve control	8. By-products
4. Reduce error	9. Improve dissemination
5. Improve speed	10. Reduce unit cost of co-operation

### 10.3.2 Benefits of Computerised Network and Individual Functions

According to the above analysis and common knowledge, the author thus can work out the possible benefits for a computerised network and for individual functions (Table 10.7 & Table 10.8). It is noted that the benefits listed cover both internal and external benefits. As it is mentioned before, in most cost-benefits analysis, benefits need to be quantified if possible. The following benefits can be chosen for quantification in cost-benefit analysis:

1. Personnel Cost Reduction
2. Improved Manpower Utilisation  
Improved manpower utilisation leads to decreased need for positions to accomplish same level of work.
3. Improved equipment utilisation
4. Operating cost reduction
5. User effort reduction

Therefore, some calculation can be done for personnel reduction. Table 10.9 presents the personnel costs reduction for CA and ILL.

However, it is noteworthy that the cost reduction of both personnel and shared costs of equipment have been taken into account in the calculation of total least cost. It must not be doubly counted in the identification of benefits. Examining the benefits identified in individual functions, we can see that many benefits are internal service benefits. Most internal benefits are related to the operating cost reduction, improved internal efficiency and so on and most of them have been counted in the total least cost. Thus it is more reasonable here to put emphasis on the benefits of external services.

Table 10.7: Possible Benefits & Effectiveness Consideration for a Computerised Network

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Overall Costs in building and maintaining the network must be balanced against the benefits to participating libraries, which can be great:

1. Makes automation technically and economically feasibility in even small libraries
2. Sharing of expensive computer resources
  - (a) facilitates use to optimum capacity
  - (b) improves efficiency of machine use
3. Ability and willingness of libraries to cooperate and share increase
4. Standardisation is promoted
5. Provides improved management controls and data for decision-making
6. Duplication of materials and effort may be reduced through
  - (a) improved interlibrary loan procedures
  - (b) co-operative acquisition policies
  - (c) co-operative cataloging
7. Individual libraries may have improved control over acquisitions, circulations, and other procedures

Effectiveness: measured against a wide range of quality and time considerations, depend on which activities are computerised

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Table 10.8: Benefits & Effectiveness Consideration for Individual Functions

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**Computerised CA Functions**

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**Benefits:**

1. Productivity (No. of Orders processed) increased per Staff
2. Speed of Processing
3. Improved Control
4. Reduction of Staff Costs
5. File being used for other Functions
6. Paper and paper handling reduced

Benefits must be balanced against costs, unit costs per order in alternatives

Effectiveness measured in terms of Efficiency, Capacity of Processing etc.

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**Computerised ILL-UC Functions**

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**Benefits:**

1. Improved Accuracy and Control
2. Speed of Processing
3. Productivity (Volume of Loans, Items Catalogued) increased per Staff
4. Statistics more completed and accurate

Benefits must be balanced against costs, unit costs per transaction in alternatives

Effectiveness measured in terms of Efficiency, Turn-around Time and Fill Rate

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**Computerised IR Functions**

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**Benefits:**

1. Productivity (No. of Searches) increased per Staff
2. Speed of Services
3. Reduction of Staff
4. Networking facilitated through resource-sharing
5. User Effort reduced

Benefits must be balanced against costs, unit costs per search in alternatives

Effectiveness measured in terms of Efficiency, Response Time and Relevance etc.

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Table 10.9: Labour Cost Reduction in three Programmes

Total Order = 365,04 per year

Total Transactions = 1,000 requests per year

	Program One	Program Two	Program Three	Program One	Program Two	Program Three
	CA			ILL		
No. of Items per Staff	960.0	1,106.2	1,216.8	93.5	125	166.7
Unit Labour Cost per Order (Yen)	0.69	0.60	0.54	0.84	0.63	0.47
Efficiency Improved per staff	base	145.6	256.2	base	31.5	73.2
Cost saved per staff	base	100.46	176.79	base	25.6	59.3
Total Labour Cost per Year	25,187.76 (124,766)	21,902.4 (109,080)	19,712.16 (98,352)*	840.0 (36,208.8)	630.0 (27,072)	370.0 (22,032)*
Cost saved per year	base (base)	3,285.36 (15,686)	5,475.60 (26,414)	base (base)	210.0 (9,136.8)	370.0 (14,176.8)

\* The data in Blanket is calculated by the salary of full position

## 10.4 Mechanism for Cost-benefits Comparison—AHP

### 10.4.1 Introduction

In general, decision making involves the following kinds of concerns: 1) planning; 2) generating a set of alternatives; 3) setting priorities; 4) choosing a best policy after finding a set of alternatives; 5) allocating resources; 6) determining requirements; 7) predicting outcomes; 8) designing systems; 9) measuring performance; 10) insuring the stability of a system; 11) optimising; and 12) resolving conflict.

It must realise that during the comparison, much decision-making processes will be involved. Claimed as offering a new logic, Analytical Hierarchy Process has been applied to forecasting, decision-making, planning and system analysis. AHP is a straightforward and pragmatic method, which has the following distinguished characteristics: 1) systematic, 2) easy of use, 3) flexibility, and 4) pragmatic.

The AHP is basically designed to: 1) set priorities for the elements in each level of the hierarchy according to their impact on the criteria or objectives of the next higher level; 2) structure multi-person, multi-criteria, multi-time period problems with uncertainty and risk hierarchically. It is a particularly useful vehicle for allocating resources, planning, analysing policy impacts and resolving conflicts, as it can deal in a standard way with such intangibles as objectives, feeling, power, social values, and other common ideas in our society for which we have no established measure. (Saaty, 1980)

### 10.4.2 Methods

The method can be briefly described as follows: establishing hierarchies, and giving the elements of one level, say, the third, of a hierarchy and one element,  $e$ , of the next higher level, comparing the elements of level 3 pairwise in their strength of influence on  $e$ . Insert the agreed upon numbers, reflecting the comparison, in a matrix and find the eigenvector with largest eigenvalue. The eigenvector provide the priority ordering and the eigenvalue is a measure of the consistency of the judgement.

As it has been recognised, the design problem in this project is actually resource allocation problems. To allocate a resource (mainly budget), we need to look deeper into what is needed and how it should be allocated. A simple example would be to allocate the resource to several alternatives. To do this, we must prioritise the alternatives according to their benefits and costs. Thus we need look at the alternatives in terms of what purpose they fulfil and how strongly and also in terms of what it would cost to bring out these alternatives.

## Two Hierarchies

To calculate the benefits of alternative we need to consider a hierarchy of objectives and attributes of alternatives and the alternatives themselves to judge how much they each contribute to the fulfilment of the objectives. The next step is to consider a hierarchy for the cost of bringing about the alternatives.

Following the methodology, we need to establish two hierarchies. Based on the analysis of system objectives and the components of network benefits and costs, two hierarchies, therefore, can be set up (Figure 10.10 & Figure 10.11).

The following principles are thought to be useful in AHP:

1. Benefit Element—Identify all components for each benefit expected to be received as a result of undertaking a project.
2. Cost Elements—Identify all components for each costs expected to be incurred as a result of undertaking a project.

Examining the Table 10.5 and Figure 10.10 & Figure 10.11, we may discuss network benefits in terms of user, participating libraries and network systems etc.

User benefits consist of the benefits derived from the accessibility and availability of services to users improved, satisfaction level increased, ease-of-use of system improved, delay time reduced and user effort input reduced etc.

System benefits consist of the benefits derived from system accessibility increased, resources shared, duplication reduced and services expanded etc..

The individual participating library benefits consist of staff time saved, duplication reduced, manpower and equipment utilisation improved etc..

And the costs can be discussed in terms of set-up costs, operating costs and users costs etc.

The set-up costs consist of running costs, personnel costs of equipment, material and personnel costs for set-up etc..

Operating costs consist of running costs, personnel costs for operation and maintenances etc.

User costs consist of users effort needed and inconvenience caused to users and delay in services etc.

Three different alternative programmes will bring out or lose the benefits discussed above in different degrees. Generally speaking, the computerised network can reduce the staff time, improve productivity, improve management controls etc. Benefits and effectiveness consideration for a computerised network has been discussed earlier.

Before we prioritise the elements, it is useful to summarise the results of cost analysis and

Figure 10.10: Hierarchy of Benefits of Networking

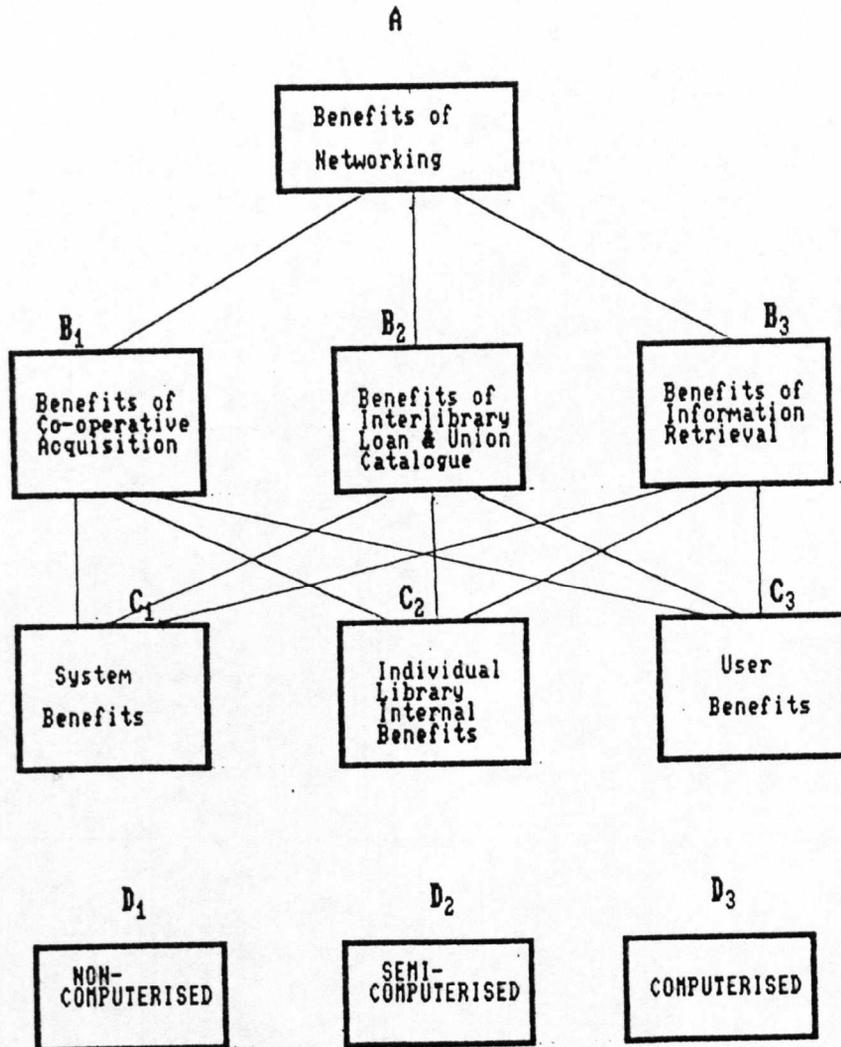
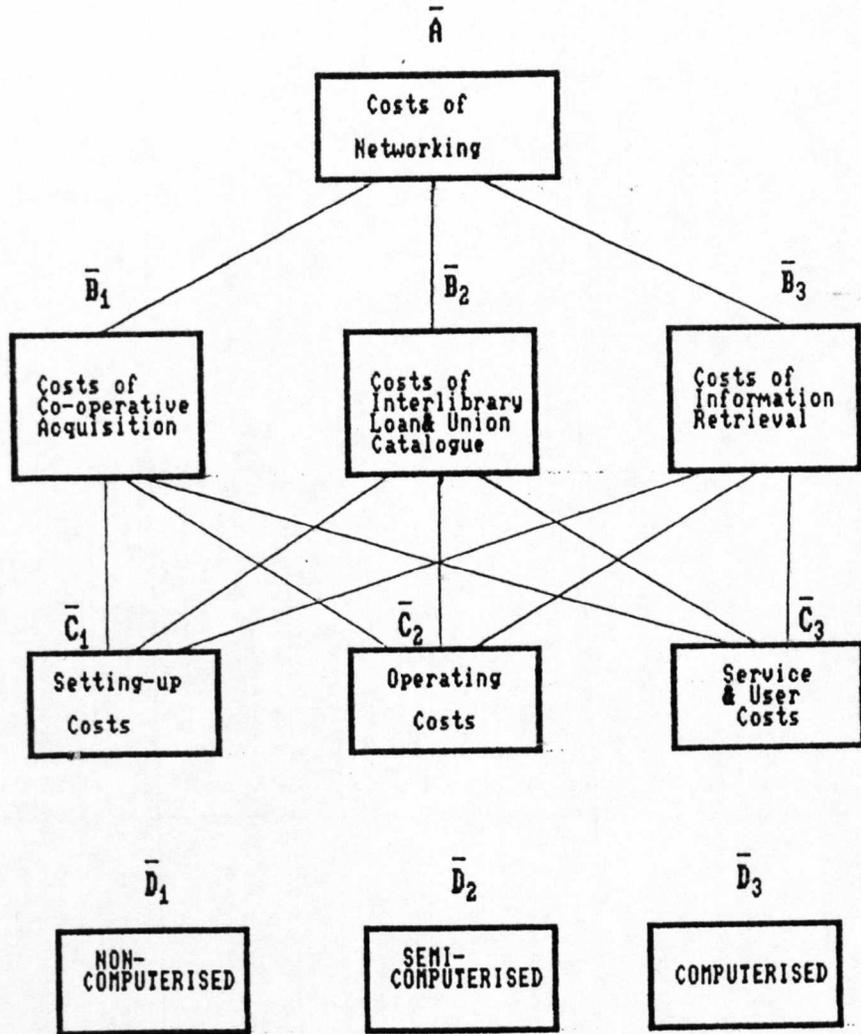


Figure 10.11: Hierarchy of Costs of Networking



benefit assessment in literal terms. Table 10.10 & Table 10.11, intend to make a comparison of cost and benefits both attribute-wise and program-wise.

**Priorities and Matrices**

The hierarchies, as presented in the last section is more or less faithful model of a real-life situation. It represents the analysis of the most important elements in the situation and of their relationship. It is not a very powerful aid in our decision-making or planning process. What we yet need is a method to determine the potency with which the various elements in one level influence the elements on the next higher level, so that we may compute the relative strengths of the impacts of the elements of lowest level on the overall objectives. The exercises of costing and benefit identification provide important information at this stage. The actual quantitative data together with qualitative judgement are powerful sources for prioritising. Consulting the scale table (Annexe 10.8), for both benefit and cost hierarchies respectively, we then can set up a series of matrix and place the priorities for the elements of each levels pairwise according to their influence on the next higher level. The judgement matrices are listed in Annexe 10.9.

**10.4.3 Results and Discussion**

In the calculation of both benefits and costs, CA outweighs the others. The user, participating and network system benefits derived from computerised system all received high priorities.

As for costs, system costs in computerised system, operating costs in semi-computerised system and user costs in manual system all received high priorities.

Therefore, the composite benefits and costs are derived from the calculation of eigenvector in the matrices. Calculation was done by a Basic programme for AHP and the results (Annexe 10.10) are

	Program One	Program two	Program Three
Benefits ( $b_i$ )	0.133	0.347	0.519
Costs ( $c_i$ )	0.206	0.363	0.431

The criterion used in cost-benefits analysis is to find  $\text{Max } \frac{b_i}{c_i}$ , that is, choose the program with largest benefit to cost ratio.

For this case we have

Program One	Program Two	Program Three
$\frac{b_1}{c_1} = 0.646$	$\frac{b_2}{c_2} = 0.956$	$\frac{b_3}{c_3} = 1.20$

10. Cost-effective-benefit Analysis—Generation of Alternatives

Table 10.10: Cost & Benefit Comparison among Different Types of Attribute

COSTS	CA			ILL-UC			IR		
	Set-up	Operat -ing	User	Set-up	Operat -ing	User	Set-up	Operat -ing	User
Manual	Base	Base	Base	Base	Base	Base	Base	Base	Base
Semi- Computerised	Higher	Highest	Lower	Higher	Lowest	Low	Higher	Higher	Lower
Computerised	Highest	Lower	Lowest	Highest	Lower	Lowest	Highest	Highest	Lowest
BENEFITS:	Network System	Libraries	User	Network System	Libraries	User	Network System	Libraries	User
Manual	Base	Base	Base	Base	Base	Base	Base	Base	Base
Semi- Computerised	Lower	Higher	Higher	Higher	Higher	High	Higher	Higher	Higher
Computerised	Lower	Highest	Higher	Higher	Highest	Highest	Highest	Highest	Highest

10. Cost-effective-benefit Analysis—Generation of Alternatives

Table 10.11: Cost & Benefit Comparison among Alternative Programmes

COSTS	CA			ILL-UC			IR		
	Set-up	Operat -ing	User	Set-up	Operat -ing	User	Set-up	Operat -ing	User
Manual	Base	Highest	Lowest	Base	A bit Higher	Lowest	Base	Highest	Lowest
Semi- Computerised	Base	Highest	Lowest	Base	Lower	Lowest	Base	Lower	Lowset
Computerised	Base	Lower	Lowest	Base	Much Lower	Lowest	Base	Much Lower	Lowest
BENEFITS:	Network System	Libraries	User	Network System	Libraries	User	Network System	Libraries	User
Manual	Base	Lower	Lower	Base	Lower	Higher	Base	Higher	Higher
Semi- Computerised	Base	Higher	Lower	Base	Higher	Higher	Base	Higher	Higher
Computerised	Base	Higher	Lower	Base	Higher	Higher	Base	Higher	Higher

The criterion favours Program Three.

Whether the network will adopt the Program Three or not need to take the following into account:

1. The present economic and technological situation, i.e. economic and technological feasibilities.
2. The future possible input (resources, manpower and budgets etc.)

Though computerised system is the most cost-effective system, the network may not able to establish it in the near future due to financial and technological barriers discussed in the preceding chapters. Therefore, it may be more reasonable for the network to choose Program Two as the starting point of computerisation and strive for high-level computerisation when conditions become mature.

### 10.5 Conclusion and Discussion

When all the variables affecting automated network systems are considered, it is very tempting to say that no realistic comparisons can be made. What is needed is some definite statement of just what criteria can be used to determine costs and how they are derived.

How well the system attains its intended goals within the desired limits of design, development costs are usually initial costs only, but operating costs continue as the system functions. Operating costs must include the cost of data preparation, computer run times, costs of program maintenance, additional equipment costs, and cost of special forms or material needed.

Though the analysis favours the Program Three, the author believes that the Program Two is more feasible and practical to be established in the near future for a network like ZALINET.

In the western, the use of computerised system in libraries, information centres, and network is now comparatively commonplace and is no longer a controversial issue.

Over the past few years there have been many technological developments which have affected, or will affect, librarians' use of computers. One of the major developments has been the advent of comparatively cheap microcomputer systems, with increasingly sophisticated features which can be used for a variety of library applications. Another major development has been the decrease in cost and the increase in availability of telecommunications network. Many libraries now use these networks to gain access to external services such as on-line shared cataloguing systems and the on-line search services. (Tedd, 1984)

As for the situation in China, the advantages of microcomputers are appreciated by many libraries and information centres, and many of them can afford to acquire one. Besides, the establishment of telecommunication network nation-wide and region-wide is under way. But for the time being, it may be easily accessed only by those libraries in cities. For a network

like ZALINET, which covers lower level libraries, the initial telecommunication network may be beyond the reach of some remote libraries.

After the cost/benefits analysis and evaluation of technological and economic feasibility, we may draw some conclusions.

Firstly, computerised network, with nodes linked on-line, is an ultimate goal for the future development in ZALINET since it is the most cost-effective alternative.

Secondly, semi-computerised network seems more feasible and practical to be established in the near future. To set up such a system, the following should be borne in mind:

1. If the parent body of a central library has already acquire a fairly large general purpose mainframe computer, it is suggested that the centre make use of the computer facilities and programming staff. Adopting this situation is normally cheap in that the network can share the expensive computer costs. However, the computer and programming staff are not under the control of the centre and the network, and so frequently the centre has to compete with other departments for necessary computer system resources. Comparing the pros and cons, when the network is able to afford a reasonable size computer and the data processing needs a big capacity computer, the network may consider to acquire one for its own purposes.
2. It is more cost-effective if all the functions are computerised together. Centralised technical services (e.g. processing of acquisition orders and UC), and centralised user services (e.g. centralised UC services for locating ILL request and IR services) should be concentrated on one or two centres.

The reasons can be seen that all the functions can share the costs of facilities and that they can share the system output. Once a MARC file is created, it can be used in acquisition, cataloguing, ILL etc.

Finally, when a semi-computerised system is under design and planning, the network should start those functions manually first and during transit the network should pay attention to the compatibility, further utilisation of the basis created and continuity.

Nevertheless, when the author suggests that ZALINET should have a semi-computerised system and that computerised system is an ultimate goal, it does not necessarily mean that the author believes that computer is a cure-all. The author agrees with Mason (1971) for some of his statements:

1. Computer do not make everything effortless;
2. Computer-based procedures do not usually save time over the manual procedures which are replaced;
3. It is not easy to transfer the programs for computer-based systems between libraries;
4. It is not easy to combine individual library systems into a totally integrated system.

# Chapter 11

## Data Collection and Validation

### 11.1 Introduction

During the stage of data collection planning, it is essential to figure out why collect data, what to collect and how to collect data?

#### 11.1.1 Purpose of Data Collection

Data collection usually involves measuring some research phenomenon, whether it is a process, an object, or a human subject's behaviour. The objects of measurement will differ, of course, from one research project to another, depending upon the purpose of the inquiry and the availability of suitable instruments.

As mentioned above, data is important at four stages of networking design and planning. At first stage, it describes situation (e.g. the present situation of agricultural library and information system in Zhejiang province); in the second it test theories (e.g. Queueing Theory); when plugged into suitable models, it explains situations (e.g. trade-off between cost and benefits in three alternative programme); and finally, it predicts(e.g. future performance level).

At the hypothesis testing stage, it is sometimes necessary to obtain data from other sources than the individual network in question.

The purposes of the data collection in this project were identified as follows:

1. Evaluation of the existing system;
2. Determination of objective and performance measures;
3. Identification of constraints to fulfilling those objectives;

4. Estimation of parameters of the models; and
5. Testing and validation of the theoretical models.

These purposes will be discussed in more details in the latter sections.

### 11.1.2 Class of Data

The data concerning libraries, information centres and networks can be classified in various ways.

Firstly they can be grouped under four main headings: resources, activities, operations and background (Ford, 1969)

#### Resources

Labour, money, bookstock, seats, shelves and equipment are all resources which can be counted in obvious ways.

#### Activities

The activities group includes the services of the library—lending, reference, photocopying, etc. the “internal” activities—acquiring books, administration, etc; and the users’ activities—using the catalogue, consulting books and so on.

#### Operations

Operations are the links between resources and activities. At very least, we need to know how much resource is absorbed by each activity.

#### Background

Background data is mainly concerned with potential demand and external factors that influence the actual demand.

Secondly they can be categorised into two groups, quantitative and qualitative data.

### 11.1.3 Methods of Data Collection

At outset of problem solving, it is necessary to decide not so much how to collect the data, as what data to collect. Once it has been decided what is relevant, there is frequently an obvious way of obtaining the required information.

There are many analytical techniques for investigating libraries and information centres. Among the conventional techniques are Questioning Procedures, Analysis Records, Performance Evaluation and Cost Analysis. (Martyn and Lancaster, 1981)

The particular methods adopted for the data collection in this project are the following:

1. Questionnaires
2. Interviews
3. Observations
4. Library records
5. Checking books and counting requests
6. Use of published statistics
7. Cost Analysis

How these methods are applied to the data collection will be discussed together with the particular surveys, observations and library records in the latter sections.

### 11.1.4 Planning for Data Collection

Before data collection, a framework was worked out to help planning and to guide the processing of data collection (Table 11.1). Different types of objects, falling into two broad categories, i.e. Internal Efficiency and External Effects, require different approaches.

More specifically, based on the classification of four types of data, a detailed lists of data to be collected were worked out before conducting data collection (Appendix F).

The needs for statistical analysis of some data were realised. For instance, when modelling, certain hypothesis were established. The raw data collected, especially for the purpose of parameter estimation need to be processed and tested by some statistical analysis techniques in order to test the hypothesis first and then plug the data into the models constructed.

For the convenience, the collection of these four types of data will be discussed under the each surveys or other data collection activities. The following section will discuss the surveys conducted by the author when she was in China for half a year.

Overall, the data collected were mainly from the province being concerned. However additional data from outside were needed to meet the purposes mentioned above.

Table 11.1: Framework for Data Collection

INTERNAL EFFICIENCY		EFFECTS	
OBJECTS	METHODS	OBJECTS	METHODS
STAFF	SELF-OBSERVATION DIARY QUESTIONNAIRE INTERVIEW	USERS	OBSERVATION QUESTIONNAIRE INTERVIEW
RESOURCES	INTERVIEW QUESTIONNAIRE	BOOKS (USAGE) PERIODICALS	COUNT DUE DATE COUNT CITATIONS
BUDGETS	INTERVIEW QUESTIONNAIRE	SECONDARY SOURCES	COUNT THE CITATIONS
COSTS OF SERVICES	INTERVIEW QUESTIONNAIRE		

## 11.2 Description of Surveys

### 11.2.1 Surveys on Zhejiang Agricultural Library and Information Centre Statistics

#### Purpose of the Survey

The purpose of the survey was to collect resource and some background data in order to help in

1. Evaluating the existing system, in terms of resources available, and performance of the service;
2. Determining some objective measures on the basis of analysing these data;
3. Identifying resource constraints to fulfilling the objective of these libraries & information centers; and
4. Estimating parameters of the models, etc.

#### Methods and Results

The survey consisted of a questionnaire (main means) and interviews (supplements), which covered the following categories of questions:

1. Types of libraries or information centres
2. Stocks (Chinese and foreign books, Chinese and foreign periodicals, and others)
3. Number of staff and structure of staff
4. Budgets, expenditures and incomes
5. Exchange of internal publications
6. Modern facilities and equipment
7. Types of UC kept and participated
8. User requests (including circulation, ILL & IR)

Questionnaires (Annexe 11.1) were sent to all the agricultural libraries at over prefectural levels (28) in Zhejiang province, 22 of them responded and made up 78.6% response rate. Interviews then paid special attentions to these libraries which did not response. Eventually, a fairly satisfactory results were achieved to serve the purpose. The data collected are presented under the following categories (Annexe 11.2):

1. Types of library
2. Number of users (number of borrowing cards issued)
3. Number of staff
4. Book stock (Chinese and Foreign)
5. Periodicals (Chinese and Foreign)
6. Budgets (Total and proportion for library materials)

Several particular types of data are worth mentioning. First is the data about acquisition, i.e. data about how many new items acquired or how many items (periodicals) subscribed a year were collected. These data can be used as a minimum requirements for CA programme.

However, the author failed to gather the distribution data of items acquired subject-wise since there was no such data available in the library records.

Second is the data about the collection overlap between libraries. It is, however, a time-consuming job and the author could only afford to collect the overlap data about foreign language periodicals and new acquisitions among six libraries, CNRRI, TRI, ZAAS, ZAU, ZISIT and ZL (Annexe 11.3).

The data collected in this category serves the following purposes:

1. To help derive the data about number of titles accessible in the whole system, i.e. the coverage of collection;
2. To evaluate the existing overlapping degree of collections.

Besides, two operation type of data were thought useful:

### I. Budget

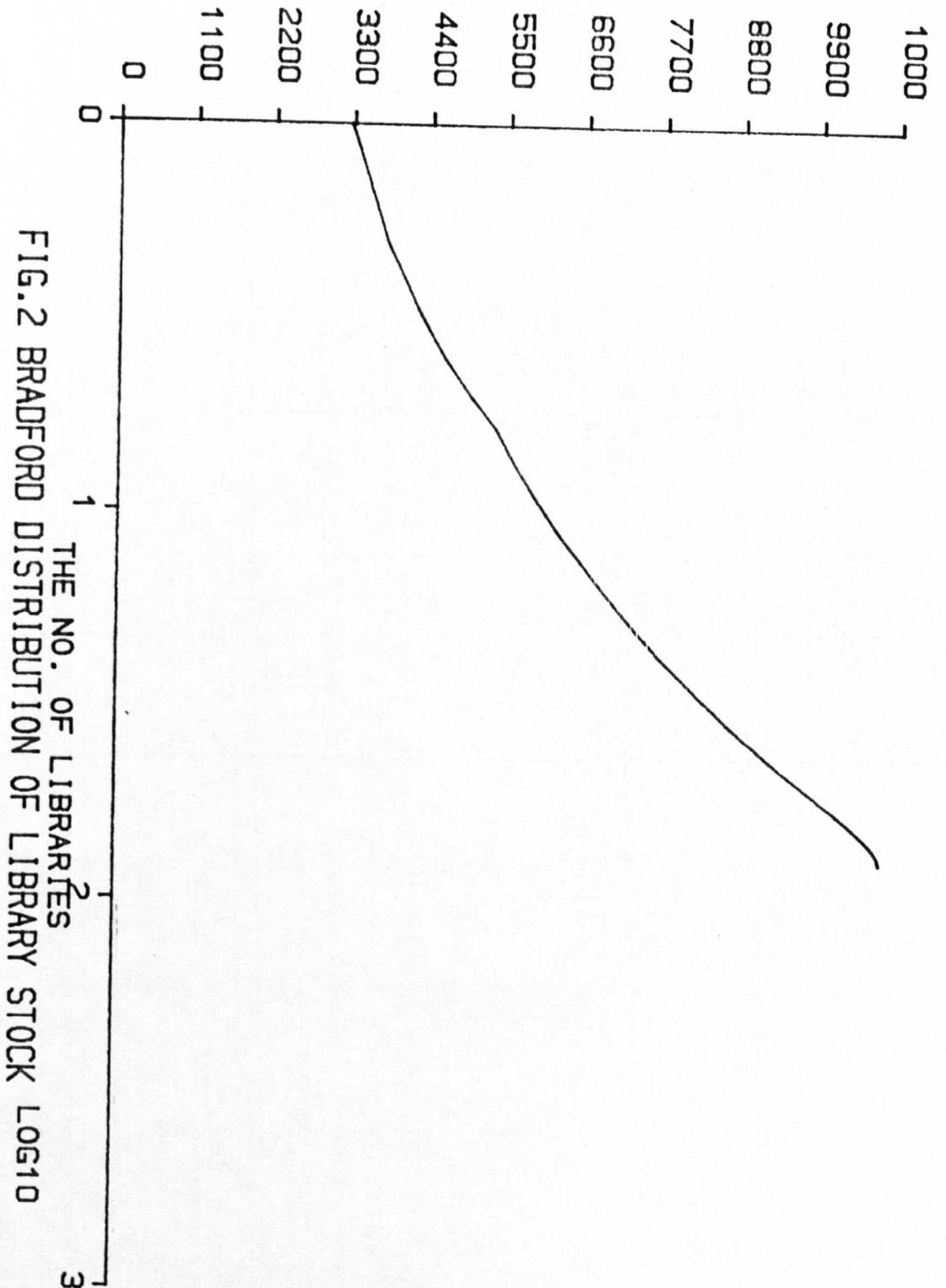
The total budgets and the proportion of budgets for library material at each node were deliberately collected in order to set up budget constraints. Furthermore, the data about the investments for compilation of UC and for setting up IR centre or services were gathered by interviewing some organisations.

### II. Staff

Data about number of staff in the libraries and the distribution of them at different section were collected.

A similar category of data were collected under the survey on *Zhejiang Public Library Statistics*. The data can be regarded as background data since public library system is supplement to the network. Data was collected by copying a detailed statistics disclosed in the "Exhibition on the Development of Zhejiang Public Library". The data was plotted according to Bradford Distribution. A profile can be seen that the public library system is fairly established (Figure 11.1).

Figure 11.1: Bradford Distribution of Stocks in Zhejiang Public Libraries



### 11.2.2 Surveys on ILL Demands & Services

#### Purpose of the Survey

The following purposes of the surveys were identified:

1. Evaluating the present situation of ILL in the system examined (e.g. scale, willingness, ways & channels etc.);
2. Determining the effectiveness measures (e.g. probability of satisfaction, turn-around time);
3. Determining the costs for processing ILL request; and
4. Determining the scale, structure and policy of ILL.

The following data were decided to collect in this survey:

1. Scale of ILL and number of transactions
2. Satisfaction of the transaction
3. Resources involved
4. Ways of ILL
5. Channels of ILL transaction
6. Average turn-around time
7. Responses to the cases when handling ILL request
8. Processing time for ILL (both borrow-in and loan-out).
9. Demands and requests on ILL
10. Comments on the present status of ILL services.

#### Methods

The methods used to collect the data of this category were the following:

1. Questionnaire
2. Interviews
3. Library Records

#### 4. Published Statistics

A questionnaire entitled as "Survey on ILL Demands & Services" was designed to serve the purpose (Annexe 11.4).

It is obvious that the questionnaire aimed at finding out the present situation of ILL and the efficiency, time and cost data of ILL transactions.

Besides, the data about number of ILL transaction were collected under "Survey on Library and Information Centre Statistics".

In reality, it was rather difficult to gather enough data from the system the author investigated on. Therefore, some data were added from outside system by visiting the libraries, interviewing library staff and analysing some published data etc.

#### Results

Annexe 11.5. summarises the results of the surveys both in the system being designed and in other systems. From the results, we can see the following trends:

1. The scale of ILL, i.e. number of libraries transacting with, varied greatly. Generally speaking, apart from the national library and some existing informal network, most libraries were only carrying a small scale of ILL service, in terms of transactions handled and libraries contacted;
2. In the system being designed, percentage of satisfaction ranged from 37.5% to 87.5% for loan-out, and from 30.0% to 88.9% for borrow-in. The libraries contacted with were not restricted to those in the system being designed. While the other system investigated seemed to have a higher percentage of satisfaction (50.0%-99% for loan-out and 48.1%-93.1% for borrow-in);
3. As for ways of ILL, most libraries had their "library staffs to carry out the whole process". Still in some libraries, "the whole process were completed by users themselves";
4. Regarding channels of ILL transaction, mailing predominated and "interchangeable library card issued" was a common phenomenon of ILL in China;
5. As far as average turn-around time is concerned, over twenty days were not uncommon; However, delays in the National Library are minimum since they handle the request within the same day of arrival;
6. Responses to the cases when handling requests varied from library to library:
  - (a) if the item was not in collection, many of them rejected the request. But still some relayed the request to other libraries;

- (b) if the item was on-loan by the local user, many libraries rejected the ILL request, and some had the request wait in the queue. But none of them would recall the local users;
- (c) if requests for the same items posed simultaneously by local users and users of other libraries, some of them adopted "local user priority" policy, some "ILL request priority" policy and some "First- come, First-served policy".

Two questions were not answered to the satisfaction, i.e. resources involved and average turn-around time (detailed processing time). For these categories of data, many libraries had no such records. The reasons were obvious: 1) many libraries had no dedicated staff dealing with ILL and the devotion of their time depended on the number of transactions arisen, which again varied greatly from time to time; 2) ILL services were not yet compulsory in many libraries thus no formal devices were established to record detailed data. And in fact, it was not appropriate to ask about processing time in such a questionnaire manner. Realising that, the author carried out an observation for processing time, which was discussed in the last chapter and more details will be given under cost data later.

In addition to the questionnaire method, Library Records were used to calculate the average turn-around time, satisfaction rate and geographical location of resource libraries.

Here the author intends to take the survey in ZAAS as an example. The author was permitted to access the library record (written forms) of ILL in ZAAS. The forms recorded 1) the name of requester, 2) bibliographical data of the document requested, 3) date of requesting and replying, 4) results of transaction (satisfied or not), and 5) cost of photocopying. Two samples were taken to work out the satisfaction rate and average turn-around time.

Annexe 11.6. presents the results of the survey. Some reflection can be made from the results:

1. Satisfaction rates were reasonably high;
2. The more recent year (1987 comparing with 1984) had higher satisfaction rate;
3. The location of resource libraries concentrated on Shanghai, Beijing and Hangzhou. But a higher dependence was placed on the libraries in Shanghai than Beijing and locality (Hangzhou); \*(Shanghai is nearest biggest city to Hangzhou);
4. Average turn-around time (25 days) was not so different from the other cases; and
5. The users were charged for the cost of photocopying only. Thus the costs increase as the number of pages photocopied increase.

### 11.2.3 Surveys on UC Compilation

#### Purpose of the Survey

The survey intended to find out the following types of data:

1. Types and forms of UC existed in the system investigated;
2. Number of participating libraries
3. Coverage of the UC
4. Resources involved
5. Number of copies produced and circulated (Printed)
6. Time period to complete the UC

The above data will help:

1. Evaluating the existing situation of UC compilation;
2. Determination of set-up costs for UC compilation;
3. Carrying out cost-effective analysis of UC compilation and allocation.

### Methods and Results

There were two major sources for the data collection:

1. Surveys by Interview and Questionnaire
2. Published Data

One questionnaire was specially designed to find out the data listed above (Annexe 11.7).

Such data were not available in the systems the author investigated on. Therefore, some libraries or organisations at a higher level, or some libraries which have compiled UC, were chosen as the object for investigation. The questionnaire also served as the list of question to help conduct some interviews.

The data about the number of UC for locating requests at each node were not available. Annexe 11.8. summarises the results.

#### 11.2.4 Surveys on IR Services

##### Purpose of the Survey

Again the purposes were obvious: evaluating the existing situation of IR services, determining the cost of IR services etc.

### **Contents of the Survey**

The survey aimed at finding out the following data:

1. Types of IR services (manual or computerised, off-line or on-line, SDI service or RS services)
2. Number of topics searched annually
3. Response time and other effectiveness measures
4. Charge for searching
5. Staff time per search

### **Methods and Results**

The following three sources are major sources for data collection concerning this topic:

1. Interviews and Questionnaire
2. Library or Information Centre Records
3. Published Statistics

Some of the data under this heading were collected under the "Survey on Library and Information Centre Statistics". One category was devoted to collect the data about IR services.

But the data about how many IR request there were in the whole system was rather incomplete. So the User Estimation Model constructed (see Chapter Nine) can be used to estimate the number of requests and predict the future requests under consideration of the number of scientists and users.

The request and efficiency data about either manual or on-line or off-line IR were also intended to be collected in order to make a cost-effectiveness comparison between them.

#### **11.2.5 Surveys on User Information Needs and Behaviours**

##### **Purpose of the Survey**

This survey intended to find out the information about users; information need and behaviour, with particular reference to those co-operative functions.

## Contents and methods

Two questionnaires were designed to meet this end:

1. Instant Questionnaire (Annexe 11.9.)
2. Questionnaire of Users' Information Needs and Behaviour (Annexe 11.10)

### I. Instant Questionnaire

This questionnaire intended to find out the following information:

1. User's need on different forms of information
2. Availability of items, or probability of satisfaction
3. Reasons of dissatisfaction
4. Need for ILL services
5. Reasons for not enquiring on ILL

Based on the above information, we may obtain a rough picture of user's need and the performance of library services in the system investigated.

The questionnaire was deliberately designed as simple and concise as possible so that the readers would be patient enough to fill in when they leave the library. During the survey, the author distributed the questionnaire to 8 different types and levels of libraries and asked the library staff to place them along the issue desks. When the readers were leaving, he could be asked to fill in the form by the library staff. The results were fairly satisfactory. Annexe 11.11. presents the data gathered in the survey. From the table, we can see the following trends:

1. Users came to library for reading more than borrowing;
2. Users borrowed or read more books than periodicals;
3. The average availability was fairly good (91.4%)—this may implies the low information need and utilisation.
4. The major reasons of unavailability were "Items not in Collection" and "Items on-loan";
5. A high proportion (41.7%) of users did not demand ILL services;

Among major reasons are

1. ILL services were not available—user might have not been aware of the existence of the services since they were not compulsory or not advertised etc;
2. No UC services were available to find out the location information;
3. It took too long to get the document requested;
4. It was too troublesome.

## II. Questionnaire of Information Need and Behaviour

The survey intended to find out the frequency of use in

1. Language of documents;
2. Types of documents;
3. Subjects and orientation of documents;
4. Decades of documents (Publishing Date);
5. Approaches to finding a clue and other data;
6. Causes of dissatisfaction;
7. Percentage of research or teaching time spent on consulting and reading documents;
8. Responses to the unavailability of document (i.e. when item is on-loan);
9. Responses to the inaccessibility of document (i.e. item is not in collection).

85 copies of the questionnaire were distributed to the research staff in CNRRI. To assure a high response rate, the author chose the head of each department as the first points for distribution and then the head distributed them to the staff concerned. This was because that the internal delivery system for mail was not efficient enough. By this way, the author was able to obtain a reasonable higher response rate (56.5). Nevertheless, because of the nature of agricultural research, some researchers traveled around from time to time and it was difficult to get hold of them.

The results are summarised in Annexe 11.12.

Here, the following important findings can be derived:

1. *Language*—Chinese material accounted for a majority proportion of information needed. Among foreign language materials, English and Japanese ones were dominant;
2. *Language and Form*—Chinese periodicals ranked the first and then foreign periodicals the second;

3. *Subject*—"Subject of one's own" ranked the first and then "relevant subjects" the second;
4. *Decades of the material*—Recent material (1980S) ranked the first.
5. *Clues of Reference*—"Abstract and Index journals" ranked the first and then "New Books & Periodicals," and "Citation and Reference of Papers" the second and third respectively;
6. *Causes of Dissatisfaction*—"Not in Collection" ranked the first; then "Failure in finding" the reference needed;
7. *Time spent on consulting information*—Majority spent around 10-20% of their research time consulting information;
8. *User Responses to the Unavailability*—Majority wished to make a reservation and recall the borrowers;
9. *User Responses to the Inaccessibility*—Majority wanted to "suggest the library to acquire and subscribe the items" and many desired on ILL.

The above findings are certainly valuable information in the practices of design and planning of network functions and in the establishment of performance criteria of those functions. For instance, from the survey, we can learn what materials users demand most, in terms of language, type, subject and time period. How good is the availability of local libraries? These are all very important information for the design of CA.

### 11.2.6 Survey on Views from Library Directors

#### Purpose of the Survey

As we all know, before design and planning network, it is crucial to analyse the motivation of networking. No networks can be effective without the true willingness from the individual libraries. Preferences and proposals about networking from decision-making level are obviously valuable guideline to analysts and designers. But bearing in mind, gathering opinions from library staffs and user communities are as essential and important as that.

This survey aimed at finding out the attitudes, viewpoints from library directors. The following issues have been particularly focused on:

1. Points of view about the way of relief in the situation of rapid growth of publications, inflation, tightened budgets and increased demand;
2. Outlook on the establishment of a formal network;
3. Opinions about the favourable conditions of, and constraints to networking;

4. Points of view about the influence to and impact on the libraries and information centres by networking;
5. Preference to the scale, type, level and configurations of network;
6. Preference to the candidate(s) as a co-ordinating organisation of network;
7. Proposals about the co-operative activities which should be carried out in the network;
8. Opinions about the source of funds;
9. Proposals about the connection between nodes; and
10. Comments on the present status of ILL services in China, etc.

## Methods

Under this theme, interview method was adopted. Before interview, a list of eleven questions was prepared. Among these questions, some was open-ended, some yes-no questions and some structured questions. The intention was to explore as much information of interests as possible. Ten library directors, from libraries of different types and levels were chosen to be interviewed. Appointments were made through telephone. Most interviews took roughly thirty minutes to go through. During interview, it was necessary to guide these directors to stick the questions of interviewer's interests.

## Results

Annexe 11.13 presents the question list together with the summary of the results. Based on the analysis of the summary, we may derive the following important findings:

1. Networking has been thought as an efficient way of relief (of economic difficulties in libraries), but not necessarily the first and only choice.
2. Many of them were not so optimistic about setting up a large scale and formal network in the near future.
3. With critical views on China's present situation, many of them felt that there were more constraints than favourable conditions for networking. Among main constraints are recognition, technological, financial and administrative constraints.
4. Generally speaking, the attitudes towards the networking from various level of libraries were somewhat different. They can be summarised as follows:
  - (a) The libraries possessing big collections were afraid of being taken advantages and being overburdened. They intended to close the door to other small libraries.

- (b) Some middle-size libraries had the concept of "small-scale peasant economy" in management. They were only willing to co-operate with bigger libraries and get more benefit from them.
  - (c) Some small-size libraries put too much dependence on the big libraries without trying their bests.
5. Concerning influence of networking on individual libraries, most of them thought that networking would put on "too much work-load on library staffs". As for impact, "improving the effectiveness of library or information centres" was regarded as the most important impact;
6. The viewpoints about the structure of network were asked in terms of the following:
- (a) Types of network  
Most of them (50%) preferred the subject network of same sectors (e.g. Agricultural Research Library and Information Network).
  - (b) Administrative and Geographic Scale  
Many of them (50%) preferred provincial network.
  - (c) Levels  
Many of them preferred three levels consisting of provincial, prefectural and county levels.
  - (d) Configurations  
Majority (70%) preferred hierarchical configuration.
7. Regarding co-ordinating organisations, many of them emphasised on the important role of the agricultural departments of provincial governments. And many preferred the establishment of executive group, with full-time staff in charge and committee consisting of directors of big libraries.
8. As regards with co-operative activities (network functions), ILL services, compilation of union catalogues, CA, widespreading exchange of material and IR services all received high preferences. And they are listed in a decreasing order of preferences.
9. As far as the funding is concerned, many of them thought that network should be funded by both participating libraries and government investments.
10. As for the connection among nodes, many of them preferred the establishment of centres throughout national, provincial, prefectural levels, contacting with nodes in other prefecture, provincial through centres.
11. As far the comments on the present status of ILL services in nation-wide or region-wide. Most of them thought that the present situation was not satisfactory at all.

As mentioned above, apart from the data collected from the system being concerned, additional data either from outside or from other categories of sources, were needed.

## 11.3 Additional Data Collection (for three important types of data)

### 11.3.1 Background Data

#### Purposes

The purposes were obvious:

1. Identification of the environmental factors;
2. Identification of the potential capacities of the network being designed;
3. Identification of potential user needs;
4. Identification of possible constraints;
5. Establishment of performance criteria and measures.

#### Types of Data and Methods

Major sources of data collection were the following statistics and publications:

1. Zhejiang Agricultural Statistics
2. Statistics of China's Agricultural Research Institutes
3. Statistics of Provincial Agricultural Information Centres (libraries) in China
4. Various Publications
5. Bibliographies

The data collected from the above five sources were extensively used in the preceding chapters, especially in Chapter Five and Chapter Ten.

The data gathered from the first three sources are mainly resource data (budget, personnel and stock etc.).

Besides, the following background data was thought particularly useful to gather:

#### I. Total number of titles universally available (Annual World Output)

The data about number of titles of Chinese books, Foreign books, and distribution of books among subjects, Chinese periodicals and Foreign periodicals on Agricultural

Sciences or relevant subjects were collected from National Bibliographies, Book News and some published papers etc. Appendix E described the sources of data in more details.

### II. Bradford distribution of some specific subjects

The data were collected by some published paper and bibliographies. The data were used to help set up desired proportion of periodicals, reasonable target for subscription, in terms of rank (vide Appendix E).

### III. Potential users of network

The data about potential user distribution among categories and geographical location were collected from some published statistics. All the staff in agricultural field and agriculture related field were regarded as potential users.

### IV. Subject coverage of the network-to-be

It was decided according to the nature of organisation covered. The network-to-be covered a broad range of subjects including agriculture, animal husbandry and horticulture etc.

### V. Geographical distribution of nodes

Data was collected from the statistics.

### VI. Communication means

The situation (descriptive) of telecommunication system was investigated by visiting the Zhejiang Telecom.

### VII. Total budgets for some parents organisations in the system

A statistics disclosing the total budgets (research) for the research institutes, was consulted. Then a picture of the financial situation of these institutes and how much we can expect from these budgets to improve library and information services was gained. For example, according to some principles, universities in China are suggested to spend 5-10% of their budgets on libraries. In reality, most of them are spending around 5% of budget or even less. This is a phenomenon needing attentions.

### VIII. Personnel distribution of parents organisations

Again, the statistics disclosed the personnel distribution. In order to design a network capable of meeting various needs, it is important for the designers to know the network users(including potential users), in terms of population, subject orientations and profession structures (vide Appendix 6.1.).

## 11.3.2 Request data and Loan Period

### Purposes

The main purposes of collecting this type of data can be stated as follows:

1. Identification of users' needs quantitatively and qualitatively;
2. Estimation of parameters for mathematical models;

### Types of Data and Methods

Request data are usually regarded as activity data and the following data were collected:

- I. Number of requests on information of Agricultural Sciences in 10 sub-classes (distribution from 29 nodes)

The data was collected under the following categories:

1. Chinese Books
2. Foreign Books
3. Chinese Periodicals
4. Foreign Language Periodicals
5. Proportion of Collections
6. Proportion of Demand

- II. Number of request for ILL and IR services

To give an example, the author here intends to describe the collection of the first type of data, i.e. number of request in different class. As for the groups of collection, they can be determined by various ways: its level of usage or the original sub-classes or the level of usage in a specific class. The data were collected by taking some samples and counting the due date label of the books. Class S was chosen as the sample and the libraries' card catalogue were used to pick up the books of every "fifth" items on the catalogue. And then the dates stamped during one year (August 1986—July 1987) on the date due label were counted.

The status of the items was decided as follows: number of items not available at the time of counting; number of items loaned, 0, 1, 2, 3, 4, 5 times. When counting the total times of the loan, the status of "not available" was counted as at least once. Annexe 11.14. presents an example of data collected in JHAS.

The following data were derived:

1. Average request of each title in a specific sub-class at each node;
2. Average request of the titles in a specific sub-class in the system;

3. Average request of all sub-classes at each nodes;
4. Average request of all sub-classes in the system;
5. Proportion of demand;
6. Proportion of book stock.

Again, as an example, Annexe 11.15 summarises the average request on Chinese Agricultural Books from the data of 28 libraries.

The data derived was to estimate the parameters in both formulas for “Material Accessibility” and “Probability of Dissatisfaction”. In the former, it is regarded as average demand from each node on each title of a group which is accessible. In the latter, it is defined as average arrival rate ( $\lambda$ ) on each title at each node. During the counting, the duplications (i.e. number of copies of a title) were purposefully counted so that the average duplication of each title were able to be derived.

The data about loan period was useful to estimate the parameter of the return rate in the queueing system, i.e. local availability in this project. If we analyse the data of unavailability rate and loan period, we, therefore, can derive the value of probability of dissatisfaction and return rate, which are useful to estimate the parameters in queueing system. The former can help set up a performance measure (by trade-off between desired objective and reality) while the latter can help derive the average return rate, which can be plugged into model for analytical or optimising solutions.

### Results

Annexe 11.16 presents an example of the request data from individual library and summary of request data of 28 libraries.

Annexe 11.17 summarises probability of dissatisfaction and loan period from 28 libraries.

As mentioned above, a major usefulness of the above data is to estimate the parameters in the model. To assure the minimum bias and error, it is essential to carry out statistical analysis for these data and to test if the standard error is reasonably small and if the data conforms with the empirical distribution (e.g. Poisson Distribution). The detailed statistical analysis will be discussed in a later section.

### 11.3.3 Cost Data

#### Purposes

One very obvious purpose of collecting cost data in this project was to carry out cost analysis, and eventually cost-effective-benefit analysis.

## Types of Data and Methods

The following types of data were identified:

1. Costs associated with CA—Purchases of Stock
  - (a) Average price of books (Chinese and Foreign) and periodicals—sampling and published data;
  - (b) Cost requirements for achieving certain level of effectiveness measures;
  - (c) Total costs of acquisition (Agricultural Stocks);
  - (d) Costs of acquisition in previous year (1987);
  - (e) Budget available for present year;
2. Costs associated with acquisition processing
  - (a) Set-up costs (equipment, resources) for different alternative programmes;
  - (b) Running costs for operations;
  - (c) Staff costs for processing
  - (d) Unit cost for services
3. Costs associated with ILL-UC system
4. Costs associated with IR system

(3) and (4) all consist of the same cost components as (2).

Unfortunately, the data about cost of CA, ILL-UC, and IR services by Manual or Off-line or On-line were not all available in the network being designed. Some data had to be collected in the libraries and information centres at some higher level, but they were still incomplete.

Detailed presentations of cost data and descriptions of data collection were given in the last chapter. Here the author will emphasises on the problems and difficulties in the data collection, especially that of processing costs.

Among the major difficulties in collecting cost data are:

1. Existing manual services had incomplete cost figures about the services, in terms of investment and resources incurred;
2. Almost nowhere the cost data about computerised system can be collected since few computerised systems, in terms of library automation, MARC bibliographical systems and computerised IR services, existed in China;
3. When collecting data about processing time for acquisition, a diary exercise was conducted. It was difficult to convince the library staffs that data recorded was not to check individual's work efficiency.

Most Chinese library staffs were not familiar with survey methods in general and not to mention this type of self-observation. Thus, the author was only able to conduct a small scale of data collection through the co-operation from the library staffs in ZAAS & ZAU.

4. Similar difficulties appeared in the data collection of ILL processing time.

The general problems and difficulties will be discussed under the heading of *Difficulties in Data Collection*. Some problems from statistical analysis' points of view will be discussed under the heading of statistical analysis.

### 11.4 The Estimation of Parameters

As the author emphasised in the preceding sections, one important purpose of data collection is to estimate parameters of the mathematical models. Once a mathematical formulation is developed, it is almost always the case that data are necessary for estimating unknown inputs and parameters of the models.

Before the data collection, the author worked out a plan of data collection to meet the demand of parameter estimation.

For each formulation, a table was prepared with two broad categories, i.e. parameter to be estimated and raw data to be collected. The former includes variables, goal and constraints to be estimated (Annexe 11.18).

The collection of these raw data has been described and discussed in the preceding parts.

Data collection is a important but tough job. It suffers from various barriers. The following section is to discuss the problems in the data collection of this project.

### 11.5 Problems in Data Collection

#### 11.5.1 Psychological Barriers

There were four major types of psychological barriers to the exercise of data collection. They were recognition, acceptance, familiarity and fear.

Firstly, in most cases, the object being investigated, including library directors, library staffs and users did not fully recognise the importance of data collection in 1) improving their performance; 2) providing information for planning new services and management; 3) improving satisfaction of services etc. This situation were caused by the various factors, such as backwardness in library management and technology, library tradition and unfamiliarity of survey methods etc.

Secondly, because of the unawareness of the importance, many of them might not accept the idea of data collection and refuse to co-operate.

Thirdly, though some of them realised the importance and decided to co-operate, they might not be able to co-operate well because of the unfamiliarity to these survey methods.

Fourthly, many of library managers were not very keen in improving their performance or had fears of disclosing data about their performance and resource situation. Individual staff had some fear of being checked upon their performance and efficiency. And library directors and staffs had the fears of disclosing the secrecy of the libraries. Nevertheless, many of them did not actually know what data were secret. For the sake of safety, they would rather not say too much.

### 11.5.2 Traditional and Technological Barriers

In the past, most libraries did not record the data about their acquisition, circulation and catalogue etc. Recent years, many of them have started recording these data. However, some of them were not clear about the usefulness of these data. And some of data were collected in such a way that data was not very useful or the derivation from these data is time-consuming. In many cases, data recorded was rather incomplete. The possible causes were because that data collection was a time-consuming and costly job and that there was the lack of modern technology to facilitate the job, such as computers.

### 11.5.3 Limitations in the Data Collection from the Author

The above barriers all impaired the capability of the author to collect complete and desired data. Besides, there were following further limitations:

#### Time

It was a ambitious plan to collect such wide varieties of data within half a year. And it would be even more ambitious if scale, sample and time period for each survey were of certain sizes. Thus some compromise had to be made for each survey. Some of them might not be to the standard of Statistician.

#### Space (Distance)

Potential nodes of the network scattered everywhere in the province. Travelling to every corners was not feasible, if not impossible. Nevertheless, the author did make efforts to visit four capital towns of prefectures and three capital town of counties. Different types of libraries were visited. Besides, travelling outside the province was necessary to collect some valuable

information at some higher level libraries and existing networks (informal), such as Beijing Library, ISTIC, Shanghai Library and North-western library network etc. Long distance travelling was made to the cities of Beijing, Shanghai and Xi'an but no more could be afford to.

### **Money and Personal Capability**

The author was funded a limit amount of money by the employer, CNRRI. It was difficult for the author to travel around and to distribute too many questionnaires, of which the latter needed printing assistance \*(Chinese typewriter is much more complicated than English one. To type, a professional typist is required) and postages. In addition, because of the limitation of individual's capacity, such an ambitious plan and time-consuming job were far more than one person can load. However, to buffer the above difficulties, the author tried to adopt methods to save the expenses, for instance, delivering questionnaire to directors first and asking them to distribute in the libraries.

### **Authority**

Being an individual researcher, from a non-authoritative body, the author was faced with the problem of the lack of authority when contacting with these libraries and information centres. Thanks to the introductory letter from the employer of the author, the author was able to visit and contact the library directors and staffs. However, at the beginning, many of director were puzzled about why the author came to collect these types of data. After a detailed explanation, many of them were clear about the purposes of the author but wondering how to pass the explanation to their staffs and users. After necessary discussion with directors and library staffs, the author was able to persuade them to distribute the questionnaires on their own behalf, by stating the purpose of improving their own services. The author believed that in this way, the users would co-operate better.

Because of the barriers, limitations and difficulties discussed above, the sufficiency, quality, reliability and accuracy of the data inevitably were affected. Statistical analyses of some data are necessary but some problem will remain throughout the analyses.

As mentioned earlier, the raw data usually needs to be processed and tested in order to test the hypothesis and plug into the models constructed. The following section is to discuss the hypothesis to be tested, the types of raw data to be statistically analysed, the techniques of statistical analysis applied, and the results of statistical analysis etc.

## 11.6 Statistical Analysis

### 11.6.1 Reasons for Statistical Analysis

In general, statistical techniques may have many purposes. Descriptive statistics consists of methods and procedures for summarising, simplifying, reducing, and presenting raw data, to communicate the essence of the data to another. The purpose of such methods is essentially reportorial, as with the presentation of summary data to an administrator. The aims of inferential statistics are somewhat more ambitious. Inferential methods and techniques are used to make predictions, to test hypotheses, and to infer characteristics of a population from the characteristics of a sample. The frequency distribution is a means of imposing a degree of structure and order on numerical research data. Before data are organised, they are called raw data. In frequency distribution, raw numerical data are often ordered and arranged in an array according to their numerical values. Normally, the arrangement is from the least to the greatest observation (i.e. in ascending numerical order); however, the data can also be placed in descending order of magnitude. (Busha and Harter, 1980)

In this project, both descriptive and inferential statistics are applied in order to

1. Give a general picture of user request, resources (budgets) and price of documents etc by descriptive statistics;
2. Derive the mean of raw data, which can be further used to estimate the parameters; and
3. Test hypotheses (e.g. difference between the distribution of raw data (request) and theoretical Poisson Distribution) by inferential statistics. And frequency distribution is used to describe the Poisson Distribution.

More specifically, the following hypothesis related to the modelling of both descriptive and mathematical models was made before the data collection:

1. Different subject classes of titles may have different average number of request (network- or system-wide);
2. There may be a difference among the average number of request from different libraries;
3. Request (arrival) distribution in the system may conform with the empirical Poisson Distribution; and
4. The derived average processing time (distribution) from the observations made may be used to represent the real situation for a population etc. With the chosen criteria, the samples (i.e. observations made) are sufficient.

Two major data, i.e. request data and processing time data fall into the category which needs statistical analysis. The following sections will give account to this purpose.

### 11.6.2 Statistical Analyses of Request Data

From the raw data, the average number of requests of 11 subclasses of Chinese and foreign books were calculated and further summarised. (vide Annexe 11.16). Two sets of data were input into the computer to carry out statistical analysis by Microsta. The following statistical analysis were conducted:

1. Descriptive Statistics
2. Frequency Distribution
3. Analysis of Variance
4. Chi-square & Kolmogorov-Smirnov Test

#### Descriptive Statistics

Descriptive statistics was used to those commonly-used measures including sum, mean, standard deviation, and standard error etc.. Annexe 11.19 presents the summary of descriptive statistical data on 11 subclasses (both Chinese and foreign books) from 28 libraries.

#### Frequency Distribution

Frequency Distribution was used to give some picture of the request. An example of the print-out of frequency distribution is attached in Annexe 11.20. And the Aggregated Frequency Distributions are calculated. The treatment gives an illustrative picture of request distribution.

#### Analysis of Variance

The technique of analysis of variance can be briefly as follows: taking all the observations in samples from several populations (corresponding to several treatments), one breaks the variability about the overall mean into components, one associated with the actual population variability and the others associated with variations in sample means caused by the various factors involved.

The purpose of the analysis of variance in this project was to test the first two hypothesis mentioned above.

One-way ANOVA, Randomised Block ANOVA and Two-way ANOVA were carried out by the computer program and suppress treatment means are presented in Annexe 11.21 (a.b.c.). And Annexe 11.21 (d) summarises the results of ANOVA. For the case of the request data on Chinese books, analysing the result of one-way ANOVA and consulting the table of Percentage

Points of the F-distribution, we can see the value of  $F_{0.05}$  is 1.83 when  $V_1 = 10$  and  $V_2 = 297$ . The result from the statistical analysis of the request data,  $F = 17.615$ , which exceeds  $F_{0.05}$ . Therefore, there are significant differences among the 11 treatments, i.e. average requests on different classes. Then if we look at the result of Randomised Blocks ANOVA, the F ratio for Treatment and Block are 17.665 and 1.031 respectively, of which the former exceeds  $F_{0.05}$  (1.83), when 5% is the chosen significance level. That means that there are significant differences among 11 Treatment, i.e. request on different classes. While the latter is less than  $F_{0.05}$  (1.52). That means that there are no significant difference among Blocks, i.e. average requests from different libraries. Again, in the case of the request data on foreign books, the same conclusion can be drawn: there are significant difference among requests on different classes, but no significant difference among the average request from different libraries when 5% is the chosen significant level.

### Chi-square Statistics—Goodness of Fit test & Kolmogorov-Smirnov Test

Both techniques were used to test the Goodness of Fit between request data and the theoretical Poisson Distribution. The theoretical Poisson Distribution were obtained by entering the mean rate of occurrence,  $X_1$  and  $X_2$ . And the program then displayed the probability and cumulative probability for each value of  $X_1$  and  $X_2$ . Annexe 11.22 shows the output of the theoretical Poisson Distribution.

It is noticeable that the majority of the data have such a trend, that is, the “zero” group in the raw data was greater than that in theoretical distribution, but vice versa for “once” group. If we analyse the “zero” group, we can make such an assumption that in this group there are two sub-groups, of which one will never be borrowed in the future, i.e. the dead books, and the other are potentially borrowable. We can ignore the former groups when carrying out Chi-square test. But how we divide this group into two should be based on a recognised and reasonable methods. To solve this problem, a special Poisson Distribution called Zero-truncated Poisson Distribution was used. Therefore, the zero-group could be estimated by some simple calculation as follows:

$$e^\alpha \left( 1 + \alpha + \frac{\alpha^2}{C_2} + \frac{\alpha^3}{C_3} + \dots \right)$$

$$f(0) = ?K$$

$$f(1) = K\alpha$$

$$f(2) = K \frac{\alpha^2}{2}$$

$$\frac{f^2(1)}{f(2)} = \frac{K^2 \alpha^2}{K \frac{\alpha^2}{2}}$$

$$K = \frac{f^2(1)}{2f(2)}$$

The Chi-square test is normally applicable in situation in which determination of population parameters such as the mean and standard deviation is not an issue. Rather, the data in question fall naturally into discrete categories and are summarised in what is called contingency table. Individual entries in the table are called cells. The computer programme carries out the Chi-square test by entering observed frequency and predicted probability and giving out the value of Chi-square. Annexe 11.23 (a) shows an example of Chi-square test. And Annexe 11.23 (b) summarises the test results for the request data on both Chinese and foreign books from 28 libraries. The former are the results of original data, and the latter the results of zero-estimated data.

Consulting the table called Percentage Points of the Chi-square Distribution(1), we see that at 0.05 level at 5df and 6df, the values of  $\chi^2$  is significant if they are larger than 11.07 and 12.59 respectively. We can see some of the original data did not show a very good conformity with the theoretical Poisson Distribution under Chi-square test. The number of set data significant and insignificant by Chi-square test are summarised in Annexe 11.24. Again they present the results for original data and zero-estimated data respectively. It is noted that the data by zero-estimation gave better goodness of fit.

Beside Chi-square test, Kolmogorov-Smirnov Tests were used to test the same sets of data. The computer program carried out the tests and gave the value  $D_{max}$  and two critical values at 0.05 and 0.01 levels. Annexe 11.25(a) presents an example of K-S test. The most of the original data gave a good fit with the theoretical Poisson Distribution, which can be seen in Annexe 11.25(b).

To sum up, the statistical analysis of request data proved that average number of requests were different from class to class, but no significant difference of average number of requests existed among the different libraries, and that the request (arrival rate) did not conform the Poisson distribution well but the zero-truncated data did. Therefore, the average or mean values derived from the zero-truncated data can be (or have been) plugged into the models without influencing the reliability of the models and the results derived from the models.

### 11.6.3 Statistical Analyses for CA an ILL processing time

In the data collection of both sets of data, a diary-like self observations were conducted, which has been described in the previous chapter. In order to derive the average time duration for each tasks of CA, the author gathered data about four staff dealing with acquisitions during a period of four weeks. For a similar purpose, i.e. to derive percentage time devoted to each tasks of ILL transaction, the author collected data about two staff handling request for a period of two weeks. In the latter case, less objects were involved because of the fact that ILL services had less workload than acquisitions. The data derived was the mean of around 90 observation. The standard error for each entry of data were calculated and presented in Annexe 11.26.

95% is chosen as the level of confidence, which means that measures derived from the random observations could be expected to fall within calculated limits 95% of the time. Using the formula  $L = 2\sqrt{pq/n}$  for determining the allowable error in the sample mean, L, at 95%

confidence, we can determine  $L = 0.046$  for such a sample (90 observations). If we choose 90% as confidence, the allowable error for this sample equals 0.063. Checking the standard error listed in Annexe 11.28., the results of mean duration for each task gave accuracy within  $\pm 6.3\%$ .

As for the data for ILL transaction, around 50 observations were made. The standard error for each tasks are presented in Annexe 11.27. If we chose 90confidence, the allowable error for this size of sample is 0.085. Checking the standard error of mean percentage of time for each task, they all gave accuracy within  $\pm 8.5\%$ .

The results of the statistical analysis proved that the average time duration for ILL and CA could represent the real situation since there were no statistical significance among the samples.

### 11.6.4 Statistical Analysis and Validation

Before the theory and its implications can indicate anything to us concerning a particular real-world system such as library circulation desk, however, the basic assumptions underlying the model must be valid in that empirical system (as in any other operations research model). In particular, the queueing model previously described assume that the distribution of arrivals to the system can be described by a Poisson distribution and that the service times can be described by an exponential distribution. These assumptions must be verified by collecting and analysing real-world data.

The validation of queueing system has been tested by the request data collected in the system being investigated. And the discussion of Chi-square and K-S tests for this purpose was given in the preceding section. The results has shown that the modified distribution confirmed with Poisson distribution.

### 11.6.5 Discussion

From the viewpoints of Statistics, some data may be lack of representatives and accuracy because of either inadequacy in sample size, in terms of number of observations in one library and number of libraries involved in observation, or the lack of randomness. The major causes were these barriers and difficulties the author was confronted with during data collection.

## 11.7 Summary

Data collections are important in the process of modelling. Quantitative and qualitative data collected will play different parts in the construction of descriptive and mathematical models. However, a careful plan is crucial to the success of data collection. The reasons of collecting data, types of data to collect, methods of collecting them and needs for statistical analysis

## 11. Data Collection and Validation

must all be identified and borne in mind throughout the process of data collection.

In this project, enormous efforts were made in the data collection. The data collected can largely serve the purposes mentioned above. However, dissatisfaction remains and was largely caused by the barriers existed.

## Chapter 12

# Summary and Synthesis (Review)

### 12.1 Introduction

In this Chapter, the salient points of previous twelve chapters will be reviewed and summarised under three broad heading: theoretical considerations, prologue of the study, core of the study (design and analysis of design). The design of network is concerned with a broad range of paired or related issues, such as overall system function and individual functions, network organisation and individual libraries, and present situation and future development etc. Those disparate issues need to be pulled together and the relationships among them need to be fully understood throughout the project. It is certain that a synthesis of those issues is very important. Thus attempts are made to synthesise some separate issues after reviewing individual chapters.

### 12.2 Theoretical Considerations (Part One)

In this part, three major issues were considered as essential and integrated components of the project. And the theoretical considerations of those issues are important guidelines to the practices of network design and planning. The three issues are:

1. *Problem Area, i.e. Theme*—Co-operation, Resources-sharing and Networking (Chapter One)
2. *Problem Areas and Approach*—Design and Planning of Information System (Chapter Two)
3. *Approaches*—Review of Methodologies (Chapter Three)

In a similar manner, all three broad issues were discussed and described by

1. Identifying definitions;
2. Exploring the theories and states-of-the-arts;
3. Identifying the components of these issues; and
4. Reviewing the previous studies.

But each issues has its own salient points to be emphasised. The following sections are to be devoted to individual issues.

### 12.2.1 Co-operation, Resource-sharing & Networking (Chapter One)

#### Definitions

The definitions of these terms are enormous. But the interpretation and emphasis varied greatly. It is easiest to consider library co-operation, resources sharing and networking as “generic” and mostly synonymous. A preferred definition, (reflected by the author), to cover all these three terms, are: “two or more libraries or other organisations from either same geographical areas, or same subject fields or same profession interests, pulling together, share the resources and accomplish what they can not do, or cannot do as well, separately”.

The author’s emphasis was on the organisational characteristics of the network though some technological aspects were inevitably involved in as it is time of dramatic technological changes, which have impact on the organisational structure of networks.

#### Three Major Factors of a Library Network

Three major factors of a network were identified by Kent (1978) as:

1. Types (configurations) of Network
2. Types of Sources Material
3. Operations (Functions) performed

The advantages and disadvantages of each configuration are examined and discussed. But upon a closer examination, few if any networks are of a pure type. In reality, many library and information networks have or intend to have a mixed configuration in one system. The determination of configuration, in terms of management, largely depends on the existing administrative structure of the system being designed.

As for the second and the third factors, they can be decided by the system objectives, service orientations and user needs etc.

## The Impetus for Networking

The impetus of networking can be summarised as follows:

1. Growth of the Knowledge Record
2. Fragmentation of established Disciplines into new sub-fields and Emergence of Interdisciplinary and Multidisciplinary Subjects
3. Rising of User Expectation (Demand)
4. Rising of Costs in the Collection of Information
5. Alternatives to Print in storing and transmitting Data
6. Advances in Communication Technology

1,2,3, and 4 have caused two recognitions: *Recognition One* is that no single library can be wholly self-sufficient in the faces of demand for a broad spectrum of bibliographic requirement in support of user needs; And *Recognition Two* is that impossibility of funding from governmental or non-governmental sources a multitude of libraries duplicating a good deal of their efforts.

Therefore, economic and time pressures are forcing organisations to share rather than duplicate information and other resources.

New technology provide the possibilities and capacities of processing huge batch of bibliographical data.

## Objectives of Network

Different networks have their own specific objectives to reflect the requirement of decision-makers, needs of users and the performance of individual libraries.

Nevertheless, Kent (1976) tried to identify general objectives of resource sharing network as ones to provide a positive net effect

1. on the library user in terms of access to more material or services, and or
2. on the library budget in terms of providing level service at less cost than if undertake individually.

## Network Functions

An array of network functions is performed by the existing networks. The number of frequently cited functions exceeds twenty. Those functions can be grouped into two: "goal-oriented" and "means-oriented". The former attempts to accomplish the primary goals of the network while the latter contributes support to the accomplishment of the goals.

However, it will be too ambitious for a network to cover too many functions.

## Barriers to Networking

Notling (1969) gave a very comprehensive summary of various barriers under four broad headings: 1) Psychological, 2) Lack of Information and Experience, 3) Traditional and Historical Barriers and 4) Physical and Geographical Barriers.

Many countries and networks suffer from similar barriers. Nevertheless, the degree of seriousness varies. Some other barriers appearing in certain countries, or networks, are not necessarily shared by the others.

## Governance of Network

Governance of network plays very important roles in formulating network goals and objectives, setting up policies, and overcoming the barriers to networking etc. The categories of governance are decided by various factors. And no formula exists for choosing governance structure, which largely depends on the category selected.

### 12.2.2 Design and Planning of Information Systems (Chapter Two)

#### Concepts

In the broadest sense, a system is a set of interacting components, with its environment outside. Decided by its nature, information system handles information of any kind, with interlinked entities and processing.

#### System Design of Information Systems

It is recognised that there exist no generally accepted procedures for information systems design. But there are some cardinal principles to be borne in mind throughout the design, that is, having a clear pictures of the rationale and objectives of information system being designed, the needs of user community, and the existing infrastructure. A good system design tries to foresee all interactions, and to avoid unwanted ones.

Under this heading, several researchers' description of system design were reviewed and important parts were cited as theoretical guidelines. It was hoped that they could help the author work out her own design procedures.

### **Design and planning a complex information system—Network**

The development of (advanced) networks of library and information services was categorised by Slamacka (1970) and Rouse (1976) into two principal approaches:

1. By beginning with existing systems and services, and improving their efficiency;
2. By formulating new objectives and functions for a to-be-designed system.

The procedures for a to be designed system follows the sequence of three phases:

1. Assessment of the market;
2. Design of Information Services; and
3. Design of the Information System.

While the redesign of system involves the second and more often, only the third.

The design and planning should pay attention to two types of methods to induce the efficiency: technical and organisational methods.

Four network planning elements were identified by Fiels and Drescher (1987) as: motivation, setting of planning process goal, identification of key stakeholders and their involvement in planning, and decision making process to be employed.

The design and planning of network, including redesigning, calls for more specific methodologies.

### **12.2.3 Review of Methodologies (Chapter Three)**

#### **12.2.4 Introduction**

The importance of methodology in the research were emphasised: the core of research.

The decision about methodology should be based on 1) knowledge of basic research methods; 2) careful literature search; and 3) recognition of problems stated.

This chapter reviewed basic research methods, the methodologies applied in the previous studies and so on.

The research methods were classified according to different criteria: a) types of approaches, i.e. non-quantitative and quantitative approaches, b) different phases of system development, and c) different stages of systems approach etc..

### **Non-quantitative Approaches**

In this section, the definition, types and characteristics of non-quantitative approaches were identified.

Around nine methods regarded as conventional research methods, can be used to cope with the non-quantitative problems. Among the most frequently used methods are survey, observation, descriptive and comparative study, and case study etc. Non-quantitative problems are those falling into social, behavioural, psychological and political categories.

Special attentions were paid to the applications of non-quantitative approaches to network studies. And the purposes of launched studies were identified and summarised.

It is discovered that the category of descriptive and comparative studies predominates in the previous studies including description of total systems, or individual components of systems, or description developed through observation or survey techniques. And some example were given when discussing these studies.

### **Quantitative Approaches**

In this section, operations research and statistical techniques are of major concerns.

Definition and concepts of operations research were given. Further introductions about OR were made by discussing its components: i.e. model, processes, and model-building. The important role of good model and model-building was emphasised: the essence of operations research. And the characteristics of a model in OR is identified as a mathematical, and necessarily an approximate, representation of reality.

There are varieties of OR techniques. In this project, the conventional techniques were identified, such as Decision Theory (e.g. Utility Function). Resource Allocation (Linear, or Integer Programming), and Queueing Theory (e.g. Stochastic Process) etc..

The possible application areas in library and information world were summarised by Leimkuhler and examples were given in each application areas.

Emphasis was placed on the application to network studies. The applications can be versatile since library networks offers fertile ground for contributions by developers of mathematical models.

In the review, important works were described, in terms of problem areas, models constructed and techniques applied. The major contributors include Doggan, Nance, Rouse and Rouse etc. The application areas were identified as planning, design, evaluation, prediction and decision-making of network overall systems or individual functions.

Both advantages and limitations of operations research were identified. Bommer assessed the situation of OR application in library and information world and stated four major reasons why OR has failed to achieve its potential. Rouse(S.H)'s comments agreed with Bommer's assessment. On top of that, he suggested the possible solution to the problems confronted.

### Some Special Considerations

Two important issues were thought needing special attentions. They were 1) Performance Criteria and Measures, and 2) Cost-effective-benefits Analysis.

#### I. Performance Measure

One important role of performance criteria and measure was recognised: providing a quantitative assessment of system outputs (services).

The objectives of performance criteria were identified. Williams (1976) suggested eight network factors, i.e. reliability, flexibility, accessibility, availability, acceptability, efficiency, effectiveness and quality control.

Nevertheless, there exist problems and limitations of performance measures. Among major limitations are

1. There is no recognised objective standard.
2. Most measures are relative;
3. It is difficult to design measures serving assessment of both general and particular aspects of performance; and
4. No performance measures can give a complete picture, etc.

#### II. Cost-effective-benefit Analysis

The concepts of effectiveness, costs and benefits of an information service were clarified.

Five types of cost studies identified by Roberts, were described.

1. Cost Analysis
2. Cost Distribution and/or Cost Allocation Studies
3. Unit Costing and Timing Uses Cost Analysis
4. Cost-effectiveness Analysis
5. Cost-benefit Analysis

The five types form a hierarchy of increasing complexity and diversity of application.

Cost analysis is the basic mode of study which provides information for the other descriptive and analytical methods.

It is realised by the author that cost-effective and cost-benefit analysis are the ultimate interests of the project. The former is system oriented: which of several alternatives performs best according to the effectiveness criteria specified and does so at a given level costs. And the latter is also a systematic comparison between the cost of carrying out a services and the value of that services.

### Remarks

As the author stated before, the main purposes of reviewing basic research methods and methodologies applied, is to seek for suitable research methods and to help design the methodology of the author's own. The author believes that the review is fairly comprehensive and it is certainly a valuable guideline to the project.

### 12.3 Prologue of the Study (Part Two)

Before the design and planning, the purposes and objectives and decision problems of the project need to be stated. The approaches to the problem areas need to be decided, which may be based on 1) the theoretical guidelines; 2) characteristics of network; and 3) decision problems in the project. Moreover the existing infrastructure of the system being designed and its environmental factors need to be examined. Two chapters were dedicated for the above purposes. Chapter Four identified the problem areas and sought for suitable methodology while Chapter Five examined the system and environment in a critical manner. Those two chapters provide a prologue of the study. The following sections are devoted to the summary of both separately.

#### 12.3.1 Methodology applied to the Study (Chapter Four)

It has been realised by the author that it is of importance to clarify the purpose and objectives of the project before the decision about methodology to be applied is made.

The objectives can be summarised in a simple sentence: i.e., the author intends to design and plan an agricultural library and information network in China, in other words, to seek a cost-effective-benefit network model suited to Chinese circumstance. A decision was made about the approaches to be adopted—the systems approach, which takes the form of both descriptive and mathematical models.

## Design and Planning

To guide the practice of design and planning, the overall design procedures were identified and flowcharted.

The design procedures are applicable to both approaches. The non-quantitative approaches are applied to describe, identify and evaluate some qualitative factors and assist the quantitative approaches. While the quantitative approaches are expected to set up operations research models and to test the hypothesis.

Besides, two devices were worked out to assist the overall design and planning. They are Top-bottom and Two-level planning.

In the Top-bottom planning, three levels were identified—program, structure and function policy levels. Therefore, the Top-bottom and Bottom-top flows of design and planning aim at answering the following questions: in what mode, with which structure, and by which policies, the network and network functions will perform most cost-effectively? The underlying philosophy in this device is embodied in the overall design and the design of individual functions.

In the two-level hierarchical planning, two levels of trade-offs were emphasised, i.e. resources allocation among co-operative activities and resource allocation among different criteria (desired levels) within one activity. Many trade-offs need to be made at two levels, such as trade-off between effectiveness-benefit criteria and costs, between cost requirements and budget constraints etc.

The whole project may be summarised as taking the cost-effective-benefits of the services as overall criteria, and cost-effective-benefit analysis as a processing tool to determine 1) what is the best model? 2) which alternative programmes will be run? and 3) what is reasonable resources allocations among and within co-operative activities.

## Non-quantitative Approaches

In this section, the issues to which the non-quantitative approaches are applied, are identified. They are the following issues:

1. Description & Evaluation of L&I Systems in China
2. Description of ZALINET
3. Some Design Issues
  - (a) Determination of Configuration of the Network;
  - (b) Identifying the Objective of Network;
  - (c) Identifying Environmental Factors;
  - (d) Identifying the Resource, Nodes, Links and Users;

- (e) Defining Performance Measures; and
- (f) Identifying the Constraints, etc.

The discussions of each issues included the particular methods adopted, the components of each issues and the chapters dedicated to the issues. And the detailed descriptions were left for the later chapters.

### **Quantitative Approaches**

Modelling procedures were identified and flowcharted. Brief discussions of each steps were given.

The procedures were embodied in the formulation of the following issues:

1. Mathematical Modelling in Formulation of Individual Objective Functions
  - Optimal Resource Allocation—CAP
  - Cost-effectiveness of ILL-UC Services
  - Cost-effectiveness of IR Systems
2. (Mathematical) Modelling in Overall Network Trade-off

In the discussion of each issues, the particular techniques and problems to be solved were outlined. And specific chapters devoted were indicated.

These mathematical models mainly serve the purposes of trade-offs. The complete quantitative solutions are left until the numeric data become available. Nevertheless, the derivation of some analytical and hypothetical solutions were made and examples were given. And qualitative conclusions were drawn based on the analysis of the models.

### **Data Collection**

The usefulness of data (both published and survey data) was appreciated and generalised.

The classification of data was identified. The methods of data collection and statistical analysis were outlined.

### **Conclusion**

The methodology consists of a variety of methods, such as descriptive analysis, survey methods, mathematical programming, and CEB analysis etc. And it is the combination of non-quantitative and quantitative approaches, and the combination of descriptive models and mathematical models and hybrid models.

### 12.3.2 General Overview on Library and Information Systems in China (Chapter Five)

In the preceding sections, most cases reviewed are from the western situations. Whether the theories and techniques employed are applicable and how they can be adapted to Chinese circumstances need a careful diagnosis of the existing system, its environment and its background etc.

This chapter was intended to give a critical overview of the Chinese system and their environmental factors.

#### General Description of China

The general description of China covered its geographical scale, population, administrative division, transportation, agriculture, science and technology and economic situation. The most distinguished characteristics of China are its vast land, big population, less developed economy, and high dependence on agriculture in its economy.

In agriculture, there exists various unfavourable conditions. However, the reform of rural economy has been inspiring and has already brought out great impacts.

#### Structures of China's Library and Information System

The present situations of the overall totality were examined under the following headings: 1) organisations, 2) information resources, 3) dissemination, 4) personnel, 5) services, 6) utilisation and 7) co-operation.

The overall totality are regarded as environment and background to agricultural library and information system.

##### I. Organisational Structure

The organisational structure of the system is rather complicated, which consists of more than nine sub-systems. Among the main sub-systems are public, academic (research), university & college library systems and sci-tech information institutes.

These sub-systems have been erected either on a series of administrative levels or on administrative organisations. As for organisational structure, some are composite star, some are ring mixed with star and some are hierarchical.

The varied structural characteristics complicate the infrastructure of Chinese library and information system. It mixes all the standard configurations.

There was lack of co-ordinating body across the sub-systems until 1987. However, the complicated administrative relationship has restricted the present co-ordinating body (interlibrary co-ordinating organisation in ISTIC) from exerting its full effects.

## II. Information Resource

As for information resource, China is faced with the following severe crisis: a) low coverage, b) high degree of unnecessary duplication, c) bias towards to the information resources at research levels, and d) low utilisation etc.

## III. Dissemination Structure

The publication of periodicals can be regarded as typical indicator. In the process of information dissemination in China, the research institutes and information institutes play important roles.

The subject bias of information dissemination is given to applied science and engineering. And intellectual bias is given to research level.

“Internal publications” (not open to public subscription) occupy an overwhelming proportion of publications. This is a rare phenomenon in the world.

More and more attentions have been paid to the publication of secondary sources since early 1980s.

## IV. Personnel Structure

In China, recent years, both quantity and quality of librarian and information workers have been improved.

A high proportion of university graduates is desired and it happens in both the systems of university library and Chinese Academy of Science.

However, there has been a shortage of qualified librarianship and information science personnel. The training and education of this subject to staff is necessary.

## V. Services Structure

The changing trends in China's library user services was viewed as a) changing from single function to multiple functions, and b) expanding from document services to information services.

The present services covered almost exhaust the check-lists of some developed countries.

## Present Status of Co-operation in China

The concept of co-operation, resource-sharing and networking in China are not new. The history of networking can be traced back to the late 1950s. Nevertheless, networking were paralysed due to the “Cultural Revolution”.

Since 1976, library services in China enter a period of recovery and progress. The examples given in this section illustrate the progress made, such as the compilation of “Chinese Thesaurus” through joint efforts, the establishment of committee to assume the role of co-ordination and so on.

With an critical overview, the development of co-operation, resource-sharing and networking in China is admittedly left behind. Major constraints are from the following:

- a. Technical    b. Administrative
- c. Financial    d. Motivation

## Overview of China's Agricultural Library and Information Systems

The development of agriculture, and the reform of rural economy have brought out dramatic changes, which have raised increased demand on information and challenged some existing incompatible performance of agricultural library and information systems.

Faced with new challenges, it is important for library and information systems to readjust and improve their services. A effective system calls for scientific allocation of information resources, and effective dissemination and services.

This section aims at giving a critical overview of present situation of China's Agricultural and Information systems, in the same manner as did for totality, but emphasis was given to the necessity, impetus, favourable conditions and constraints of networking.

Major characteristics of the system can be summarised as follows:

1. Mixed nature of system organisational structure;
2. Bias in the distribution of information resources geographical area-wise, sector-wise and organisation-wise;
3. Predominance of "internal" mode for publications; and
4. Inadequate control in co-operation and networking.

### I. Organisational Structure

The libraries and information centres can be characterised according to their patron, i.e. parent organisations. Five sectors were identified: 1) Research, 2) Education, 3) Administrative, 4) Production, and 5) others.

The system consists of four horizontal levels, i.e. national, provincial, prefectural and county levels and five vertical sectors mentioned above. However, the links between these various libraries and information centres are loosened and communications are difficult due to the complex administrative relationships.

As for internal structure, university libraries contain information units while research libraries are contained in the departments or institutes of sci-tech information.

### II. Agricultural Information Resources

In agricultural library and information system, there exists similar problems to the totality, such as low coverage, unnecessary duplication, bias towards information at research levels and low utilisation etc.

Figures and examples were given when discussing coverage, duplication degree, distribution and utilisation.

### III. Dissemination of Agricultural Information

A set of statistical data collected by Jiang and his colleagues was translated and reproduced to give a general picture of agricultural information output in China.

Majority of periodicals concern general and agricultural engineering subjects. And agricultural research institutes play a major role in the process of dissemination.

However, with the reform taking place in the rural economy, more attentions have been paid to practical, technical and marketing information, which was largely ignored in the past.

Large numbers of secondary sources have emerged since early 1980s, of which a big proportion is translation-oriented. It would be more sensible if Chinese agricultural abstracting services focus on domestic literature and provide a good supplement to world agricultural abstracting services.

### IV. Agricultural IR System in China

For the time being, manual IR still predominates in China. However, the establishment of computerised IR systems are under way, and their scales are expanding. In this section, some figures and examples were given to illustrate the picture of the development.

As for China's Agricultural IR system, four major steps were taken, i.e. 1) importing foreign tapes, such as CAB, AGRICOLA, & AGRIS etc., 2) compiling Agricultural Thesaurus of Subject Terms, 3) building domestic agricultural databases and databanks, and 4) setting up AGRIS centres. And the future of Agricultural IR system is promising.

### V. Co-operation between agricultural libraries and information centres

Various interlibrary co-operative activities are carried out among some agricultural libraries and information centres.

One fairly established activity is the exchange of material. Nevertheless, two major problems exist. They are

1. A lack of formal organisation
2. Only small scales of co-operations are exercised.

## Types of Agricultural Libraries and Information Centres, and Their Users

In this section, the agricultural and agricultural relevant libraries and information centres in five categories were identified. Their status of development, orientation of services, and contribution to agricultural information were discussed. Meanwhile, attempt was made to identify their users, users' needs and behaviour.

### I. Research Sector

In research sectors, four types of libraries and information centres were identified from national to prefectural levels. Their orientation and responsibility are decided by their administrative levels, specialisations and geographical locations etc.

National centre (STDIC-CAAS) aims at developing into a solid back-up for other lower-level libraries and information centres.

Specialised institutes play very important roles in promoting the research and production in their locality. Their libraries and information centres are expected to become subject centres and provide effective services to satisfy users' demand on subject information.

Information institutes containing libraries in provincial academies of agricultural sciences are one of the strongest candidates of a provincial centre due to their stock status, their important roles in agricultural research, education and production in the province.

Information divisions in prefectural agricultural research institutes are developed to facilitate agricultural research, productions and technological extension in the locality (including six to seven counties).

Types of users in research sector were identified as 1) researchers, and 2) non-researchers (including administrators, technicians, experimental worker and others). Their information needs and behaviours vary, which are related to their intellectual levels, research experiences, foreign language ability and speciality etc.

## II. Education Sector

Two main types of educational bodies were identified, i.e. agricultural universities or colleges (high education) and agricultural schools (vocational schools).

Generally speaking, agricultural university and college libraries have been stocked with larger collections than others. And they are ideal organisers of the training courses for their colleagues from other sectors. Compared with university libraries, they are more specialised. More books about elementary knowledge and practical skills are stocked due to the characteristics of education.

Three major types of user were identified, i.e. students, teachers, and others (including administrator, technician, experimental farmers). Information needs and behaviour from those three types are very different. They may require information of similar subjects, but different levels and purposes.

## III. Administration Sector

One major type of organisation was identified in this sector—agricultural departments at three levels (provincial, prefectural and county), which are policy-making or pre-policy-making bodies.

At provincial level, three divisions serve the purposes of information provision, i.e. 1) Archival Offices, 2) Reference & Internal Publication Divisions and 3) Libraries, of which the first one is better established.

The officers in the departments rely on three major types of information sources; 1) official publications, 2) reports from production fronts; and 3) foreign & domestic literature. They have built up their own channels and networks to acquire the information needed, which seems reasonably efficient.

## VI. Production Sector

Two major types fall into this category—State-run Farms and Specialised House-hold farms.

Libraries and information services in this sector are the least developed in China. Libraries (probably only reading-room) are usually stocked with insufficient collections. And the nearest possible access to a bigger collection for both types of farms are county public libraries, technological extension stations and county agricultural departments. Unfortunately these libraries or information services themselves have difficulties in satisfying the increased information demand due to their limited collection.

The major user group in this category are farmers, technical personnel and administrators.

To satisfy the information needs of these groups, the three sectors mentioned above, have taken some effective measures but much more are needed.

## V. Others

Five types of libraries or information centres were identified and described under this heading. They are

1. Libraries and information services in technological extension centre and stations;
2. Agricultural sections in public libraries
3. Agricultural Divisions in provincial and prefectural institutes of sci-tech information;
4. Libraries or information services in township enterprises and in the respective administrative bodies;
5. Agricultural library association and agricultural sci-tech information association.

The above have played important roles in the provision of agricultural information. It would be desirable if they could be more easily accessible by more users, in terms of reading, borrowing and retrieving etc.

Finally, the user groups, their information needs and services to them, were summarised.

## 12.4 Core of the Study (I) — Design

This part is divided into two sub-titles, i.e. design and analysis of design.

Design includes four chapters concerning the overall design and the design of four individual functions, i.e. CA programme, ILL-UC and IR systems. Analysis of design consists of two chapters, i.e. CEB (Cost-effective-benefit) analysis, and data collection and validation.

Overall design is concerned with the issues at system level, i.e. network level. While the design of individual functions took the similar fashions for each, which can be summarised as follows:

1. Review of the history, the state-of-the-arts, and present situation of the particular network functions in both advanced countries and China;

2. Identification of definitions for particular functions and principles for their design;
3. Identification of design issues, including objectives, key components, configurations and methods etc;
4. Exploration of impacts of new technology on the particular functions and definition of the particular functions in three alternative programmes;
5. Construction of models, both descriptive and mathematical, for the particular functions;

However, as Chapter four pointed out, the mathematical model in this project mainly serve the purposes of indicating trade-offs and help to draw some analytical and qualitative solutions.

In this research project, CEB analysis was adopted to generate the alternatives—which alternative programme is most cost-effective? Chapter Ten described the process of cost analysis, benefit identification, and finally the generation by Analytical Hierarchy Process. In the chapter of data collection, descriptions were given to the particular surveys, observations and other data gathering exercise and statistical analysis.

#### 12.4.1 Overall Design (Chapter Six)

This chapter aimed at describing design issues at network level and establishing the overall design logic and structure. Based on those work, an attempt was made to give a brief description to the network being designed, i.e. ZALINET.

Following the procedures identified in Chapter Four, this chapter embodied the following procedures at network overall system level:

1. Identifying objectives;
2. Identifying nodes, links and resources;
3. Determining network structure;
4. Establishing overall performance criteria and measures;
5. Identifying alternative programmes;
6. Identifying governance, policies and standard; and
7. Determining network functions.

The embodiment under each heading covered the following contents:

1. How important are the particular issues?
2. What are the procedures for identification and determination?

3. What are to be considered when identifying and determining the particular issues?
4. What are the results of identification and determination?
5. How are these results linked with the issues in the following chapters, i.e. the design of individual functions?

### **Objectives**

The establishment of high-level overall objectives were proposed to reflect the national objectives, the need of users and the performance of individual libraries etc.

### **Identification of Nodes, Link and Resource**

This was based on the identification made in Chapter Five. Altogether, over fifteen types (from five sectors and three levels) of libraries and information services were identified. And their link and resources were also identified and assessed.

### **Determination of Network Structure**

The determination of network structure was suggested to base on 1) knowledge of basic configurations, 2) existing infrastructures, and 3) technologies applied. Thus the configuration of the China's Agricultural Library and Information Networks should be composite star, in terms of management.

### **The Establishment of Performance Criteria and Measures**

The establishment of performance criteria and measure is usually thought as the first stage of modelling. Attempts were made to set up overall performance criteria and measures for the network. At this level, five criteria were identified, including Accessibility, Availability, Timeliness, Reliability and Cost-effectiveness etc.

### **Identification of Alternative Programmes**

Cost-effective-benefit comparison between manual and computerised system were thought vital in such a time of technological change. The technological advancement in the world and the Chinese situation were examined. Then three alternative programmes were identified and defined.

## **Governance**

The governances in Chinese circumstance mainly fall into the first category of six, identified by Stevens, i.e. governance by governmental agency.

## **Network Functions**

Based on the review of various functions performed by existing networks and networks in design in both advanced countries and China, more than a half dozen functions were chosen as major functions for the network being designed, of which four were decided to design in detail. It has been realised that it is vital to understand the relationship between functions in the process of design.

## **Brief Description of ZALINET**

The embodiment of the design procedure was also illustrated by a brief description of the network being designed. The following aspects were covered:

1. Geographical Scale
2. Types of Nodes
3. Governance
4. Co-ordinating Body
5. Objectives
6. Types of Functions of the Network
7. User Groups and Information Needs

### **12.4.2 Design of CA Programme (Chapter Seven)**

The structure of the chapters dedicated to the design of individual functions were outlined in the beginning of the summary of the Core of the Study (I)—Design. Thus here the author intends to make a summary along this structure.

## **General Considerations**

### **I. Introduction**

Under this heading, both the history and present situation of CAP in the advanced countries and China were reviewed; definitions were clarified; key elements of CA were identified and methods of CA were reviewed.

History of CA programme can be traced back to late 1940s in USA and late 1950s in China. The existing CA programmes vary in terms of their scale, formality and methods.

The main impetus to CA programmes are increased output of information and tightened budgets in libraries etc. And benefits of CA can be summarised as increased accessibility, cost-effectiveness, reduced duplication and waste etc.

The major obstacles to CA may stem from 1) user habit, 2) local autonomy, 3) institutional difference, and 4) conflict between the responsibilities of a library to its own users and those which undertakes as a member of network in economical aspect etc..

## II. Definitions and Concepts

Three terms were identified as the most frequently used terms to describe the concepts of co-operations in collection development. They were 1) Information Resource Allocation, 2) Co-operative (Co-ordinated) Collection Development, and 3) Co-operative Acquisition. It was decided that CA would be used for the most of cases.

## III. Design Issues

Six elements identified by Fiels were thought useful principles of the design. Among them are Firm Commitment, Interlibrary Communications and Physical Access to Material etc.

## IV. Methods of CA

Two main methods were identified. They are subject specialisation and frequent consideration about filling gap by network executive committee.

## Optimum Distribution of AIR—Descriptive

Under this heading, geographical characteristics of agricultural production was regarded as one very distinct characteristics, which have influenced the existing patterns of information resource distribution. The future information resources allocation should take this into account.

Three principles were worked out to guide the information allocation. Some justifications and examples were given to support these principles.

Based on the principles proposed, the infrastructure of AIR centres nation-wide can be recommended as four levels, i.e. national, regional, provincial and city (town). The possible candidates of centres at each levels were identified and the locations (cities) were illustrated.

As for a province-wide information resource distribution, some more specific principles including political issues and strategic allocations were proposed.

Some strategic allocations and responsibility assignments were made and suggested to follow. They include

1. The assessment of the collection strength and subject bias of the libraries and information centres;
2. The identification of geographical characteristics of information resource distribution;
3. The differentiation of sectoral characteristics of information resource distribution;
4. The identification of resources already available and future possible input.

Based on the identification of design issues and principles in information resource distribution. A brief description of CAP in ZALINET was given, in terms of objectives, co-ordinating body, funding, commitment, interlibrary communication, physical access, and standardisation etc.

### Model of Optimum Resource Allocation—Mathematical

Four performance criteria have been identified to describe how well the CAP will operate. They are 1) Network Material Accessibility, 2) Cost-effectiveness of ILL from other systems, 3) Geographical Accessibility, and 4) Local Availability.

Mathematical expression of objective functions were formulated for these four objectives. And the usefulness of these single objective functions were found as objective tools for cost analysis and trade-offs. The mathematical models can serve two major purposes. An example was given to prove the usefulness of analytical solutions derived, by which some qualitative conclusions were drawn.

### 12.4.3 Design of ILL-UC System (Chapter Eight)

#### Introduction

The importance and impetus of ILL in a network environment were recognised. And the rapid growth of the ILL services were noted. UC was regarded as useful assistance to ILL services and other services as well. Due to the recognition of the close relationship between two, these two functions were put together.

#### ILL System

##### I. Overview

ILL in libraries are not new phenomena in both advanced countries and China. In the western countries, a more dedicated approach has appeared, i.e. document delivery.

Line summarised the main features of existing interlibrary loan practices in such aspects as UC, direct requesting, centralisation, regional organisation, circulation of requests and subject specialisation etc.

Overall, ILL has advanced a great deal in recent years in both advanced and developing countries, but the situation is far from being perfect: it appears that satisfaction rates often do not exceed 70%; supply time of 3 weeks or more are norm rather than exception; and costs seem likely to be generally high.

The findings from the survey by Line et al. about ILL in developing countries, such as severe shortage of funds for libraries, unsatisfactory photocopying equipment and a shortage of photocopying supplies, poor postal services, lack of foreign currency etc., are also found in China.

### II. Design Issues

Again the design issues consist of definitions, objectives, policies, governance, components of ILL system and relevant factors, structure and scale, and methods etc.

The main elements of an ILL system were identified as a) collection of documents, b) means of locating documents, c) procedures for requesting documents and supplying documents, d) communications.

Relevant factors identified by Line are a) Geography and Population, b) Constitution, c) Stage and Nature of Development, and d) Education and Research etc.

Again the basic models identified by Line hardly exist in reality by their own alone. Each model needs to be supported by other models.

The types of transaction were categorised as a) Two-body, b) Three-body, and d) N-body Transactions, which were decided by the availability of UC. And, main tasks of ILL were identified for request and resource library respectively.

## UC

### I. Overview

UC or union lists are to be found extensively in the world. It is very common that in many countries union catalogue are compiled only for foreign material. Overall, union lists of serials are much more common than UC of monographs. Published union catalogue, especially in microform can be seen in a lot of cases. In advanced countries, computer-held UC seems likely to supersede other UC systems.

### II. UC Systems in China

Several UC are available at national level, and most of them are in printed form. And since 1985, the design and implementation of first nation-wide union catalogue database system of Chinese Sci-tech periodicals have been under way. More than 10,000 titles of Chinese journals held by fifty-six participating information institutions throughout the country have already been stored in the database.

### III. Design Issues

Design Issues identified included definition, objectives, components of compilation and maintenance of UC.

The decision to establish a union catalogue usually involves two types of assessments, i.e. assessment of the circumstance and assessment of financial and technical resources. The objective of the UC is to facilitate access to collections, thereby making the maximum use of resources.

In this project, compilation (production) and maintenance were regarded as two major issues of design. The establishment of editorial centre was thought important in the organisation of UC compilation.

As regards with maintenance, it is mainly concerned with up-dating of UC, which is crucial in the design. Different media of UC permit different degree of convenience for up-dating. Among them, printed version is most difficult to be up-to-dated.

Concerning location of UC, the ideal locations of a single national, or regional or network UC is in their ILL centre if one exists, or strongest library in a network. This makes for better control and management, and assures the continuity.

### Impacts of Technology in ILL-UC Systems

Line (1980) categorised the main technological changes likely affecting ILL into two, i.e. possible changes in the pattern and form of publication and changes in locating, requesting and supplying documents.

As for the first category of change, it seems doubtful if conventional publication will be superseded for material for which there is a substantial market.

While regarding the second category of change, the greatest impact is likely to be that of computer technology. It can be used to construct and maintain union catalogues, and to publish them, in hard copies or more usually on Computer Output Microform (COM).

It is realised that the degree of impacts will be decided by several factors, including appropriate computer system, effective on-line systems and so on.

### Model of China's Agricultural ILL-UC System—Descriptive

When proposing and design a model for an ILL-UC system in China, Chinese circumstances should be borne in mind.

#### I. National and Regional Agricultural ILL-UC system as Back-ups for Local Networks

Overall, an National ILL-UC network consist of a national centre, planned /decentralised/regional/ ILL systems and planned/decentralised /with hierarchical/local ILL-UC systems.

This is a top-bottom infrastructure viewed from the national level administration. From a local network's point of view, a bottom-top planning is necessary. Under an unified CA programme, the network is assured to have a largest possible stock with minimum unnecessary duplications. Thus majority of requests should be satisfied within the network. While unfulfilled requests will then be sent to regional or national centres.

The reasons to have regional co-ordinating centre were stated. They can be first back-ups to meet the demands on subject information and to reduce the workload placed upon the national centre. And they are immediate access to reduce the turn-around time and costs for postage etc.

The importance of UC was examined: certain scale and forms at certain levels are essential for the network.

## II. Description of ILL-UC System in ZALINET

Under this heading, the concern is given to the ILL-UC System within the network being designed. In a similar fashion to that for CA programme, objectives, co-ordinating body, funding, standardisation, structure of ILL-UC system were determined.

## III. Identification of Components in three Programmes

The means, resources, equipments involved in both ILL and UC at three programmes were identified and defined.

## Modes of ILL-UC System-Mathematical Model

The purposes of mathematical models were emphasised, such as a device for trade-offs. And the process of formulation was described.

### I. Performance Criteria

The effectiveness criteria identified include fill rate, user satisfaction rate, and turn-around time. However, these performance measures are incomplete without costs. Therefore, what any system should achieve is maximum cost-effectiveness.

### II. Presenting Problems

The key decision problems in this mathematical model is to determine whether UC is to be produced or not and whether it will be kept centrally or locally. Three assumptions were made. They are a) UC locally accessible, b) UC centrally accessible and c) Non-UC available. The assumptions have led to three categories of ILL transaction: a) Two-body, b) Three-body and c) N-body Transaction.

The total turn-around time in three cases were formulated, which consisted of processing time, waiting time, transmitting time and delivery time etc. There were various trade-offs, such as that between handling efficiency and staff time allocated (cost), between local availability and cost and so on. The measures to reduce turn-around time were suggested.

Once the network decides to compile a UC, it is necessary to take a cost-effective consideration about a) form, b) variety, c) coverage, and d) degree of availability.

A cost-effective model was formulated by goal programming. And the underlying philosophy is that nodes with higher arrival rate, higher handling efficiency, easier accessibility and cheaper staff costs will have the priority to keep a UC and carry out UC consulting services.

### 12.4.4 The Design of IR System (Chapter Nine)

#### Introduction

Lancaster (1979) listed the history of methods for physical implementation of IR system from pre-co-ordinate indexes in completely manual mode (Pre-1940), to online computer system (1970S) and to completely paperless systems (1990S). The prediction for 1990S, i.e. completely paperless systems seems too optimistic.

However, the list indicates only the decades in which the major development in a particular types of system occurred.

In advanced countries, the computer-based IR systems have developed rapidly. Initially, computers were used to process searches in batch mode; while the general availability of on-line access to database is inevitable technological consequence of applying computers to the processing of bibliographical and referral information.

Three sectors were identified in on-line information industry. They are the producers of databases, the service suppliers or vendors, and the users of the systems.

Fairly recently, the advantages of microcomputers in IR, i.e. low cost, ease-of-use and ease-of-control etc. were appreciated. The main problem was the lack of suitable packages for IR. Many microcomputer now have communication facilities and can serve as terminals to larger systems.

Compared with advanced countries, China is left behind. The initial trial of computer-based IR systems in China occurred almost one decade later than those pioneers. While the degree of widespreading is even more left behind. The difficulties in the processing of Chinese characters have been great barriers to the development. And other problems faced include the lack of unified programme and planning, shortage of budgets and qualified technical personnel and low utilisation of the services etc. Nevertheless, through ten years efforts, much progress has been made.

With much attention and efforts in the development of computer-based IR systems in China, we should not misinterpret the situation and assume that China's IR system can be transferred from conventional manual mode to computer-base mode widely soon. The improvement of manual services is still necessary at this stage.

## Design Issues of IR System

Definitions of several concepts in IR system, such as Database, On-line IR and SDI etc. were identified and clarified. The components of IR systems identified by Lancaster (1979) were adopted.

The design issues include objectives, policies, structure, mode and types of services, hardware and software consideration.

Two major groups of factors, i.e. database factors and factors associated with the exploitation of database were also identified as design issues.

The effect of networking on IR services were recognised: sharing expensive resource, including database, hard copies of references, and new technologies (i.e. hardware, software and telecommunication) etc.

## Descriptive Model of IR Systems in China

### I. National Sci-tech IR System

National Sci-tech IR System in China is proposed a modified star configuration. Regional or Ministerial subsystems are prepared to be established as long as the conditions (e.g. telecommunication) permit. Based on these sub-networks, the national sci-tech IR network can be expected to form.

A detailed plan, consisting of three stages, were prepared by ISTIC. They are the stages of off-line services (five years), online retrieval systems (five years), on-line retrieval network (five years).

### II. National Agricultural IR System

National Agricultural IR System is a sub-system of the National Sci-tech Computerised IR System. The descriptive model presented its objective, and system structure, including organisational structure, the structures of hardware, database, software, telecommunication and system functions.

The organisational structure will be modified hierarchical, which is decided by its existing infrastructure and other factors. The national centre will be equipped with a main-frame computer, and the regional and provincial centre are suggested to acquire compatible computer systems. Several databases are proposed to build up. Among them are Foreign Agricultural Sci-tech Databases, Chinese Agricultural Bibliographical Databases, Fact and Numeric Databases, Agricultural Bibliographic Catalogue Databases and Agricultural On-going Research Project Databases etc.

The system functions will consist of multi-lingual storage and retrieval, multi-media transmission and multitype of services etc.

The importance in application of microcomputers in the system was emphasised. And the subscription to CD-ROM databases was suggested.

### III. Provincial Agricultural IR Model

Under this heading, the roles of provincial centres in Agricultural IR System was discussed since the national Agricultural IR network will eventually links up the national centre with those centres. Provincial centres include libraries or information centres in provincial academies of agricultural sciences, agricultural universities and national specialised research institutes. The fulfilment of the tasks assigned by the national plan will bring out a solid material foundation for provincial IR systems.

Based on the design issues and the roles identified, a description of IR system in ZALINET was given in following aspects: a) objectives, b) configurations, c) mode of searching, d) types of services, and e) installation of IR centres etc..

### IV. Identification of Components in Three Programmes .

Again, the resource, means, equipment involved in three programmes, i.e. manual IR system, Off-line IR system and On-line IR system were elaborated.

## Mathematical Model of IR Systems in China

### I. Performance Criteria and Measures

Three levels of criteria, i.e. effectiveness, cost-effectiveness and cost-benefits, were chosen.

Lancaster's definitions for some effectiveness measures, such as recall and precision, response times, user efforts were adopted.

### II. Modelling

The factors affecting the marketing of sci-tech information were identified and used to estimate the number of potential users of IR system.

A cost-effective model was constructed to decide the most cost-effective mode, and optimum number of IR centres and their locations.

## 12.5 Core of the Study (II) — Analysis of Design

### 12.5.1 Cost-effective-benefit Analysis (CEB)—Generation of Alternatives (Chapter Ten)

#### Introduction

Definitions of three alternatives programmes at both network level and function level were identified in the preceding chapters. These alternative programmes need a careful CEB analysis in the practice of design and planning. This chapter was devoted to describing the process of analysis.

Cost analysis and benefit assessment have provided information to assist the cost-benefit analysis processed by AHP.

The comparison between manual and computerised system, however, is not easy at all. Frequently the automated system provides capacities that almost impossible for the manual system to provide. It is rather difficult to accurately predict the costs of a projected automated system.

### Cost Analysis for Network Functions

Under this heading, cost analysis, as a basic mode of study, provides information for CEB analysis. Cost analysis can be carried out and its data presented in a variety of ways.

Usually cost analysis of a system involves the identification of the system functions, the components of functions and the resource incurred for each components. For planning purpose, it is useful to compare the total costs of different possible systems. For system designers and managers, the cost of day-to-day operations need to be compared.

A checklist of cost components in computerised systems was identified. The least total cost methodology was applied. This methodology considers all of the costs to network to acquire and to maintain the system over a five- to seven year period.

Under succeeding headings, the cost analysis of individual functions were made.

#### I. Cost Analysis of CA

Cost components of CA were identified: the full cost of CA includes not only the purchase, but the staff costs of communication, selection and acquisition.

The determination of purchase cost was based on the the assumptions concerning cost-effective. By assuming certain reasonable targets of effectiveness measures, the cost requirements for four criteria, thus can be calculated.

The assumptions of reasonable targets were based on the analysis of the data from three major sources: a) published data and statistics, b) survey data, and c) analytical solutions of single objective functions (Formulations).

The steps of determination were identified and flowcharted. Detail explanation were given in the appendix by clarifying the terms and the procedures of the calculation. Several sets of data collected in the surveys were used, such as request data (including request distribution), costs data and so on.

The results of calculations took two forms, i.e. sum of cost requirements for four criteria measures despite of forms (book or periodicals) and sum of cost requirement for different language and forms irrespective of the four criteria.

Examining the results, we can see that an overwhelming majority of budget will have to be allocated to foreign materials because of the high price and other reasons. The rank of cost requirement is as follows:  $FB > FP > CP > CB$ .

Determination of labour costs for operations was based on a diary exercise preceded in ZAU. Before data collection, the tasks of CA operation were identified and flowcharted at both network and local library levels. Only the data about manual operation were

collected since few libraries automated their acquisition procedures. Results were calculated based on the duration of processes, salary rate (unit cost per minutes) and so on.

The author believes that there will be some staff time reduction in the automated acquisition operations. Assumptions, therefore, were made for number of staff involved in three different programmes, showing a reduction of staff time and costs.

As for the total costs, the detailed cost components for each programme were identified under two headings, i.e. one-time purchase and annual fees. And costs were calculated.

## II. Cost Analysis for ILL-UC

The factors influencing the costs for processing ILL requests were identified and components of costs were specified.

Two sets of cost studies, i.e. the determination of unit cost and least total cost were carried out for three programmes. It was realised that labour cost was an important component in determining unit cost. To help calculating labour cost, the tasks of ILL transaction in either request or resource or relay library were identified and flowcharted. A self-observation method was used to gather the data about time distribution of each procedures. Attempts were made to work out unit cost for request, and resources library by different transmission means, which were based on a) Random Time Sampling in ZAAS for mail transmission, b) published data and c) assumptions.

Cost components of UC system were identified as setting up costs and consulting costs. The author failed to collect the data to derive unit cost per item catalogued or compiled. Nevertheless, some data collected were useful to the calculation of total cost.

The total least costs for ILL-UC systems at three programmes were calculated.

## III. Cost Analysis for IR System

The costs components were identified. The author had intended to apply Elchesen's methodology to the data collection about searching via CAB abstract journals, CAB tapes and CAB on-line services. Failure in collecting those data, the author tried to gather some other cost data and hoped to gain some pictures of the costs of IR services.

At the same fashion as did for the other functions, the total estimated costs of different alternative system were worked out.

## IV. Total Network Costs

Total network costs were derived by summing the total costs of four functions for three alternative programmes.

The results disclosed that the initial investments for setting up a computerised system, especially on-line system were rather high. But the average yearly cost was not much higher than their manual equivalent since the running costs was almost the same or even less.

Automating functions separately will be much more expensive than automating them together since computers and other set-up costs can be shared.

Of the four functions, acquisition function requires highest costs.

## Identification of Effectiveness and Benefit Components

The benefits of networking functions to whole network and network users were identified and summarised under three main categories, i.e. user benefits, participating library benefits and network system benefits.

Generalised benefits of automated systems summarised by Lancaster were adopted in this project. Among the benefits quantifiable are personnel cost reduction, improved manpower utilisation, improved equipment utilisation, and operating cost reduction etc.

It must be avoided that the personnel and operating cost reduction would be doubly counted in the benefit assessment since they have been counted in the cost calculation. Thus, the identification and assessment should focus on user benefits and other external service benefits

## Mechanism for Cost-benefits Comparison—AHP

### I. Introduction

Brief introduction to AHP and reasons of choosing it were given: claimed as a new logic for organising complexity and measuring priorities, AHP is a robust and tolerant device for gross data. It allows one to achieve a powerful economy of thoughts and thus avoid the difficulties existed in some conventional cost/benefit analysis.

AHP method brings all the factors together in a hierarchical decomposition of the system, with the objectives and functions represented in higher levels and structure represented in the lower levels.

### II. Method

Methodology was described under the headings of "hierarchies, priorities and matrices". Two hierarchies, i.e. benefit and cost hierarchies were established. The network benefits were mainly embodied by the benefits of individual functions and integration of functions, which consisted of user, participating library and network system benefits. While costs of network were composed of the costs for different functions, which included set-up, operating and user costs etc. The further components of three types of benefits and costs were identified.

A literal summary of the results of cost analysis and benefit identification was made to help prioritise the elements of the hierarchies. The process was made by determining the potency with which the various elements in one level influence the elements on the next higher level and then computing the relative strengths of the impacts of the elements of lowest level on the overall objective.

### III. Results and Discussion

The composite benefits and costs were calculated by a computer programme (BASIC-AHP). The criteria used in cost/benefit analysis is to find maximum  $b_i/c_i$ , that is, choose the programme with largest benefit to cost ratio.

By calculation, the criteria favoured Program Three, i.e. Computerised Network. However the author tended to propose Program Two for the network being designed due to

the consideration of its financial and technological situation.

## Conclusion

It is very tempting to say that no realistic comparison can be made until all the variables affecting computerised network system are considered.

In the western, the use of computerised system in libraries, information centres and networks is now comparatively commonplace. And China's libraries and information services have the tendency towards computerisation though the present economic and technological situation has slowed down the pace of computerisation.

The advent of comparatively cheap microcomputer systems, with increasingly sophisticated features and the development of telecommunication network has made computerised library and information network more realistic.

Thus the following conclusion were made:

1. A computerised network is the ultimate goal for the future development in ZALINET;
2. A semi-computerised network seems more feasible in the near future. And it would be more cost-effective if the existing facilities were utilised and all the functions were computerised together;
3. Before a semi-computerised system is implemented, the network should operate these functions manually first.

Nevertheless, the author does not mean that the computer is a cure-all; computer has limitations and disadvantages.

### 12.5.2 Data Collection and Validation (Chapter Eleven)

#### Introduction

Three headings, i.e. purposes of data collection, class of data and methods of data collection, were dedicated to answer the questions of why collect data, what data to collect, and how to collect data.

Both general purposes and specific purposes of data collection by this project were identified. The latter were discussed under each surveys.

Four major headings of data, i.e. resource, activity, operation and background were identified. A detailed plan under the four headings was made before data collection.

There are various techniques of data collection. Among the conventional techniques are questioning procedures, analysis of records, performance evaluation and cost analysis etc..

Around seven particular techniques were adopted in this project, such as questionnaire, interview, observation, use of published data etc.

For convenience, data collection were discussed under particular surveys made.

### Description of Surveys

Description of Surveys took such a format as a) Purpose of Survey, b) Methods, and c) Results and Discussion.

#### I. Survey on Zhejiang Agricultural Library and Information Centre Statistics

Purposes of the survey were identified, such as evaluating the existing system, setting up resource constraints and so on.

Methods were discussed and results presented. The main device was a questionnaire with around eight questions related to library resources (stock, budgets, equipment and personnel etc) and the situation of co-operation. In addition, interview and visiting libraries were used as supplement to meeting this aim.

Data collected from 28 libraries were summarised under the following categories: 1) Types of Library, 2) Number of Users, 3) Number of Staff, 4) Stock (Book and Periodicals), and 5) Budgets etc.

Discussion was given to several important sets of data, such as that of new acquisition, collection overlap, budgets and number of staff etc.

#### II. Surveys on ILL Services and Demands

Purposes were identified. Questionnaire, interview and library records were used to explore the data relevant to around ten questions. The nature of data was both qualitative (e.g. comments on ILL services) and quantitative (e.g. Number of requests handled in a particular library).

The detailed results were presented and discussed. Among important findings are

1. Most libraries investigated carried out only a small scale of ILL services;
2. Satisfaction rate were not too disappointing;
3. Mailing predominated in the channels of ILL transaction; and
4. Over twenty days of turn-around time were not uncommon.

#### III. Survey on UC Systems

Similarly, purposes were identified. Survey and published data were used to explore six issues including types of UC compiled, resources incurred and so on.

The author failed to collect the wanted data in the system being designed. To make up for this, other systems were investigated.

#### IV. Surveys on IR Services

The contents of the survey were specified. Three major sources were identified as major sources for data collection. They were questionnaire, library or information centre records and published statistics. Again the system being designed failed to provide such data. Other systems were investigated. Unfortunately what were obtained was still incomplete.

#### V. Surveys on Users Information Need and Behaviour

Purposes of surveys were obvious: finding out the user information need and behaviour, with special reference to exploring the necessity of CA program and ILL services.

Two questionnaires were used to serve the purposes. The instant questionnaire was used in a larger scale due to its characteristics, i.e. easy to distribute and answer. While the questionnaire of "Information Need and Behaviour" intended to collect data and information about nine major issues. Research staff were the object being investigated.

The findings from these two questionnaires were presented. And they are valuable information to be accounted of in the practices of design and planning of network functions (e.g. CA and ILL), and establishment of performance criteria of those functions.

#### VI Surveys on Attitudes from Library Directors

It was realised that the opinions from decision-makers, library staffs and user communities are valuable guideline to analysts and designers. Interviews were made to find out the attitudes, viewpoints and proposals of library directors from ten different types and levels of libraries.

Ten major issues were chosen for interview. The findings were presented. And some of proposals were adopted in this project.

### Additional Data Collection for Three Important Types of Data

#### I. Background Data

The purposes were identified: identification of environmental factors, potential users needs and so on.

Both quantitative and qualitative data were collected from several published statistics and descriptive papers. The data gathered were extensively used in the thesis. The following background data were thought useful:

1. Resource data of parent bodies or upper level organisations;
2. Annual world output (publications) relevant to agricultural sciences;
3. Bradford distributions of some specific subjects;
4. Number and types of potential users in the network being designed;
5. Subject coverage of network;
6. Geographical distribution and communication means; and
7. Resource distribution of parent organisations.

## II. Request Data, Request Distribution and Loan Period

This type of data was thought useful to identify users' needs and estimate parameters for mathematical models, especially queueing system.

Request data of collection were collected by counting the due label of the books. Data were presented along different sub-classes of agricultural sciences and popularity classes. Several sets of data could be derived from raw data, which then could be used to estimate parameters of mathematical model (e.g. Material Accessibility and Probability of Dissatisfaction).

Example of data presentation and summary of data were placed in Annexe.

Request distribution data (along popularity classes) were used to determine the purchase costs in CAP.

## III. Cost Data

Cost data was mainly used to carry out cost analysis and eventually CEB analysis.

Detailed cost components were identified. But no detailed discussions were given since they were discussed in the preceding chapter, i.e. CEB analysis.

The difficulties in collecting cost data in particular were discussed. And general problems and difficulties were left for a later section.

## Estimation of Parameters

One purpose, i.e. estimation of parameters was emphasised. Tables were prepared to indicate the parameters to be estimated and raw data to be collected for each formula.

## Problems in Data Collection

Three main types of problems were felt in the exercise of data collection. They are psychological barriers, traditional and technological barriers, and personal limitations.

Psychological barriers include recognition, acceptance, familiarity and fear.

Library record are almost new in most Chinese libraries. They could not yet give a complete and useful picture of library services. There are lack of modern technologies to facilitate the data collection for the purposes of library management.

Personnel limitations include the aspects related to time, space (distance), money, personal capability and authority etc..

Generally speaking, application of survey methods and library records in China are usually faced with various difficulties due to the unawareness of importance of data collection, unfamiliarity with survey methods and the lack of modern technologies etc.

## Statistical Analysis and Validation

General reasons for statistical analysis were identified and stated: descriptive statistics is essentially reportorial while inferential methods are used to make predictions, to test hypotheses, and to infer characteristics of a population.

Both descriptive and inferential statistics were applied in the project and specific purposes were identified. Statistical analyses were carried out for request data and processing time (cost data).

The hypotheses in the construction of theoretical models were reviewed and summarised.

### I. Statistical Analysis of Request Data

The particular techniques used were descriptive statistics, frequency distribution, analysis of variance and Chi-square and Kolmogorov Test.

Descriptive statistics summarised and simplified the raw data. Frequency distribution gave an illustrative picture of request distribution (Poisson Distribution). Analysis of Variance was used to test if there were significant differences among the request on different classes and among the requests from different libraries. Both Chi-square and Kolmogorov-Smirnov Test were used to test the goodness of fit between request data and the theoretical Poisson distribution.

The results from the analysis of variance indicated that there were significant difference among the requests on different classes but not the average requests (per item) from different libraries.

Chi-square test of original data did not give a good fit with the theoretical distribution but that of the zero-truncated data did. While in K-S test, most original data gave a good fit.

### II. Statistical Analyses for CA and ILL Processing Time

F-test was used and standard errors were calculated for each task (mean time duration for CA and mean percentage of time for ILL). And 90% was chosen confidence level. No significant difference were founded in both tests. Thus the mean from the observations can represent the whole population.

### III. Discussion

The barriers and difficulties confronted made the author unable to collect data with adequate sample size (in terms of number of observation in one library and number of libraries involved).

## 12.6 Synthesis

### 12.6.1 Consistency in Objectives, Policies and Organisations

The physical configurations may vary between functions as long as the maximum efficiency and cost-effectiveness are assured. However, the consistency and integration in objectives, policies, organisation etc. should be achieved.

The overall high-level and low-level network objectives were outlined in Chapter Six, and the objectives of individual functions in respective chapters. It was realised that it is vital to make sure the consistency between the overall objectives and function objectives, and between overall objectives and the objectives of participating libraries. Those sub-objectives should reflect and work towards the overall objectives.

It is believed by the author that the introductions of these four main network functions are desirable. They will greatly improve the efficiency and effectiveness of network and individual nodes; CAP provides a increased pool of information resources (increased accessibility) to satisfy various information need. ILL system supports the fulfilment of the objective of CAP and an efficient ILL system should not offset the benefits derived from CA, in terms of costs and time. UC system facilitates the ILL transaction and thus improve the exposure of information to users. IR system provides the awareness of information to users thus stimulate their information consciousness and information need. Again CA programme and ILL-UC system are the support to satisfy those increased information need.

In this project, the relationship between functions have been explored and each functions has been examined in terms of common costs and benefits. It becomes increasingly possible to achieve consistency between function policies and organisations, and to design an integrated system, in terms of technology and resources.

For each function, a sub-co-ordinated body was suggested to be established. Those bodies may or may not located in the same centre, or together with the network committee or executive body. The communications between sub-co-ordinating bodies and network committee and between different sub-co-ordinating bodies are essential. Unified policies should be established to instruct the performance of individual functions.

### 12.6.2 Trade-offs

In CEB analysis, three major types of costs and benefits were outlined to reflect the relationships between 1) network overall system and functions, 2) different functions, 3) network and participating libraries, 4) network and users, 5) participating libraries and users.

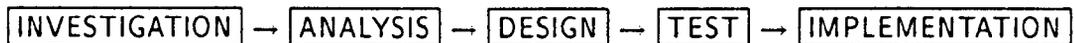
The allocation of resource among functions was suggested to be based on the CEB analysis against network system, participating libraries and users. There will be a trade-off between cost requirements (for certain effectiveness targets) and actual budget level, which may lead to a reduction in effectiveness levels. Again within the function, different policies reflect-

ing various performance criteria compete budgets and priorities. Thus some trade-offs are required.

The generation of alternatives was based on cost/benefit analysis by AHP. The criterion favoured computerised program. The budget and technological constraints led to a trade-off between levels of effectiveness and costs. Therefore, a semi-computerised program seemed more feasible and practical. But computerisation is an ultimate goal.

### 12.6.3 Relationships between System Design, and Investigation, System Analysis & Implementation

As the author stated, this research project is aimed toward design and planning. But design can not be done in a vacuum. It has to be based on the investigation and analysis of the situation of the old system, the desired functions and components of new system and environmental factors etc. If we follow the development cycle, i.e.



we can find that the design phase actually overlaps much analysis phase. In other words, design is inescapably intertwined with the two preceding phases.

In this specific research project, design should be based on the following investigation and analysis:

#### 1. Theoretical Considerations

- To explore the state-of-the-art of co-operation, resources-sharing and networking and identify the functions and components of networks;
- To provide guidelines about the state-of-the-art and principles of system design and planning;
- To describe basic methods for research;
- To specify the design issues for each desired functions.

#### 2. Background and Situation

- To examine the situation of the existing system
- To assess the market for networking;
- To identify the environmental factors of the network;
- To explore the technological and financial possibilities.

Implementation of the system design is the ultimate goal of system development. And implementation is not just the final phase. It actually must begin when the whole systems approach starts and continue throughout its duration. The designers have to ask and answer such question as these:

## 12. Summary and Synthesis (Review)

1. How can the mathematical models' parameters be measured?
2. How much will data collection cost?
3. How politically, economically and technologically realistic will the results be?
4. How long will the results remain valid?

## Part IV

# Epilogue of the Study

# Chapter 13

## Conclusion and Discussion

### 13.1 Introduction

The theme of this project has been the modelling of China's (provincial) agricultural library and information network for the purpose of design and planning. It has entailed the following sub-themes:

- *Library and information network*—organisational, logical and physical structure of the system;
- *Design and planning a system*—approach;
- *Chinese Circumstances*—characteristics of the system;
- *Agriculture*—subject area of the system;
- *Provincial*—geographical scale of the system, and
- Others

The above sub-themes will be discussed and concluded under the following headings:

1. The state-of-the-art of networking;
2. The “systems approach”;
3. Investigation and analysis (including part of data collection);
4. Design and analysis of design; and
5. Data collection for analysis, prediction and validation.

Finally, recommendations about further research will be made.

## 13.2 The State-of-the-art of Networking

The impetus identified in Chapter One and other chapters have led organisations to share or to plan to share rather than duplicate information and other resources. This trend is being adopted in China also though, China is still backward in the development of networks. Networking in China is confronted by various psychological, technological and financial barriers, which will be discussed in a later section.

The appropriate motivation is very important to the success of networks. The network objectives, structures, functions and governance should be decided according to the particular circumstances. In this project, they are related to the Chinese situation, agricultural characteristics, geographical scale and technological possibilities etc.

However, being systems, networks have their generalised characteristics, which need to be identified. And the design and planning of such systems have certain common approaches.

## 13.3 The Systems Approach—Design and Planning

The design of methodology is the core of the present kind of research. The theme of this thesis has determined that the “systems approach” is appropriate methodology to apply. System design is an important phase of the system development cycle and it overlaps with the system analysis phase, while system analysis, design and model building are inseparable notions. The review of methodologies in Chapter Three has also shown that the systems approach is a right choice. The review provides a set of suitable methods for making this methodology workable.

The author also agrees with Liston and Schoene that there are no generally accepted procedures in the art of information systems design. The establishment of a private methodology is needed.

The overall methodology in this project can be described as a principles of methods which together assist in the construction of descriptive, mathematical and hybrid (logical) models. Both descriptive and mathematical models are seriously deficient when taken singly, some blending is necessary. Descriptive models are usually easy to construct and to comprehend but they lead to some ambiguities. In contrast, mathematical models usually avoid ambiguities but lead to complications. The review indicates that the advantages of applying both descriptive studies and operations research to the information world and to networking in particular are enormous. However the first category—the descriptive predominates. The application of OR models after the 1970'S decreased largely because they become increasingly complicated. In the construction of models, survey methods, observations, statistical analysis and mathematical modelling etc are all useful in approaching different categories of issues.

The procedures of the methodology include data gathering (investigation), analysis, design (modelling) and validation etc. Two devices, i.e. top-bottom flow and two-level hierarchical planning have led to a systematic logic in the process of design and planning.

## 13.4 Investigation and Analysis

It is realised that to design an agricultural library and information network for China, the investigations should at least cover the following three broad objects, 1) Chinese Circumstances, 2) Existing Networks, and 3) Technological Possibilities in Advanced Countries.

### 13.4.1 Chinese Circumstances

#### Environmental Factors

China is an advanced developing country. Its economy, science, technology and education etc. have developed rapidly since 1976. This advance further facilitates the development of library and information systems, such as the establishment of documentation and information centres. The construction of new buildings for libraries and information institutes; the growth of co-operation, resource-sharing and networking on various scales and so on are all in progress. The importance of networking has begun to be appreciated.

Nevertheless, various unfavourable conditions have impaired the speed of progress in networking. The unfavourable conditions include the following:

1. *Geography & Population*—Extensive territory and large population—an especially large agricultural population (over 70%);
2. *Science & Technology*—Still relatively undeveloped;
3. *Economy*—Agriculture especially has not yet achieved its full potential in the development of the economy;
4. *Developmental Status of Library & Information Systems*—low collection coverage, low efficiency, low utilisation of services and backwardness in information technology;
5. *Transportation & Communication*—Both underdeveloped;

One must not be too discouraged by these unfavourable conditions. The author is quite optimistic about the future of networking since China has the following favourable conditions:

1. *Social System*—China's social system is based on public ownership, which is of great advantage to networking;
2. *Awareness*—Both the authorities, and present library and information systems now recognise the importance of co-operation, resource-sharing and networking;
3. *Economy, Science & Technology*—All are continuously and stably developing;
4. *Information Technologies*—They have received attention from different levels of authorities, libraries and information services. The applications of computers are spreading widely and rapidly.

## Assessment of the Market for Networking

This project has constructed a provincial model, Zhejiang province being taken as an example. The investigation carried in the system being modelled included survey, observation, and use of statistical data and published papers etc. The investigation has explored the market (possibility) for networking. It can be concluded by the following discoveries.

### I. Situation of Libraries and Information Centres

The resources of most libraries and information centres are inadequate, in terms of stock and budget. Modern facilities are lacking, especially in those libraries at the lowest administrative level. There exist big gaps among libraries, in terms of stock, budget and equipment. For example, the composite performance index defined in this thesis varies greatly among the libraries and most of them are rather low. This implies that the staff efficiency and the book stock could not satisfy (potential) users' information needs. (*vide* Survey on Zhejiang Agricultural Libraries and Information Centres Statistics)

This situation has led the libraries to seek solutions. Most library directors realise that networking is one of most effective ways of relief though some of them are not optimistic about the establishment of a formal network in the near future. The reactions are quite different between big libraries and small libraries. (*vide* Interview about Attitudes of Library Directors)

### II. Users' Information Need

As for users' information needs, it is noted that the information needs of each group of users have been increasing. This increase are simulated by the increased availability of secondary sources, IR services and modern technologies; by developments in agricultural research, education, production and marketing; and by the radical reform in rural economic systems etc.

The existing information resources in individual libraries show serious inadequacy in satisfying the increased information needs. Users desire ILL services to satisfy those unfilled requests by their local libraries. On the other hand, a large number of users need to be alerted to existence of information by the effective information services, such as IR and current awareness services (*vide* Survey on User's Information Need and Behaviours)

#### 13.4.2 Advanced Networks

Networks in some advanced countries have developed greatly. The following trends may be noted:

1. Towards a high degree of computerisation with on-line via telecommunications;
2. Towards multitype networks, i.e. a network including various types of libraries, academic, public and special libraries;

3. Towards multi-functional networks, i.e. a network for cataloguing, interlibrary loan and information retrieval etc;
4. Towards regional and local networks; and
5. Towards commercialisation.

### 13.4.3 Technological Possibilities

The investigation has also explored the possible technologies employed in libraries, information services and networks to perform various functions in the advanced countries. Based on this, the possible future development for China's libraries, information services and networks, in terms of information technology, may be predicted and proposed.

It is obvious that the impacts of new technologies on the information world are dramatic, especially that of computers. Computer will continue to increase in power and decline in cost, methods of data transmission will become cheaper and more efficient, new storage devices will permit vast quantities of text to be held in a readily accessible form, and terminals will fall in price to a reasonable low point. These developments, highly probable, will produce the communication "structure" to permit the substitution of electronics for many activities and institutions now operating largely through print on paper.

The technological constraints to networking are still great in China. However, it is certain that the application of microcomputers will greatly facilitate automation in Chinese libraries, information centres and networks. Future networks will be computerised to a high degree though the immediate outcome may be only partially computerisation at low level. It is important for Chinese information industries to be aware of the technological development in the world, and to avoid unnecessary repetitions in terms of hardware and software design.

Nevertheless, the computer is not a cure-all. Many development may be slower than has sometimes been predicted and their economic implementation may prove difficult and will certainly take time.

The investigation and analysis have provided fundamental information for the design and the analyses of the design.

## 13.5 Design and Analysis of Design

It is believed by the author that to design such a complex system, an overall and systematic plan is needed. The overall design of the network should be prior to that of the individual functions. And the functions should be designed with their relationships and integrations in mind.

### 13.5.1 Overall Design

The identification of the following elements were found crucial to the network design:

1. Objectives of the Network
2. Nodes, Links and Resources
3. Network Structures
4. Overall Performance Criteria and Measures
5. Alternative Programmes to fulfil the Objectives
6. Network Functions

Based on the identification of the above, a brief description can be given to ZALINET:

ZALINET is a multitype/provincial/agricultural library and information network, which includes over 28 nodes. Its configuration would be a composite star in terms of management. Its ultimate objectives are to improve the effectiveness of participating libraries and thus to promote agricultural decision-making, research achievements, production levels, education quality and marketing. It will perform CA, ILL, UC and IR functions, etc. ...

### 13.5.2 Design of Individual Functions

The author believes that the choice of those four functions as the major network functions is the correct one; they are among the most conventional network functions and they are obviously very important to the system being designed.

Though the design issues identified, and approach applied in the design of those four functions are at a similar fashion, the individualities in their objectives, their structures and their alternative programmes must be distinguished and their relationships must be understood in the practices of the design, bearing in mind that most networks have mixed configurations. It may be hierarchical for the ILL function but centralised for CA processing.

#### CA Programme

CA programme is proactive—its goal is to have the item there before it is requested. Recently, in the western countries, a number of major efforts have refocused attention on CA and its

potential impact on library services. Concurrently, new technology has begun providing more powerful tools and methodologies in support of CAP.

It is believed that the principles proposed for the distribution of information resources have reflected the reality. In China, both nation-wide and region (province)-wide, there exist distinguishing geographical characteristics in agricultural production, research, education and marketing; and also of distribution patterns of agricultural production forces, it is therefore, reasonable to suggest 1) treating a region (area) as a unit; 2) co-ordinating the different professional systems and 3) managed in a central mode.

In assigning responsibility for collection and allocation of information resources, more specific measures needed to be taken. Among them are

1. The assessment of the collection strength and the subject bias of libraries and information centres;
2. The identification of geographical characteristics of information distribution;
3. The differentiation sectorial characteristics of information resource distribution; and
4. The identification of resources already available, both human and material and future possible input etc.

Four performance criteria, i.e. Network Material Accessibility, Cost-effectiveness of ILL from other systems, Geographical Accessibility and Local Availability are all important. And their mathematical expressions provide very useful trade-offs, which allow the network administrators to work out a reasonable acquisition program with 1) optimum collection size; 2) optimum rules for acquiring or borrowing; 3) optimum allocation of limited funds between collection size and duplicated copies both among libraries and within libraries; and 4) optimum allocation of collection among network nodes and subjects.

### ILL and UC System

Without an effective ILL system, CA programme cannot be effectively implemented. ILL is of great and growing importance. The improvement of satisfaction rates and speed for ILL will depend heavily upon the UC and holding lists.

The ILL transactions considered in this project include both those internal to the system being designed and those external to the system.

To design the ILL function for a local network, it is important to take a bottom-top approach, i.e. from local to higher level back-ups. This will lead to a more local user-oriented model. The CA program usually decide the scale and nature of interlibrary loans both within and outside the network. In turn, CA should be formulated or reformulated according to the availability and accessibility of other back-up systems, i.e. national and regional ILL devices.

The proposed ILL infrastructure for a local network and its two upper level back-ups, i.e. national and regional centres, has taken the following into account:

1. The existing patterns
2. Design principles
3. Cost-effectiveness

The decision about form, variety, coverage, and degree of availability of UC services should be based on the cost-effective analysis.

The performance criteria of ILL-UC system identified in this project are thought important in the design. Among them are satisfaction rate, turn-around time, cost of ILL, and cost-effectiveness of UC availability etc.

The satisfaction rate of ILL largely depends on the network material accessibility, geographical accessibility (CA programme) and the availability of UC. Turn-around time is related to a number of variables. The trade-offs should be taken between cost and the following:

1. Increased staff time for ILL handling and improved handling efficiency;
2. Increased duplication of copies; and
3. Introduction of a UC service.

### IR System

The importance of IR is obvious: it is to satisfy the need to locate documents dealing with a particular subject or capable of answering a particular question. This function is closely related to the document delivery function, in many aspects for known documents which are likely to stem directly from IR activities previously conducted.

Overall, in China, on-line access to international hosts should be expanded and a national on-line sci-tech IR network is an ultimate objective. However, for the time being, what Chinese library and information systems should emphasise are the following:

1. Improving conventional IR services;
2. Building up Chinese databases and databanks, and introducing foreign databases under an unified plan;
3. Popularising the use of microcomputers in libraries and information centres;
4. Introducing CD-ROM technology.

To support the fulfilment of the ultimate objective, the central government should facilitate the development of national and regional telecommunication systems.

As a sub-system of National Sci-Tech IR system, the National Agricultural IR system should be developed with its subject characteristics, i.e. broad coverage (e.g. from crop cultivation to animal husbandry to fishery) and two levels of operation (research and practice). Under an unified plan, specialised agricultural libraries and information centres contribute the parts of information on their subjects to the overall agricultural databases.

The agricultural IR system in a province should be centralised by setting up provincial centre(s). It should make full use of national system(s), in terms of forwarding searching request via international terminals, on-line access to national databases, subscription of tapes and utilising the software packages designed by national system for in-house use etc. In other words, repetitions should be minimised.

It is very important for libraries and information centres to acquire compatible hardware and software, with national systems and with other participating nodes.

The performance criteria of IR system have three levels, i.e. Effectiveness, Cost-effectiveness and Cost-benefits. Those criteria are useful in the comparison of three modes of IR services and in the decision about how many IR centres are desirable.

### 13.5.3 Cost-effective-benefit Analysis

It is believed by the author that cost-effective-benefit analysis can provide fundamental information on which to base decision concerning the most cost-effective alternatives for any networks.

Admittedly, it is not easy to perform the analysis correctly because of either the lack of standard methodologies or the unavailability of required data.

It is found that AHP can avoid or at least buffer the difficulties arising from some conventional cost/benefit analyses since it allows one to use judgement or any other data to make careful quantified trade-offs among the relevant criteria.

In this project, the AHP process is based on careful cost analysis and benefit assessment.

The author believes that it is reasonable to categories the cost into three, i.e. that of network system, participating libraries, and users. The identification of their cost components are necessary. Similarly, benefits can be grouped into three categories, each entails varieties of benefits.

### **Cost-effective Analysis for CA-purchase**

As mentioned earlier, one of the roles of mathematical models in this project is to allow one to derive analytical solutions. The determination of cost requirements for acquisition is based on assumptions concerning the cost-effective criteria.

The results of cost determination have shown the difference from the original allocation by the system being designed. It is suggested that more budgets should be allocated to foreign materials, especially foreign books, in comparison with the original allocation. The results, however, are subject to modification after the trade-off between cost requirement and actual budget levels.

### **Cost Analysis**

The least total cost methodology is thought simple to apply and helpful in the cost analysis of four functions. Calculation of labour cost or unit costs is also desirable if data are easy to obtain.

In the costing, it is important to consider all the possible costs to the network to acquire or to maintain functions over a five to seven year period.

To calculate labour costs for a particular operation, it is necessary to identify, preferably by flowcharting, all detailed tasks in the operation.

### **Benefit and Effectiveness Identification**

It is not easy to quantify all the benefits into money value. Thus it is important here to identify the possible benefits and compare the benefits between programmes by both quantitative and qualitative assessment.

### **Analytical Hierarchy Process**

The summary of results from cost analysis and benefit assessment in literal terms is particularly useful in making judgement and prioritising the elements of matrices.

According to the results of the process, three categories of benefits derived from computerised system all received high priorities. While as for costs, system costs in computerised system, operating costs in semi-computerised system and user costs in manual system received high priorities. The final result favours a computerised system, i.e. the one with maximum benefit/cost ratio.

It has proved what several researchers concluded in their papers (Matthews, Lancaster and so on). For instance, Lancaster (1977) pointed out:

“ Automated procedures in libraries (networks) most likely will be cost-effective where either a basic machine record, once created, can be used for many different purposes, and/or the cost of development and maintenance can be shared by a network or a processing centre.” (p278)

However, the author would propose a semi-computerised system to the system being designed since the financial and technological conditions in China for computerised system are not yet, mature.

Computerised systems are the ultimate goal. But the expectation should not be excessive since computers are not the answer to everything and they have limitations.

### 13.6 Data Collection for Analysis, Prediction and Validation

The importance of data collection at four stages of networking and planning should be fully recognised. Then detailed plans for data collection need to be devised to meet the various requirements (e.g. purposes, samples and time period etc.).

The difficulties faced in data collection should, however, be foreseen before the exercises. Steps need to be taken to overcome or at least to buffer the difficulties.

The surveys made, each may serve multiple purposes in the “systems approach”. And both the quantitative and qualitative data gathered are useful sources for the construction of descriptive and mathematical models.

However, data collection in Chinese circumstances, has been faced with some special difficulties, which may be different from somewhere else. Among them are unfamiliarity with survey methods, the fear of disclosing secrets and the lack of library records, etc.

Statistical analyses of the data collected are necessary. In this project, they have derived the means, tested the hypotheses and significance thus made the models applicable and valid.

### 13.7 Further Research

The research presented in this thesis has been limited in the number of phases of system development cycle it has emphasised, in the types of models it has constructed and in the functions it has chosen to design for networking.

The implementation of such system(s) designed remains to be facilitated. Work on the optimisation, prediction and validation of mathematical models, and simulation models are largely unexplored. And other network functions must also be considered.

### 13.7.1 Implementing the System(s)

The successful implementation of a new system or the revision of an existing one is the ultimate goal of every information system study. For the specific network models designed in this project, actions must be taken to facilitate their implementation.

Implementation involves taking the results from all the previous phases of the modelling process and applying them to actually solving the problems that motivated the modelling effort in the first place. Implementation is not just the final phase of the whole modelling process. It actually must begin when the whole modelling process starts and continue throughout its duration.

In this project, the following specific models needed to be implemented:

1. The overall Network System, with proposed objectives, organisational structure, and desired functions etc;
2. The CA programme, which includes descriptive models for scientific allocation of information resources nation-wide and province-wide, and cost-effectiveness models (mathematical) for determining optimum coverage, roles for borrowing or buying, and number of duplicated copies etc. in the network.
3. The ILL-UC System, which includes descriptive models for local ILL networks and their two level back-ups, and mathematical models for turn-around time and cost-effectiveness model for determining UC locations;
4. The IR System, which includes descriptive models for national and regional IR systems, and cost-effective model (mathematical) for determining mode of IR and locations of IR centres; and
5. The cost-effective-benefit network model for determining the most cost-effective programme etc.

A successful information systems implementation program is usually composed of several distinct phases or activities, each of which contributes directly to the achievement of the end result. Among them are:

1. A system specification—the basic design document that defines the inputs, the processor functions, the data file structure, and the outputs for the new information system;
2. The implementation plan—the activity schedule and the assignment of individuals or groups responsible for carrying out each implementation activity;
3. Testing and checking-out the new system;
4. Training programmes for the associated personnel for information system testing and check-out; and
5. A formal evaluation report after a suitable period of time.

### 13.7.2 Further Work on the Mathematical Models

#### Optimisation, Prediction and Validation (Mathematical Models)

As we may know, the greatest benefit of developing a mathematical model is derived from the modelling process itself. This process requires that the individual or group involved in developing a model of some system of interest come to terms with how that system actually operates. The mathematical formulation of a model does not allow ambiguities such as undefined variables or verbose, circular definitions. Thus one must succinctly and rigorously state how system operates.

With a mathematical model, optimisation, validation and prediction are usually required. As the author mentioned earlier, those works largely remain unexplored because of the lack of required data and the lack of appropriate computer packages for computation within the reach.

However, the concepts and possible approaches need to be explained. Given the initial model, along with its parameters as specified by historical, technological, and judgmental data, one next calculates a mathematical solution. Frequently, a solution means values for the decision variables that optimise one of the objectives and give permissible levels of performance on any other of the objectives. This is the process of optimisation.

Once a mathematical formulation is developed, it is almost always the case that data are necessary for estimating unknown inputs and parameters of the model. This can potentially involve expensive data collection efforts.

However, the model can be used to avoid much of this expense and also yield initial insights to the operation of interest. This can be fulfilled by sensitivity analysis. In sensitivity analysis, we can vary our parameter guesses by plus or minus 50% and see what the model produces with each of these variations. What one usually finds is that the model's output will be sensitive to some parameter variations and insensitive to others. The practical implications are important. If varying a parameter by plus or minus 50% does not significantly affect the model's outputs, there is no reason to invest resources trying to obtain an accurate estimate of that parameter. Because sensitivity testing is essentially a part of the validation process, one must be careful to build his model in such a way as to make this process computationally tractable.

Another important purpose of mathematical models involves the quantitative predictions produced by models. If fortunate, one may find a new policy that is predicted to yield a 10% or 20% improvement in performance. If so, it is worth considering implementing such a policy in the real world. On the other hand, if the best one can obtain is a 1% predicted improvement, it may be best to leave things as they are. Therefore, prediction is important in the mathematical modelling process.

There are enormous OR computer packages available nowadays. Janczyk et al (1988) reviews fifteen Multiple-model OR packages, which are currently available for the IBM-PC and compatibles. Of these fifteen packages, Decision Systems Support (DSS) seems capable of

serving the purposes best in this project. It is operational for linear programming, integer programming, goal programming and queueing etc.

### Multi-objective Programming

In the thesis, the construction of models for CAP were based on multi-objective planning approach. But only the single objective functions for CA were formulated. As we know, in reality, most problems are multi-objective. Thus it is desirable to apply multi-objective programming techniques to generate the alternatives, i.e. to optimise the solution.

Multi-objective programming and planning are concerned with decision-making problems in which there are several conflicting objectives.

The approach represents a very useful generation of more traditional, single-objective approaches to planning problems. The consideration of many objectives in the planning process accomplishes three major improvements in problem solving. First, multi-objective programming and planning promotes more appropriate roles for the participants in the planning and decision-making processes. Second, a wider range of alternatives is usually identified when a multi-objective methodology is employed. Third, models (if they are used) or the analyst's perception of a problem will be more realistic if many objectives are considered.

It is useful for explanatory reasons to make a distinction between multi-objective programming and multi-objective planning. Planning is the process by which analysts perceive a problem, define it, collect data about it, formulate it (perhaps mathematically as a model), and generate and evaluate alternatives for solving it, leading to the end of the process when decision makers choose an alternatives for implementation. Thus planning is defined as the sum-total of the activities of analysts and decision makers from problem perception to project implementation. Multi-objective planning is problem specific and it is this characteristics that distinguishes it most from multi-objective programming. Multi-objective programming models may be a piece of the planning process: they address the generation and evaluation phases. Multi-objective programming is a specific form of mathematical programming, a highly structural and formal mathematical procedure for finding the optimal solution to a decision problem. Multi-objective programming deals with optimisation problems with two or more objective functions. (Cohon, 1978)

The general multi-objective optimisation problem with  $n$  decision variables,  $m$  constraints and  $p$  objectives is

$$\begin{aligned} \text{Max } Z(x_1, x_2, \dots, x_n) \\ = [Z_1(x_1, x_2, \dots, x_n), \\ Z_2(x_1, x_2, \dots, x_n), \\ \vdots \\ Z_p(x_1, x_2, \dots, x_n)] \end{aligned}$$

s.t.

$$G_i(x_1, x_2, \dots, x_n) \leq 0$$

$$i = 1, 2, \dots, m$$

$$x_j \leq 0$$

$$j = 1, 2, \dots, n$$

There are several different approaches to multi-objective programming and planning problems. The following are major ones:

1. Generating techniques (e.g. weighting method)
2. Techniques that incorporate preference (e.g. goal programming)
3. Multi-decision making methods (e.g. Analytical Hierarchy Process)

### Simulation

Mathematical analysis sometimes is not powerful enough to yield general analytical solutions to situations as complex as are encountered in information systems. The alternative is the experimental approach.

The mathematical model of the information system is constructed. Such a mathematical model is a detailed description that tells how conditions at one point in time lead to subsequent conditions at later points in time. The behaviour of the model is observed and experiments are conducted to answer specific questions about the system that is represented by the model.

“Simulation” is a name often applied to this process of conducting experiments on a model instead of attempting the experiments with their real system. ...

The definition of simulation describes system (for which simulation methods are appropriate) as being complex, being subject to random fluctuations, and having relationships that are difficult if not impossible to analyse mathematically. (McMillan & Gonzalez, 1973)

The two applications of simulation are the design of systems and the analysis of system behaviour.

Computer simulation has come into increasing widespread use to study the behaviour of systems whose state changes over time...

Simulation can follow such procedures flowcharted in Chapter Four.

In the extension of this project, GPSS is suggested to simulate the ILL queueing system. By simulation, we can find out how long the queue will be under the different assumptions of

configurations (e.g. centralised, or decentralised or hierarchical), resource allocations (e.g. different number of staff or computer terminals etc.) and availability of UC (e.g. UC locally available, or UC centrally available or non-UC available) in the system.

GPSS (which stands for General Purpose Simulation Systems) is a programming language which is specially for discrete-event simulation. In discrete-event simulation, the system is only studied at time points when changes of state occur. As a computer language, GPSS has the following advantages:

1. It is easy to learn, even for those with no prior programming experience.
2. It is very powerful and flexible, in the sense that short programs written in GPSS can simulate quite complex systems.
3. It has “automatic output”, i.e. in writing the program, one has merely to name a queue that one is interested in and then the GPSS processor which interprets the program will automatically collect data about this queue and output the relevant statistics at the end of the simulation run.
4. It has “good diagnostics” i.e. if the program contains mistakes, the GPSS processor will indicate the location of each mistake and the type of mistake, which simplifies debugging.
5. GPSS is well documented compared to other simulation languages. (O'Donovan, 1979)

### 13.8 Design and Planning of Other Network Functions

Apart from the four network functions designed in detail in the preceding chapters, more efforts need to be made to design and plan some other functions which are important to the network.

Those functions may fall into either of the three categories identified in Chapter One. For instance, continuing education, or training, whether for professionals within the network, or for users in general is a function that serve patron directly; exchange of materials is a function that serve library interests directly and the patron indirectly; and communication activities such as publication, the holding of meetings, etc. are functions that support the network activities. Under the following heading, the author intends to list the important functions and give the definitions to those functions.

#### 13.8.1 Exchange of Material

Exchange of material is a useful co-operative method in building library resources. The materials to be exchanged are either internal publications or duplicates. The channels for exchange are either directly between libraries or indirectly through a central library. During

the planning stage, an agreement must be reached among the network members to send one another a copy of all the publications produced by their parent organisations, as well as a copy of all their duplicates to the national or provincial focal point, which announces the availability of the duplicates in its collection, or sends them directly to individual members.

### 13.8.2 Newsletters

Newsletters represent a well-received types of network publication because of their interesting format and topical news content. On-going/planned network activities and recent network publications are some typical news items.

Newsletters are prepared in the provincial focal point, based on regular contributions submitted by network members who report on networking and information activities and on central activities, such as workshops, announcements of publications, extracts of important articles, training and user education programmes, and other topic.

### 13.8.3 Joint Directories

Directories are very important in networking. Directories may be subject-specific, focusing on projects, personnel or staff, addresses, consultants and experts, training programmes, research activities, educational institutions and other organisations engaged in agriculture-related activities.

### 13.8.4 In-service Personnel Training

Training in skills development, with particular focus on network operations, should be offered periodically. The need for training arises due to periodic increases in network membership, personnel turn-over, the emergence of new trends and practices in library and network operations, the introduction of new projects requiring new inputs from personnel, and other related developments.

Training may also cover techniques for the development and the use of thesaurus retrieval systems, abstracting and indexing, techniques of information dissemination and writing/editing for specific audiences, the monitoring and evaluation of document utilisation, and the management of networks etc.

### 13.8.5 Workshops and Meetings

These activities are undertaken periodically to serve as a means of informing network members of projects which may need their mutual assistance and collaboration, of problems requiring their inputs, of guidelines for the standardisation of produces/operations, of policy

revisions/reviews, of the network's progress and the problems that have yet to be threshed out.

### 13.8.6 Standardisation Functions

This includes the establishment of minimum standards for each network function so as to create a minimum level of compatibility within the network as well as among networks.

While standardisation is a difficult problem, it is really a "one-time" problem, with much co-operation, debate, research and experimentation in the beginning, followed by a decision and relative stability, subject only to periodic review and modification. Hence, it is a problem area for the beginning of a network, but a routine function thereafter.

### 13.8.7 Marketing Function

Network functions and the tasks they accomplish must be known both to members as well as to potential members. In addition, evaluation of present services and of the demand for new services must be an on-going process. These, as well as fair and cost recovery pricing, are the responsibility of marketing. The publication of brochures and other useful documents is also within the marketing area.

## 13.9 Concluding Remarks

The following general conclusions about networking can be given:

1. Co-operation, and networking require commitment to the ideal of improved service through resource sharing. The attitude of participating libraries towards a co-operative programme may be the most crucial factor in determining success or failure;
2. The strengthening of individual libraries must go hand in hand with any co-operative programme. Co-operation can never be a substitute for a good local collection adequate to meet basic everyday needs;
3. Co-operation requires money. Adequate and assured financial support is essential to the success of any co-operative project; co-operative programmes should never be viewed primarily as a way of saving money;
4. All participating libraries in a co-operative programme should benefit, including the largest;
5. Computer-based networks offer promise for the future, but they present many unsolved problems; and
6. Rigorous evaluation of co-operative programs is as essential as careful planning.

## Chapter 14

# Recommendations

### 14.1 Introduction

No networks can be developed without recognising the importance of networking and without true willingness to co-operate from both the related authorities and the potential participating libraries. Networking could not be successful until certain conditions, psychological, technological, financial, become mature.

It is realised that this specific project will not be able to be implemented until it has obtained the necessary supports and co-operations from the related authorities and potential participating libraries and information centres.

Thus, an important task for those who have realised the importance and necessity of networking is for propaganda urging the related authorities and potential participating libraries and information centres to be prepared and to create the necessary conditions and environments for the fulfilment of the idea of networking.

### 14.2 Recommendations to Authorities and Decision-makers

Authorities (including parent organisations) usually play very important roles in the promotion of network development. They are usually involved in decision-making, policy-making, funding and other important activities. Therefore, their recognition, attitude and motivation are of vital.

To facilitate the development of library and information systems as a whole, and that of networking in particular, the following steps need to be taken by the related authorities, especially the Commission of Science and Technology and the Agricultural Departments at different Levels:

1. *Objectives and Policies*—Long-term overall objectives should be formulated by the central government. And unified high-level policies, and local policies under the unified policies should be worked out to assure the fulfilment of the overall objectives;
2. *New Technologies*—Measures are needed to facilitate the development of new technologies, i.e. computer systems, telecommunication systems and photocopying systems etc.
3. *Investment*—More investment should be put in the development of library and information systems (e.g. expansion of services, enrichment of information resources and introduction of modern technologies etc.) since information is intellectual investment, which will bring out enormous benefits. In particular, networking needs financial supports.
4. *Personnel Structure*—Again, in general, both the quality and quantity of librarians and information workers need to be improved. And their status should be upgraded. This will provide a good manpower input to networks.

To sum up, it is very important that the upper level administrative organisations, and parent-bodies of these information services provide good conditions for the work in libraries and information centres, and give full support in terms of manpower, money and resources.

For this specific research, it is vital for the author to present the authorities at different levels with the reasons why networking is one of most effective ways of improving library and information services' performance and to convince them that the models constructed are appropriate to be implemented. Much effort needs to be made and difficulties must also be foreseen.

Modification needs to be made towards the preferences of the related authorities and participating libraries after the careful discussion with them. Once the design models are approved by the related authorities, they are recommended to perform the following roles:

1. Policy-making
2. Investment
3. Organisation and management

### 14.3 Recommendations to Potential Participating Libraries

In the future network(s), nodes at different levels, of different sectors and with different specialities, will perform different roles and have different responsibilities. Their future performance should reflect the overall objectives of network(s). The tasks should be undertaken under the unified programmes.

For instance, under the unified CA programme, the national centre should acquire documents as comprehensively and exhaustively as possible. On other hand, it should avoid duplicating some highly-specialised and marginal materials to some particular specialities with the specialised institutes. The latter are at a better position to collect these materials.

Overall, the potential participating nodes should work towards the fulfilment of the idea of networking. And, once they have been networked, they should strive for the objective of the network(s).

The following recommendations are made to urge the potential participating libraries and information centres to improve their services and to get ready for networking.

### 14.3.1 National Centre

STDIC-CAAS is the national centre of the agricultural library and information system. It is an important back-up for regional and provincial networks. To exert its best influence in the national network, it should fulfil the following tasks well:

1. Acquiring, processing, storing and providing both foreign and domestic agricultural documents systematically, comprehensively and exhaustively;
2. Analysis of, and research on the present situation of both foreign and domestic trends and development level of agricultural production, science and technology, then providing information for production, decision-making and key research projects;
3. Exploring agricultural sci-tech information resource, building databases and providing IR and consultancy services;
4. Organising and publishing journals, books and translated works on agriculture sci-tech theory, applied technology, information and sci-tech extension;
5. Organising and co-ordinating agricultural sci-tech library and information works, training programme and exchange of experiences nation-wide, and conducting co-operation and exchange of agricultural information with other countries;
6. Carrying out researches on the theory and methods in agricultural sci-tech librarianship, information science and publishing, and facilitating the modernisation of library and information services.

### 14.3.2 Libraries and Information Centres in Specialised Institutes

To improve the effectiveness of their services and to exert the best influences in the future national agricultural library and information network, the libraries and information centres in the specialised institutes should

1. Exhaustively and systematically collect and store both foreign and domestic documents in the field, and provide consultancy services to different types of users in various forms and through different channels;
2. Build up a solid document foundation, then process and report those collections, and finally establish information retrieval system matching with the characteristics of speciality;
3. Strengthen the editing, printing, publishing and distribution capability thus improve the quality of information dissemination and reporting, and consequently improve the social effects;
4. Carry out investigation, analysis and research in the light of the major problems appeared in the research, production, key research projects and developmental strategies in the field and provide information for decision-making, plan-management and research project processing;
5. Under the unified plan by CAAS, be in charge of the compilation and translation of subject abstract and index journals, which lays a foundation for the development of computerised information retrieval;
6. Establish a subject sci-tech information network and fulfil the role of co-ordination well;
7. Explore the channels for information exchange and carry out information exchange and co-operations with relevant information services .

### **14.3.3 Information Institutes (or Divisions) and Libraries in Provincial Research Sector**

It is planned by the related authorities that the sci-tech information institutes (containing libraries) in provincial academies of agricultural science will become the provincial centres of agricultural documentation and information. They are, therefore, strong candidates for the co-ordination and organisation of co-operative activities in the network. The centres should:

1. Broadly collect both foreign and domestic agricultural sci-tech literatures and meanwhile pay special attention to local materials and try to establish collection and document services with local characteristics and satisfy most information needs locally;
2. Organise the building up of local agricultural sci-tech databases based on the local information resources and supplement the national databases in the computerised information retrieval system;
3. Carry out information investigation and SDI services, and thus provide scientific basis and forecasting information for decision-making and processing of key research projects in the province;

4. Report the sci-tech achievements and disseminate sci-tech information efficiently and effectively by utilising various channels and modern means, thus convert the information into production forces quickly. At the same time, strengthen the dissemination of information on rural marketing and technological economy and further promote the development of rural commercialised production; and
5. Actively undertake those tasks assigned by the national agricultural sci-tech information system, organise and co-ordinate the local information work, and set the programmes for training, technical supervision and experience exchanging.

The agricultural research libraries or information services at prefectural level should:

1. Provide information mainly to agricultural research and technical extension on a prefecture-wide scale;
2. Be stocked mainly with important domestic agricultural books and periodicals, and core foreign agricultural books and periodicals; and
3. Be equipped with computer terminals so that they can retrieve information directly from the national centre and provincial centre in the future.

#### 14.3.4 Agricultural University Libraries

Agricultural university libraries usually have big collections. They should play very important roles in the provincial networks. To tap the full potential, they need to:

1. Consolidate the bibliographic function, i.e. the collecting, sorting and processing of bibliographic resources. And establish information retrieval systems to increase the utilisation of documents and information;
2. Strengthen appropriate services for students and teachers;
3. Improve the quality of the information-oriented journal, newsletter or current awareness and the performance of information consultancy services;
4. Organise co-ordinating teachers to carry out agricultural information investigations, and strengthen translation and compilation work;
5. Carry out information exchanges with relevant domestic and foreign organisations;
6. Undertake the task of teaching basic knowledge of information science and librarianship for postgraduate students, senior undergraduate students and teachers, putting emphasis on information retrieval and utilisation; and create conditions to permit professional training of on-job agricultural sci-tech information and library staff; and
7. Carry out research on the theory and method of information and librarianship.

## 14.4 Summary

Overall, attention needs to be paid by both authorities and potential participating libraries to:

1. Adjusting and reforming the organisational structure of whole agricultural library and information system and internal structures of individual libraries and information centres to extend the communications between different professions, sectors and levels of libraries and information centres, and between librarian and information workers;
2. Enlarging the coverage of information resources, expanding the services and adjusting the bias in the provision and dissemination of information in order to satisfy the information need with increased quantity and changed orientation. More practical and marketing information should be provided; special attention should be paid to improving the services to the largest groups of users, i.e. farmers;
3. Recruiting more qualified personnel: sci-tech information officers, as one part of researchers, should possess knowledge of the speciality, foreign languages and librarianship or information science. Experienced researchers, willing to move to information work are ideal candidates. Besides, it is essential to provide opportunities for librarians and information officers to be trained so that their knowledge can be continually updated and improved, their views broadened, and their sensitivity towards information increased. Additionally, librarians and information officers should have equal chances as the researchers to be promoted and rewarded;
4. Facilitating the development of information means and paying attention to the application of new technology in information work; and
5. Increasing the investments and budgets for sci-tech information—an investment in intelligence. It is important to allocate more budgets to create necessary conditions for the development of information services.

The optimum pace of development of the system overall will depend very greatly on the support from authorities, motivation of potential participating libraries. The author believes that the above preparations will make the whole agricultural library and information systems prosperous and enable the networks to succeed.

Once the related authorities and potential libraries accept the idea of networking and have created a sound environment for networking, the author would recommend that

1. A provincial-scale subject network is more appropriate and efficient than others under Chinese circumstances;
2. Multitype network is feasible in a provincial subject network;
3. The network should be multifunctional but over-ambitious plans should be avoided;

4. The conventional four functions, i.e. CA, ILL, UC and IR should be the priorities in such a network;
5. Governance and organisation are vital; communications among sectors need to be improved to facilitate the organisation;
6. Objectives including long-term and short-term, and high-level and low-level, should be first identified; low-level objectives should be function-oriented;
7. The CA programme should reflect the geographical characteristics of agricultural production and the focus should be put on highly specialised and expensive items;
8. Certain focal points with large stocks and UC services should be established to facilitate ILL transaction;
9. The UC should start from union lists of serials and foreign publications;
10. IR should be centralised. The centre should make full use of national IR system(s);
11. Models constructed in this research are based on the consideration of cost-effectiveness-benefits, which, thus, are appropriate to be adopted and implemented though they are subject to some modifications; and
12. Overall, the network should consider to automate some operations though high degree of computerisation is not realistic for the time being, etc.

## Appendix A

# Background of Zhejiang Province

Zhejiang Province is situated in South-eastern Coast of China. It is in the middle of the sub-tropical zone.

In the North, Hang-Jia-Wu Plain is regarded as the most fertile triangular plain along the Yangtse River; While the west and south are composite part of South-eastern hilly zone in the China.

The administrative structure in Zhejiang can be described as follows:

1. Seven major cities directly administered by the Provincial Government;
2. Four prefectures;
3. Ten cities administered by prefectural governments;
4. Eighteen districts administered by city governments; and
5. Sixty-seven counties.

## Populations and Distribution

According to the data from the Census in 1982, the total population in the province has reached 40m. The population density is 382 persons per square kilometre, which is 2.6 times greater than the national average—105 persons per square kilometre. It ranks the seventh in China in terms of population size. The distribution of population, however, is rather uneven among the areas, which is affected by the following factors:

1. Natural topography;
2. Economy;

Table A.1: Distribution of Population in Zhejiang

Professions	Proportion	Profession	Proportion
Agriculture, Animal Husbandry Forestry and Fishery	62.41%	Public & Services	0.55%
Mine, Timber	1.02%	Health, Sports & Welfare	0.74%
Electricity, Gas & Water	0.26%	Education & Culture	1.96%
Manufacture	23.50%	Science & Technology	0.10%
Geological Reconnaissance	0.07%	Bank & Insurance	0.18%
Construction	2.99%	Government Departments	1.12%
Transportation & Postoffice	1.81%	Commercial, Food Process	3.24%
		Others	0.05%

3. Culture; and

4. Transportation etc.

The distribution of population along the professions has been estimated in the Census and is listed in Table A.1.

It can be seen clearly that vast majority of the population are engaged in agriculture, animal husbandry, forestry and fishery. And in the above areas, population concentrates much on agriculture. It occupies 91.48 per cent. Of the population who are engaged in agriculture, animal husbandry, forestry and fishery, there are about 12,539 scientific and technical personnel. This type of population is distributed in five main sectors (Table A.2).

The characteristics of the population in Zhejiang Province can be summarised as

1. Dominant position of agricultural population;
2. Low proportion of population engaged in construction, transportation, post and telecommunication, business, and public services; and
3. Lack of specialised, technical personnel.

Table A.2: Distribution of Sci-tech Personnel in Agriculture (Zhejiang)

SUBJECT	NUMBER	PROPORTION
SEED & PLANT BREEDING	678	10.11%
CULTIVATION	1,445	21.56%
SOIL & FERTILISER	395	5.89%
PLANT PROTECTION	714	10.65%
ANIMAL HUSBANDRY & VETERINARY	1,213	18.10%
COTTON & FABRES	161	2.40%
SILK-WORM	663	9.89%
TEA	308	4.59%
FRUITS	205	3.06%
AGRICULTURAL ENGINEERING	388	5.79%
OTHERS	533	7.95%
<b>TOTAL</b>	<b>6,703</b>	

### Major Characteristics in Economic Structure

The economy of Zhejiang is mainly based on Agriculture and Light Industry. In the latter, collective and small size enterprises occupy the superiority position. Zhejiang is a comprehensive agricultural production area with high level technology but limited lands and resources. It is one of the highest yielding area in China. In the plain area, the land is fertile and is the base for major staple food (e.g. rice) and cash crops. While the vast mountainous areas and extensive oceanic areas give varieties to the Forestry and Fishery Productions.

## Appendix B

# Explanation of CA Mathematical Models

### Material Accessibility

Here, the author intends to explain each variable in the formula.

The variable  $I$  is quite straightforward; it denotes the number of title classes. The classes can be defined according to the divisions of classification or popularity levels (or level of usage). For example, in this project, 11 classes have been decided according to the sub-classes of the class, agricultural science in the *Chinese classification scheme*. And five popularity classes decided according to the usage study (survey).

$J$  denotes the number of participating libraries in the network. In this project, 28 libraries and information centres at national, provincial and prefectural levels have been chosen. Among them are research, university, public and other type of libraries.

$T$  denotes the total number of titles universally available. The data can be collected from some bibliographies or some published statistical data. In the case of Chinese books, the data has been collected by counting the number of titles disclosed and listed in the *National Bibliography of Agricultural Sciences: 1949-1985*. The degree of the comprehensiveness and completeness has not been evaluated. However it is the most comprehensive Chinese bibliography on agricultural sciences the author could possibly find. The data about the total number of foreign books published in the world have been found from some published papers or Book News. Although this is a controversial issue, we can choose the data with closeness to the others and the data disclosed in more authoritative sources.

$u_t$  denotes the average number of requests on the titles universally available. In theory, the data can be obtained by collecting the request data on the titles both accessible and inaccessible in the network. The latter can be, somehow, the request data on ILL from other libraries outside the network. However, it is not so easy to get complete data for the latter case

in practice, especially under the circumstance when the ILL systems has not been so popular and formalised in China. Nevertheless, we can assume a value under the consideration of both the request data on the popular books and less popular books etc..

$I_{ij}$  denotes the number of items in class  $i$  to be allocated to library  $J$ , which is the control variable in the formula.

$u_{ij}$  is defined as the average number of requests on class  $i$  from library  $J$ . The gathering of such data involves the following procedures: 1) using a library catalogue, and dividing books into groups according to their classes; 2) checking the books of every five books in the catalogue and counting the borrowing records in a year time in the due date label of each book checked; 3) presenting the data in the table according to the frequency of borrowing; 4) calculating the average number of requests on each class. Thus, the average number requests on the titles of each class can be obtained.

$(\sum_{i=1}^I \sum_{j=1}^J I_{ij})$  is defined as the total number of items in the network, which includes the duplicated copies of the same title.

$O\%$  is defined as the average rate of collection overlap between libraries, which can be determined by the analysis of the data from the investigation on the degree of collection overlap and the standard (if there is one, more accurately the common cases).

$I_n$ , here, denotes the minimum title requirement in the network, which can be determined by the consideration of both the total number of titles universally available and the present situation of those participating libraries. A reasonable proportion can be derived.

$O_i\%$ , with the similar characteristics to  $O\%$ , denotes the average overlap rate of class  $i$  between libraries.

$I_i^L$  is defined as the lower-level title constraints of each class, i.e. the minimum title requirements for each class. It can be the existing number of titles the network holds. If it is too low, we can determine a proportion of the total number of titles in each class universally available.

$I_i^U$  is defined as the upper-level title constraints in class  $i$ . In most case, the total number of titles in each class universally available can be used as this constraints. However, if the value is too high by judging, for instance, the total number of foreign books on agricultural science published in the world, we can decide a proportion of that number. In reality, China was only able to introduce a small proportion of foreign books annually, saying around 20 per cent in 1986 for the whole country. While the regional network will be able to acquire even less proportion of that.

$(\sum_{i=1}^I \sum_{j=1}^J I_{ij}) \times O_i\%$  is defined as the number of items overlapped in each class. And  $[\sum_{i=1}^I \sum_{j=1}^J I_{ij} - (\sum_{j=1}^J I_{ij}) \times O\%]$  is defined as the total number of titles of each class to be acquired in the network, which will be determined after optimisation.

$\sum_{i=1}^I I_{ij}$  denotes the number of items library  $j$  is going to acquire, which includes the title overlap with other libraries.

$I_j$  is defined as the minimum title requirement for library  $j$ , which will assure the minimum satisfactory level. It can be decided by the consideration of the present status of those participating libraries and the standard collection size.

$c$  denotes the average cost of each title in each class. We assume that there are two cases when optimisation is carried out. In the first case, the average cost of each class is the same. In the second case, the average cost of titles in each class is different. The data about cost can be collected by survey methods. If there is no statistical significance between classes, we can assume that the average costs of the titles among the class are the same.

$B_j$  is defined as the budget constraints of library  $j$  for purchasing the titles of  $I$  classes. The data can be collected again by survey methods.

## Geographical Accessibility

It is noted that with an uniform distribution, both the probability of initialising an ILL request and the probability for node  $k$  to satisfy the request, i.e. number of relay times are equal among the nodes. Therefore, no matter how different the number of the requests from different nodes are, the result of the Expected Average Distance for any type of request are the same as the product of relay times and two probabilities. If we assume that resource distribution is skew one, consideration of the number of the request is necessary.

When one copy of title  $i$  is circulated in the network, the Expected Distance is  $D^1$ , two copies,  $D^2$  and  $m$  copies  $D^m$ .

We intend to minimise the Expected Distance to satisfy a request of any type, which can be expressed as

$$\begin{aligned} & \text{Min}\{D^1x_1 + D^2x_2 + \dots + D^m x_m\} \\ & \qquad \qquad \qquad \text{s.t.} \\ & \qquad \qquad \qquad x_1 + x_2 + \dots + x_m = 1 \\ & \qquad \qquad \qquad c^1x_1 + c^2x_2 + \dots + c^m x_m \leq B \\ & \qquad \qquad \qquad x_k = \{1 \text{ or } 0\} \quad k = 1, 2, 3, \dots, n \end{aligned}$$

## Local Availability

Examining the formula, we can find that

where

- $P_i^1$  is the average probability of dissatisfaction when one copy of each title in class i is circulated;
- $P_i^2$  is the average probability of dissatisfaction when two copies of each title in class i are circulated;
- $P_i^n$  is the average probability of dissatisfaction when n copies of each title in class i are circulated;
- $x_1, \dots, x_n$  are zero-one integer variables;
- $c_i^1$  is the conversion co-efficiency between the cost for one copy of each title in class i and the probability of dissatisfaction when one copy is circulated;
- $c_i^2$  is the conversion co-efficiency between the cost for two copies of each title in class i and the probability of dissatisfaction when two copies are circulated;
- $c_i^n$  is the conversion co-efficiency between the cost for n copies of each title in class i and the probability of dissatisfaction when n copies are circulated;
- $C_i^1$  is the unit cost of one copy of each title in class i;
- $C_i^2$  is the cost of two copies of each title in class i;
- $C_i^n$  is the cost of n copies of each title in class i;

The conversion co-efficiency reflects the priority of the designer on the measure of the Probability of Dissatisfaction.

The steps of computation can be summarised as follows:

Step 1: rank  $P_i^1 + c_i^1$ ,  $P_i^2 + c_i^2$  and  $P_i^n + c_i^n$  into a vector with an increasing order according to their values;

Step 2: rank the costs into a vector with an increasing order;

therefore,

$$V_1 = [P_i^1 + c_i^1 \quad P_i^2 + c_i^2 \quad \dots \quad P_i^n + c_i^n]$$

$$V_2 = [C_i^1 \quad C_i^2 \quad \dots \quad C_i^n]$$

Step 3: compare the elements of Vector 2 with budget constraints,  $B_i$ , until the situation when C is greater than  $B_i$ . Thus, we can find the optimum value from Vector 1.

## Appendix C

# Major Factors relevant to the Design Of ILL System— identified by Line

### Geography and population

A very large country whose population is concentrated in a few urban centres creates far fewer problems for library services than a country of a similar or smaller size whose population is widely scattered in small towns: fewer libraries are needed in the former cases, and the telecommunication system required can be relatively simple.

### Constitution

A country with a federal constitution that gives a high degree of autonomy to states or provinces may find centralisation less feasible and acceptable than one with a non-federal constitution.

### Stage and nature of development

Not only will the volume of demand per head of population normally be far greater in developed than in developing countries, but the nature of demand is likely to be significantly different, with a greater emphasis on agriculture and medicine in most developing countries, and a higher level of demand for pure science and very recent publications in developed countries.

## Education and research

One would expect the average level of literature requested on ILL in developing countries to be rather “lower” than in developed countries, but one would also expect this to be a temporary phenomenon; as local libraries improve and the level of education become higher, the level of literature requested is likely to become gradually “higher”.

## Communications

In most countries, mail will be used for the great majority of requests and loans.

Although an adequate system of communications is of course essential if ILL is to take place at all, within certain limits speed of transmission may not be critical. Studies in several developed countries have shown that the most serious delays occur not in transmission but in requesting and supplying libraries.

## Book production

Users in the more productive countries are clearly likely to find more of the literature they require in their local libraries, or available elsewhere in the country, than users in countries that produce little. It is also easier for such countries to ensure adequate provision of at least a fair portion of literature required on ILL.

## Library resource

The strength of existing library resources, and money available for developing new resources, are clearly two critical factors, which depend in the first case largely on history and in the second on economic development. While a developed country may be prepared to make available substantial additional resources to have a fast ILL service, if necessary duplicating the resources of other libraries, in developing countries the emphasis may have to be on maximising the use of existing libraries.

## Appendix D

# UC Compilation and Cost-effectiveness

### Issues in Compilation

#### Selection of Contributing Libraries

A specialised catalogue will include, and probably concentrated on, the holdings of specialist libraries, but notifications of strong collection in the subject in question in other more general libraries would also be desirable. A general catalogue on other hand would have as a basis the holdings of large libraries, which provide the largest number and widest spectrum of publications, and supplement them with smaller research and special libraries which will contain additional items.

Regardless of the value or size of the collection of a particular library, a major criterion in deciding whether to include a library in a UC is its ability and willingness to supply items on ILL. Comprehensiveness of coverage may appear to be an ideal, but the belief that "the more libraries included in the UC, the more comprehensive the catalogue" is false. The aim should be an optimum number of libraries that between them can supply an optimum percentage of book in the country or region.

#### Types of Union Catalogue

UC can be classified according to its contents (i.e. for serials or monographs); its subjects (i.e. comprehensive or specialised) and its media (i.e. cards, or book, or microform or computer tapes)

As for its media, i.e. its physical forms, there are card catalogue, printed catalogue or machine-readable data base giving access via a terminal, printed or microform products. When consid-

ering the physical form the UC should take it may be useful to consider their advantages and disadvantages (attached). Decision, therefore, can be made through a careful cost-effective comparison.

### **Form of Entry**

The form that entries in UC should take depends upon the intended use of the catalogue. If it is to be used also a bibliographic or cataloguing tool, then the entries will of necessity be extensive, and aim to be complete and accurate. The cross-references that will be necessary will only increase the size and decrease the manageability of the catalogue; staff time will increase as entries from contributing libraries are made to conform to the established standard, and as ILL request are searched for in a large and complicated catalogue. The liability to error is also likely to grow. The requirement for entries in a UC that is to be used only for ILL purpose is much simpler. The basic requirement is for entry under author and title, with date and edition providing supplementary aids to identification where necessary.

### **Content of Bibliographic Record and Compilation**

The content of bibliographic record usually includes bibliographic information, and holding and lending information.

### **Aspects needing attentions**

During compilation, the following aspects needing attentions:

#### **Arrangement**

The arrangement of the UC should facilitate rapid access and efficient use. The preferred print or display for the main sequence is usually alphabetic for the western languages items. As for Chinese, either in the order of number of radicals or alphabetic order for phonetic alphabet.

#### **Access Points**

Access points other than title can include author(s), subject headings, key-words, cross reference, and ISBN etc. These should be provided by means of indexes or be integrated into the main sequence with the aim of giving multiple approaches appropriate to the items covered and aiding the user who has at hand an imprecise title citation. Where the UC is created in

an automated environment, the creation of multiple access points creates less work than in a manual environment.

## Filing System

In order to use the UC successfully, the filing arrangement must be understood.

## Comparison among different Media of UC

### 1. Card Catalogue

- can constantly be kept up-to-date by interfiling new information without re-sequencing the file.
- the basic material for the creation of the card catalogue are inexpensive;
- a highly sophisticated infrastructure is not necessary to the library;
- possible access points in a card catalogue in theory are unlimited; in practice, references and added entries are limited by the amount of work required to produce them and by the physical amount of space they take;
- it is possible to produce a printed catalogue from a card catalogue and vice versa, recognising that this is a labour-intensive process;
- the card catalogue is bulky in size;
- access is limited to those on site;
- information cannot be transferred easily;
- duplicate copies of the catalogue, to protect the information from loss or destruction, do not exist; and
- changes to cataloguing rules present major problems for the coherence of the catalogue.

### 2. Printed Catalogue

- the printed catalogue is portable;
- it may be produced in multiple copies and widely distributed;
- it cannot be kept up to date unless derived from machine-readable data;
- when frequent supplements are produced, this involves the user in multiple searches;
- the number of access points is limited by space and resource; and
- the librarian may have less control over the technical details of the production of the printed catalogue than a card catalogue.

### 3. Machine-readable data base

- the machine-readable data base can be kept up to date.

- information can be stored compactly;
- the tape of the data can be duplicated and widely distributed;
- changes to catalogue roles can sometimes be accommodated by writing programs to change elements of the record automatically;
- card catalogue, printed catalogue, microform catalogues can all be produced from the data base; in addition, the data base can be consulted on-line or off-line; and
- if so programmed, can admit searches via a terminal. not only by access points, but by a combination of access points. Similar, can admit searching by keyword;

#### 4. Microfiche

- microfiche is compact and lightweight;
- the support is inexpensive;
- it can be updated frequently when derived from machine- readable data;
- it can be distributed cheaply through the postal system;
- special apparatus is needed for viewing;
- where dependent upon a machine-readable data base, i.e. Computer Output Microform (COM), see also related points above; and
- where dependent upon filming card or printed catalogues, see also under those heading.

## Cost-effectiveness of UC

We assume that there are two major kind of costs involved for UC service irrespective of forms

1. Setting-up cost,  $C_j^s$  (including cataloguing, compiling and printing etc.)
2. Staff cost for UC consulting,  $C_j^R$ .

Thus the unit cost of a request being satisfied by staff at node j is

$$C_j^R = \text{staff hour}(S_j)/\text{per request} \times \text{salary rate}/\text{per staff hour}$$

If  $R_j$  requests enter node j per year, the staff cost at node j annually will be

$$C_j^R \times R_j$$

And total staff cost per year in the network is

$$\sum_{j=1}^J C_j^R R_j$$

Therefore, the total cost of having UC in the network is

$$\sum_{j=1}^J C_j^R R_j x_j + \sum_{j=1}^J C_j^s x_j$$

or

$$\sum_{j=1}^J (C_j^R R_j + C_j^s) x_j$$

Some effectiveness measures can be set as goals

$$(\text{Goal}) \frac{1}{R} \sum_{j=1}^J S_j h_j x_j \geq E(\text{Handling Efficiency})$$

And it will subject to staff constraints.

Thus, we intend to minimise the total cost of UC services in the network and the whole formula can be expressed as:

$$\text{Min} \left\{ \sum_{j=1}^J (C_j^R R_j + C_j^s) x_j \right\}$$

$$(\text{Goal}) \frac{1}{r} \sum_{j=1}^J S_j h_j x_j \geq E$$

$$(\text{Goal}) \sum_{j=1}^J [T_j x_j + T'_j (1 - X_j)] \leq T$$

s.t.

$$\frac{1}{J} \sum_{j=1}^J S_j x_j \leq S$$

$$0 \leq S_j x_j \leq S x_j$$

$$x_j = 0 \text{ or } 1,$$

$$j = 1, 2, \dots, N.$$

where

$J$	is number of nodes;
$C_j^s$	is the setting-up cost of UC services at node $j$ ;
$C_j^R$	is the unit staff cost for UC consulting;
$R_j$	is number of ILL request for UC consulting at node $j$ ;
$x_j$	is control integer variable of UC availability;
$R$	is the total number of UC consulting request in the network;
$S_j$	is staff hours available at node $j$ annually;
$h_j$	is average number of request handled per staff annually;
$E$	is minimum handling efficiency;
$T_j$	is the expectation value of two-body transaction time from node $j$ ;
$T_j'$	is the expectation value of three-body transaction time from node $j$ ;
$S$	is staff hour constraints in the network.

The nodes with high arrival rate, high handling efficiency, easy accessibility and cheap staff costs will have the priority to keep a UC and carry out a service for UC consulting.

## Appendix E

# Determination of Purchase Costs for CA Programme

Here the author intends to take the ZALINET as a case study and go into the details of the flow by clarifying the terms used and explaining the procedures of quantification of some values. Table E.1 presents a summary of the data about the number of items universally available, the number of items accessible in the system and the reasonable target of stock or acquisition. The data were achieved by data analysis from two major sources: a) published data and statistics and b) survey data.

### Number of Items Universally Available

By the number of items universally available, the author means the total number of publications which has been published in the world for a certain period. In other words, such a number of publication are available and accessible in theory. In the most cases, the data on a specific subject will be more interesting when working on specialised library and information network. For instance, in this project, only the data on agricultural sciences are of concern. And the data were collected by the division of form and language.

#### 1. Chinese Book and Periodicals

In the case of the total number of Chinese Books on agriculture the data were gathered by counting the number of titles listed in the *Chinese National Bibliography of Agriculture, Forestry, Animal Husbandry and Fishery 1949-1985*, which is claimed as one of the most comprehensive bibliographies on agriculture science available in China. While the data about the number of Chinese periodical published was adopted from the data estimated by Jiang. The Data in the blanket includes the internal publication, which are not distributed through conventional channel, i.e. subscription from post offices.

#### 2. Foreign Book and Periodicals

The data about the number of the foreign books published for 30 year has been found from several published papers or "Book News". Though, it is still somehow a controversial issue, we can choose the one which is more likely to be publicly recognised and

E. Determination of Purchase Costs for CA Programme

Table E.1: Summary of Data about No. of Items Universally Available

Forms Quantity	CHINESE BOOKS	CHINESE PERIODICALS	FOREIGN BOOKS	FOREIGN PERIODICALS
NO. OF ITEMS UNIVERSALLY AVAILABLE	19,000	471 (2,291)*	300,000	7000-8000
NO. OF ITEMS ACCESSIBLE IN THE SYSTEM	15,200	350 (1,232)*	8,800	250
DESIRED STOCK LEVEL	18,050 (95.0%)	462 (95.0%)	37,500 (12.5%)	1,000 (12.5%)
NO. OF NEW ITEMS UNIVERSALLY AVAILABLE, p.a.	1,100	450	10,000	7000-8000
NO. OF NEW ITEMS ACCESSIBLE IN THE SYSTEM	900	350	300	250
DESIRED ACQUISITION LEVEL	1,045 (95.0%)	462 (95.0%)	1,250 (12.5%)	1,000 (12.5%)

\* Data in the Blanket includes publications subscribed not from Post office

acceptable estimation or which is disclosed in more authoritative sources. It has been estimated that about 10,000 foreign books and about 7000 to 8000 type of periodicals on agriculture or relevant to agriculture are published annually in the world.

### Number of Items Accessible in the System

By the number of items accessible in the system, the author means the number of items which the libraries to be networked have already collected and stored. In a network environment, those items should be accessible by its users from different locations. The number of items accessible in the system were collected by survey methods, discussed in Chapter Eleven. The determination of overlapping rate was also based on the survey.

### Reasonable Acquisition Target

By Reasonable Acquisition Targets, the author means the acquisition targets that is reasonable to achieve in order to improve the accessibility and availability of stock. They usually represent comparatively high proportion of publication universally available, thus to satisfy the most requests placed upon the network by its users. The determination of reasonable acquisition targets should be based on at least one of the following:

1. Published data about publication on specific subject universally available;
2. Present stock situation of libraries to be networked;
3. Situation of other systems either in China or in other countries;
4. Citation data and usage data.

Once we have gathered some of the above types of data, we should be able to derive the reasonable acquisition targets by the analysis of those data. One simple way is assuming a reasonable percentage of the number of items universally available. Here, 95% has been chosen as a standard for Chinese materials while 12.5% for foreign material. The latter is based on the data disclosed by Zhang. It has been estimated that only about one-eighth of foreign publication is introduced into China annually. Since acquisition of 12.5% of foreign publications is affordable by the national level, it is certainly a reasonable target for a provincial level to strive for under the present circumstance.

### Distribution of Demand on Reasonable Acquisition Targets

#### A. Books

The classes are divided in accordance with the popularity, that is, how many times the items have been borrowed during a period of time, for example, one year. Data were collected by taking some samples and counting the due date label of the books. Class S, i.e. Agricultural Science in *Chinese National Classification Scheme*, was chosen as the sample and the drawer of library card catalogue were used aside and then the dates stamped during one year (August

1986 - July 1987) on the date due label of every "fifth" item on the catalogue were counted. The status of the items are divided as follows: 1) NA, i.e. number of items not available at the time of counting; 2) 0, 1, 2, 3, 4, 5, i.e. number of items loaned zero times, once, twice, three, four and five times. When counting the total times of the loan, the status of "not available" was ignored since it causes some inconformity with Poisson distribution. Then from the raw data, the average number of request of 11 subclasses of Chinese and Foreign books and the proportion of demand on different popularity classes in 28 libraries have been both calculated. Two sets of data have been processed by a statistical software package called Microsta. Chi-square tests have been carried out to test the conformity with Poisson Distribution, and to derive the average number of request on 11 classes and average proportion of demand on popularity classes.

By averaging the proportion of demand in 28 libraries, we, therefore, get the proportion of the demand on the different popularity classes in the network (Column I). Then the actual distribution of total demand—18,813 and 5,651 on Chinese book and foreign book respectively—were calculated (Column II). Proportion of the stock with different popularity were estimated (Column III). Examining the two sets of proportion, we can see that they conform with the Bradford Distribution, i.e. small proportion of core stock satisfies large amount of user's need. Total stock were summed upon the stocks of 28 libraries. Then the distribution of the stocks along the popularity classes was calculated (Column IV). The two sets of proportions along the popularity classes are the average based on statistical analysis of the data surveyed in 28 libraries. They should be somehow reliable and represent a common situation since there is no significant difference tested by Chi-square test (Table E.2 & Table E.3).

Therefore, by using the same sets of proportions, we should be able to work out the number of the demand on the reasonable acquisition target and the distribution of reasonable acquisition target along the popularity classes.

### B. Periodicals

It is noticeable that the data collection and estimation of the demand on periodicals usually vary from that for the books. According to Line's finding, i.e. 20-80 rule, we know that around 20% of periodicals contribute almost 80% of literature on specific subjects. This rule can be used to help the selection of periodicals in the network environment. However, in order to make micro-level decision about the overlapping degree for different group of titles, more detailed distribution need to be worked out. Some published citation data and usage data were used to serve the purpose.

Table E.4 presents the distribution of demand among the groups. The division made follows the principles of Bradford Law

### Overlapping Degree

Here it is useful to recall one of the four criteria for CA—Geographical Accessibility. The criteria intends to give out an optimum overlapping degree, i.e. the solutions about how many libraries will collect one specific title or one specific group of titles. In other words, how many

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Table E.2: Proportion of Demand along Popularity Classes (Chinese)

$\lambda$	Prop. of Demand (I)	No. of Demand (5,651) (II)	Prop. of Stock (III)	No. of Stock (6,643) (IV)	No. of Demand on Desired Acquisition level (V)	No. of Desired Acquisition Level (VI)
$4\frac{1}{2} +$	2.8%	158	0.5%	33	30	6
$3\frac{1}{2} + 4\frac{1}{2}$	9.8%	554	2.3%	153	116	29
$2\frac{1}{2} + 3\frac{1}{2}$	18.4%	1,040	5.7%	1,222	213	71
$1\frac{1}{2} + 2\frac{1}{2}$	30.4%	1,712	13.7%	2,019	342	171
$\frac{1}{2} + 1\frac{1}{2}$	38.6%	2,176	34.0%	2,259	425	425
$0 + \frac{1}{2}$	0.0%	0	43.7%	2,903	0	546
<b>Total</b>	<b>100.0%</b>	<b>5,651</b>	<b>100.0%</b>	<b>6,643</b>	<b>1,126</b>	<b>1,250</b>

Table E.3: Proportion of Demand along Popularity Classes (Foreign)

$\lambda$	Prop. of Demand (I)	No. of Demand (18,813) (II)	Prop. of Stock (III)	No. of Stock (17,613) (IV)	No. of Demand on Desired Acquisition level (V)	No. of Desired Acquisition Level (VI)
$4\frac{1}{2} +$	3.4%	640	0.7%	123	35	7
$3\frac{1}{2} + 4\frac{1}{2}$	8.9%	1,674	2.7%	476	112	28
$2\frac{1}{2} + 3\frac{1}{2}$	19.8%	3,725	7.6%	1,339	237	79
$1\frac{1}{2} + 2\frac{1}{2}$	33.2%	6,246	10.0%	3,170	376	108
$\frac{1}{2} + 1\frac{1}{2}$	34.8%	6,547	35.8%	6,305	374	374
$0 + \frac{1}{2}$	0.0%	0	35.3%	6,217	0	369
<b>Total</b>	<b>100.00%</b>	<b>18,832</b>	<b>100.00%</b>	<b>17,630</b>	<b>1,134</b>	<b>1,045</b>

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Table E.4: Distribution of Demand among the Groups (Chinese)  
(Chinese)

GROUPS	Cumulative Number of Titles	Number of Titles	Propor- -tion	Overlapp ing Degree	Number of Items	Cost (10.3Yen)
50% Literature	30	30	6.4%	28	840	8,652
80% Literature	103	73	15.4%	25	1025	18,797.5
90% Literature	170	67	14.2%	20	1340	13,802
95% Literature	236	66	14.0%	15	990	10,197
98% Literature	254	10	3.8%	10	270	2,781
99% Literature	330	76	16.1%	5	380	3,914
100% Literature	471	141	30.0%	2	282	2,904.6
<b>Total</b>		<b>471</b>	<b>100.0%</b>		<b>5,927</b>	<b>61,048.1</b>

copies of a specific title (exclusive of duplicated copies within a library) will be collected by the network.

In Chapter Seven, the author has described and explained the analytical solutions of geographical accessibility. Table E.5 & Table E.6 presents the results of the product of average relay times and number of request, corresponding with different number copies, saying one, five, ten ..., up to 25, which increases by five. Then, the author further decides a measure as a reasonable product of relay times and number of request. The measures should be different between Chinese and foreign materials since the latter are far more expensive and should be acquired at less quantity. The measures determined for Chinese and foreign materials are  $\pm 5.16$  and  $\pm 7.62$  respectively. The higher the product in the same popularity class is, the less copies will be available and the more relay times will be needed. It is obvious that too many relay times is not desirable to the users. Here we need take a consideration of cost-effectiveness about the policy to be adopted. By comparison with the reasonable measure, we, therefore able to work out the overlapping degree for each popularity classes. If we multiply overlapping degree by the number of titles in the class at the reasonable acquisition target, we can obtain the number of items at different class. By summing them up, we have the total number of items. Finally, we derive the average overlapping degree through dividing the total number of items by the total number of titles.

### Average Number of Items Per Node

If we divide the total number of items (excluding duplicated copies) in the network by the number of nodes, we, therefore, have the average number of items per node, which will help the determination of the duplicated rate and the total number of items (including duplicated copies).

### Duplicated Rate

To work out this measure, we need again to recall the performance criteria—Local Availability. To guarantee a reasonable local availability (probability of satisfaction in local libraries), we, sometimes, need to have multiple copies for a specific title or a group of titles in the local libraries. But what the policy should be adopted for different popularity classes needs a consideration of cost-effectiveness. As mentioned and described in Chapter Seven, a reverse measure—probability of dissatisfaction has been chosen. Table E.7 & Table E.8 present the result of the probability of dissatisfaction under the assumption of one, two and three copies. Then the author takes the average number of items per node, and distributes it according to the two sets of proportions, i.e. proportion of demand, and proportion of stock. Based on same method as the one for the overlapping degree, the author, therefore, decides a reasonable measure for probability of dissatisfaction. Again such a decision should be made in accordance with the consideration of cost-effectiveness. The measures marked with asterisk \* are chosen as an tolerable probability of dissatisfaction for each popularity classes. Therefore, the author is able to work out the duplicated rates for each popularity classes if multiplying the duplicated rates by the number of titles in different classes. And by summing them up, the author obtains the total number of items per node (including duplicated copies), finally average duplicated rate can be derived through the total number of items per node diving by the number of titles per node. In the case of periodicals, either Chinese or Foreign, "Non- duplicate" policy will

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Table E.5: Product of Average Relay Times & No. of Requests (Chinese)

GROUPS	Cumulative Number of Titles	Number of Titles	Propor- -tion	Overlapp ing Degree	Number of Items	Cost (170.0Yen)
Nuclear Zone	190	190	2.4%	2.00	380	64,600
50% Literature	800	610	7.6%	1.00	610	103,700
60% Literature	1120	320	4.0%	1.00	320	54,400
70% Literature	1320	200	2.5%	--	--	--
80% Literature	1600	280	3.5%	--	--	--
90% Literature	4320	2720	34.0%	--	--	--
100% Literature	8000	3690	46.0%	--	--	--
<b>Total</b>		<b>8000</b>	<b>100.0%</b>		<b>1,310</b>	<b>222,700</b>

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Table E.6: Product of Average Relay Times & No. of Requests (Foreign)

(UNDER THE ASSUMPTION OF DIFFERENT NUMBER OF COPIES)

$\lambda$	when M = 1 R = 13.99	when M = 5 R = 4.75	when M = 10 R = 2.54	when M = 15 R = 1.72	when M = 20 R = 1.33	when M = 25 R = 1.07	Prop. of Titles	Number of Items	Cost
$4 \frac{1}{2}$	69.95	23.75	12.78	8.68	8.04	5.35*	7	175 (7 x 25)	525
$3 \frac{1}{2} + 4 \frac{1}{2}$	55.96	19.08	10.16	6.88	5.32*	4.28	28	568 (28 x 20)	1,688
$2 \frac{1}{2} + 3 \frac{1}{2}$	41.97	14.25	7.62	5.16*	3.99	3.21	79	1,185 (79 x 15)	3,555
$1 \frac{1}{2} + 2 \frac{1}{2}$	27.98	9.58	5.88*	3.44	2.66	2.14	188	1,888 (188 x 10)	5,648
$\frac{1}{2} + 1 \frac{1}{2}$	13.99	4.75*	2.54	1.72	1.33	1.07	374	1,878 (374 x 5)	5,618
$0 + \frac{1}{2}$	0*	0	0	0	0	0	369	369 (369 x 1)	1,187
							1,045	6,839	18,117

\* Desired Product of Relay Times and Number of Request

be adopted in the local library level.

**Total Number of Items Accessible in the Network (including overlaps and duplications)**

This number can be calculated simply by multiplying the average number of items per nodes with the number of nodes.

**Average Price**

Table E.9 presents the average price for different forms of documents

The average price listed above were derived based on the statistical analyses of several sets of samples of price data for each forms. For each set of sample, around 100 price data were gathered on a random basis from either bibliographies or book-seller news or Ulrich Directory etc.

The total cost of purchase, therefore, can be estimated simply by multiplying the total number of items by average price.

E. Determination of Purchase Costs for CA Programme

Table E.7: Probability of Dissatisfaction (Chinese)

(UNDER THE ASSUMPTION OF DIFFERENT NUMBER OF COPIES)

$\lambda$	when $m = 1$ $R = 13.99$	when $m = 5$ $R = 4.75$	when $m = 10$ $R = 2.54$	when $m = 15$ $R = 1.72$	when $m = 20$ $R = 1.33$	when $m = 25$ $R = 1.07$	Prop. of Titles	Number of Items	Cost
$4 \frac{1}{2} +$	69.95	23.75	12.70	0.60	0.04*	5.35*	6	$\frac{120}{(6 \times 20)}$	462
$3 \frac{1}{2} + 4 \frac{1}{2}$	55.96	19.00	10.16	6.00*	5.32	4.20	29	$\frac{435}{(29 \times 15)}$	2,233
$2 \frac{1}{2} + 3 \frac{1}{2}$	41.97	14.25	7.62*	5.16	3.99	3.21	116	$\frac{1,160}{(116 \times 10)}$	0,932
$1 \frac{1}{2} + 2 \frac{1}{2}$	27.98	9.50*	5.00	3.44	2.66	2.14	213	$\frac{1,065}{(213 \times 5)}$	16,401
$\frac{1}{2} + 1 \frac{1}{2}$	13.99*	4.75	2.54	1.72	1.33	1.07	374	$\frac{342}{(342 \times 1)}$	26,334
$0 + \frac{1}{2}$	0*	0	0	0	0	0	425	$\frac{425}{(425 \times 1)}$	32,725
							1,250	3,547	07,037

\* Desired Product of Relay Times and Number of Request

E. Determination of Purchase Costs for CA Programme

Table E.8: Probability of Dissatisfaction

(Chinese Books)

$\bar{\lambda}$	$\bar{\mu}$	$\bar{F}$			Avg. Prop. of Demand	Avg. Prop. of Stock	Avg. Number of Demand on NS=216	Avg. Number of New Stock (216)	Number of Items	Cost
		one copy	two copies	three copies						
$4\frac{1}{2} +$	0	0.38	0.11	0.02*	3.4x	0.7x	10	2	$\begin{matrix} 6 \\ (2 \times 3) \end{matrix}$	18
$3\frac{1}{2} - 4\frac{1}{2}$		0.33	0.08*	0.01	8.9x	2.7x	24	6	$\begin{matrix} 6 \\ (6 \times 2) \end{matrix}$	36
$2\frac{1}{2} - 3\frac{1}{2}$		0.27	0.05*	0.006	19.8x	7.6x	48	16	$\begin{matrix} 32 \\ (16 \times 2) \end{matrix}$	96
$1\frac{1}{2} - 2\frac{1}{2}$		0.20*	0.02	0.002	33.2x	10.8x	78	39	$\begin{matrix} 39 \\ (39 \times 1) \end{matrix}$	117
$\frac{1}{2} - 1\frac{1}{2}$		0.11*	0.007	0.0003	34.8x	35.8x	77	77	$\begin{matrix} 77 \\ (77 \times 1) \end{matrix}$	231
$0 - \frac{1}{2}$		0	0	0	0	35.3x	0	76	$\begin{matrix} 76 \\ (76 \times 1) \end{matrix}$	228
					100.1x	100.1x	237	216	242	726

\*Desired Level of Probability of Dissatisfaction

(Foreign Books)

$\bar{\lambda}$	$\bar{\mu}$	$\bar{F}$			Avg. Prop. of Demand	Avg. Prop. of Stock	Avg. Number of Demand on NS=127	Avg. Number of New Stock (127)	Number of Items	Cost (77.0Yen)
		one copy	two copies	three copies						
$4\frac{1}{2} +$	0	0.38	0.11*	0.02	2.8x	0.5x	5	1	$\begin{matrix} 2 \\ (1 \times 2) \end{matrix}$	154
$3\frac{1}{2} - 4\frac{1}{2}$		0.33	0.08*	0.01	9.8x	2.3x	12	3	$\begin{matrix} 6 \\ (3 \times 2) \end{matrix}$	462
$2\frac{1}{2} - 3\frac{1}{2}$		0.27*	0.05	0.006	18.4x	5.7x	21	7	$\begin{matrix} 7 \\ (7 \times 1) \end{matrix}$	593
$1\frac{1}{2} - 2\frac{1}{2}$		0.20*	0.02	0.002	38.4x	13.7x	34	17	$\begin{matrix} 17 \\ (17 \times 1) \end{matrix}$	1,309
$\frac{1}{2} - 1\frac{1}{2}$		0.11*	0.007	0.0003	38.6x	34.8x	43	43	$\begin{matrix} 43 \\ (43 \times 1) \end{matrix}$	3,311
$0 - \frac{1}{2}$		0	0	0	0	43.7x		55	$\begin{matrix} 55 \\ (55 \times 1) \end{matrix}$	4,235
					100.1x	100.1x	115	126	130	9,740

\*Desired Level of Probability of Dissatisfaction

## E. Determination of Purchase Costs for CA Programme

Table E.9: Average Prices for different forms

Forms	CB	FB	CP	FP
Average Price (Yuan)	3.00	77.00	10.3	170.00

# Appendix F

## List of Data to be Collected

### A. Resources

1. Total collection size in the network (actual collection size of each node, annual growth rate of collection at each nodes);  
\* Total network collection size in previous year  $\times$  annual growth rate
2. Number of staff available at each node (professional, experienced, inexperienced and clerical etc.)  
→ Total No. of staff in the network
3. Funds available at each node (proportions);
4. Equipment and machine available at each node  
e.g. photocopying machine, microform reader and terminals etc.
5. Staff available for each co-operative activities.

### B. Activities

1. Acquisition  
—How many new items acquired a year (distribution of each subject)
2. Lending  
—Level of total demand on each popularity classes, proportions of book collection, and proportion of demand;  
—Average length of loan period and circulation times a year;  
—User requests on each popularity class from different nodes;  
—Total number of requests at different nodes and in the network being designed;  
—Number of ILL transactions in the network and at each nodes (original requests, referral requests (if any) and terminative requests handled a year);  
—Average turn-around time.
3. IR  
—Frequency of IR searching batch
4. UC  
—Number of UC locating requests at each node.

### C. Operations

1. Proportion of budget for each co-operative activities;
2. Number of staff involved in each activities;
3. Average time taken to satisfy a request;
4. Average time to locate a item in UC
5. Unit cost per ILL request handled at different nodes;
6. Unit cost per UC consulting request at different nodes;
7. Average time taken to satisfy a searching requests by manual, or off-line or online for SDI or retrospective searching; and
8. Costs of each mode of searching.

### D. Background

1. Total number of titles universally available;
2. Bradford distribution of literature on specific subjects;
3. Potential Users of network & User distribution among categories and geographical location;
4. Subject coverage of the network;
5. Geographical distribution of nodes; and
6. Communication means.

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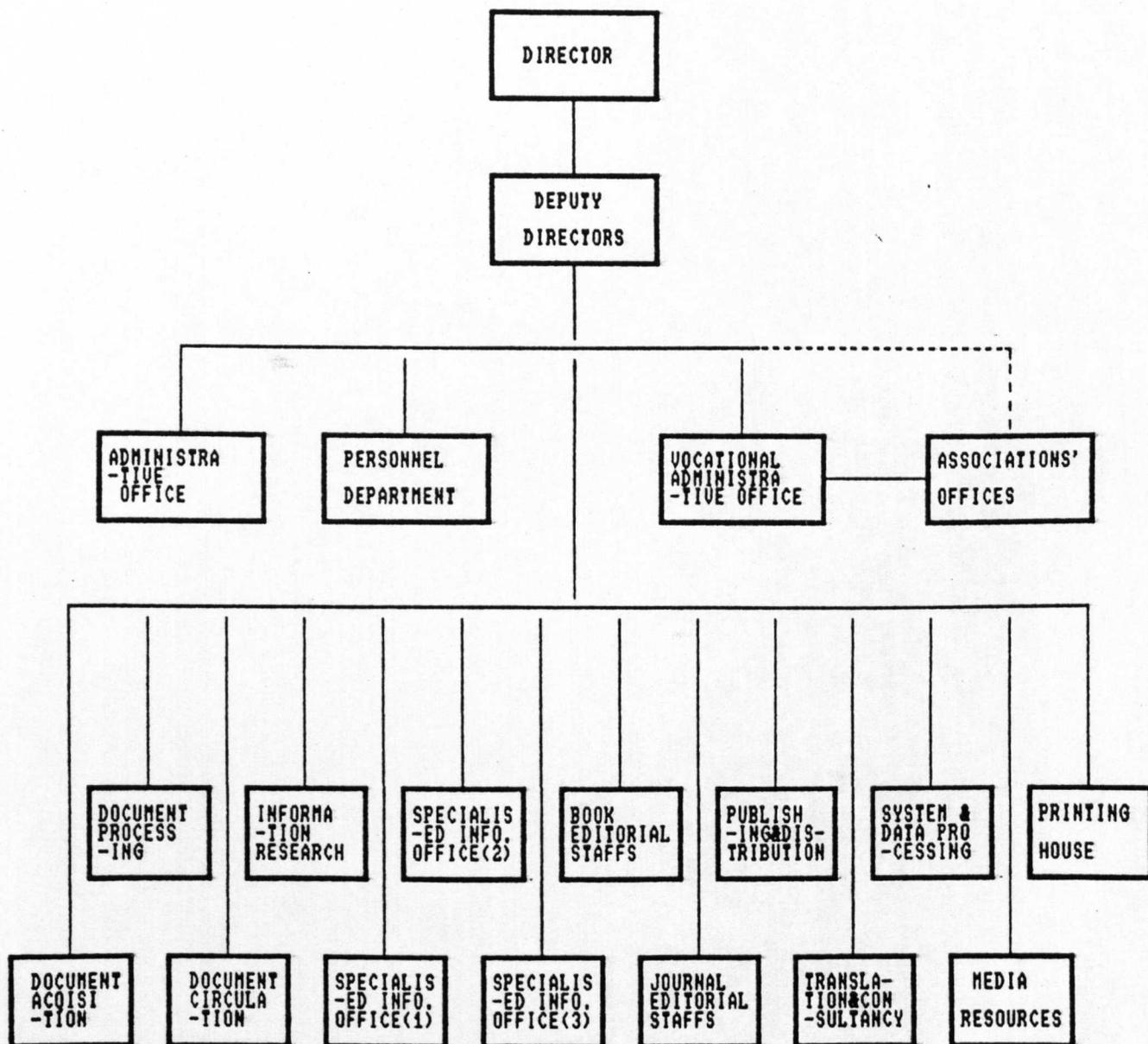


# Annexe to Chapter 5

**5.1. Comparisons of Library and Information Resource  
among 9 Countries**

Country	Year	Population of the year (10 <sup>3</sup> )	No. of Libraries	Stock (10 <sup>3</sup> )	Average Users per Library(10 <sup>3</sup> )	Average Collection per User
USSR	1980	265,542	132,000	1,824,000	2.01	6.9
BELGARIA	1980	8,862	5,008	48,930	1.53	5.5
DENMARK	1980	5,123	247	29,512	20.74	5.8
SWEDEN	1980	8,311	408	39,031	20.37	4.7
CHINA	1985	1,041,083	2,343	242,631	444.34	0.23
U.S.A.	1978	218,059	8,456	439,486	25.79	2.0
JAPAN	1981	117,615	1,437	69,103	81.85	0.6

5.2.  
ORGANISATIONAL STRUCTURE OF SIDIC-CAAS



Notes: Specialised Information Office (1) covers Agronomy, Soil and Fertilizer  
 (2) covers Animal Husbandry and Veterinary  
 (3) covers Biology and Plant Protection

# Annexe to Chapter 7

7.1. SUM OF LIBRARY PERFORMANCE INDEXES

(ALONG THE ADMINISTRATIVE LEVEL)

	NATIONAL		PROVINCIAL		PREFECTURAL		TOTAL	
	No.	Prop.	No.	Prop.	No.	Prop.	No.	Prop.
9					1	(5.6%)	1	3.6%
10								
11			1	(12.5%)			1	3.6%
12			1	(12.5%)			1	3.6%
13			1	(12.5%)	1	(5.6%)	2	7.1%
14	1	(50.0%)			1	(5.6%)	2	7.1%
15			1	(12.5%)			1	3.6%
16	1	(50.0%)	1	(12.5%)	1	(5.6%)	3	10.7%
17					2	(11.1%)	2	7.1%
18					2	(11.1%)	2	7.1%
19			1	(12.5%)	4	(22.2%)	5	10.7%
20								
21			2	(25.0%)	5	(27.8%)	7	25.0%
22								
23								
24					1	(5.6%)	1	3.6%
	2		8		18		28	

**INDEX FOR LIBRARY EVALUATION**

	CATEGORY	ADMINISTRATIVE LEVEL	STOCK LEVEL	BUDGET LEVEL	BOOK/USER	USER/STAFF	TOTAL
CHRI	R	PROVINCIAL	6	4	5	1	16
HAHS	E	PREFECTURAL	8	6	5	3	21
HARI	R	PREFECTURAL	5	6	4	2	17
HAS	E	PREFECTURAL	5	6	5	3	19
JARI	R	PREFECTURAL	8	7	5	1	21
JAS	E	PREFECTURAL	4	5	4	3	16
JCRI	R	PREFECTURAL	9	7	4	1	21
JHARI	R	PREFECTURAL	5	6	1	2	14
JHAS	E	PREFECTURAL	5	6	5	1	17
LARI	R	PREFECTURAL	9	7	5	3	24
LAS	E	PREFECTURAL	7	6	5	1	19
NARI	R	PREFECTURAL	5	7	2	1	15
NAS	E	PREFECTURAL	2	4	2	1	9
SARI	R	PREFECTURAL	9	7	4	1	21
SAS	E	PREFECTURAL	6	6	5	2	19

INDEX FOR LIBRARY EVALUATION

	CATEGORY	ADMINISTRATIVE LEVEL	STOCK LEVEL	BUDGET LEVEL	BOOK/USER	USER/STAFF	TOTAL
TASI	R	PREFECTURAL	7	7	4	1	19
TAS	E	PREFECTURAL	3	5	3	2	13
TRI	R	PROVINCIAL*	5	5	3	1	14
WARI	R	PREFECTURAL	6	5	5	2	18
WAS	E	PREFECTURAL	5	6	5	2	18
ZAA	R	PROVINCIAL	3	4	5	1	13
ZAB	E	PROVINCIAL	6	6	5	5	22
ZAD	A	PROVINCIAL	5	6	5	5	21
ZARI	R	PREFECTURAL	9	7	4	1	21
ZASO	R	PROVINCIAL	6	6	4	1	19
ZAU	E	PROVINCIAL	2	3	4	3	12
ZL	P	PROVINCIAL	1	1	4	5	11
ZICRI	R	PROVINCIAL	5	6	4	1	16

Y  
ANALYTICAL SOLUTIONS FOR THE OBJECTIVE OF  
GEOGRAPHICAL ACCESSIBILITY (EXPECTED DISTANCE)

J = 1

K	D <sub>Jk</sub>	when m = 1		when m = 5		when m = 10	
		P <sup>1</sup> <sub>IJk</sub>	P <sup>1</sup> <sub>IJk</sub> × D <sub>Jk</sub>	P <sup>5</sup> <sub>IJk</sub>	P <sup>5</sup> <sub>IJk</sub> × D <sub>Jk</sub>	P <sup>10</sup> <sub>IJk</sub>	P <sup>10</sup> <sub>IJk</sub> × D <sub>Jk</sub>
1	0						
2	1	0.037	0.037	0.185	0.185	0.370	0.370
3	2	0.037	0.074	0.157	0.304	0.242	0.484
4	3	0.037	0.111	0.132	0.396	0.158	0.474
5	4	0.037	0.148	0.110	0.440	0.096	0.384
6	5	0.037	0.185	0.090	0.450	0.058	0.290
7	6	0.037	0.222	0.074	0.444	0.035	0.210
8	7	0.037	0.259	0.060	0.420	0.020	0.140
9	8	0.037	0.296	0.048	0.384	0.011	0.088
10	9	0.037	0.333	0.038	0.342	0.005	0.045
11	10	0.037	0.370	0.029	0.319	0.003	0.030
12	11	0.037	0.407	0.023	0.276	0.001	0.011
13	12	0.037	0.444	0.017	0.221	0.001	0.012
14	13	0.037	0.481	0.012	0.156		
15	14	0.037	0.518	0.009	0.135		
16	15	0.037	0.555	0.006	0.096		
17	16	0.037	0.592	0.004	0.068		
18	17	0.037	0.629	0.003	0.054		
19	18	0.037	0.666	0.002	0.038		
20	19	0.037	0.703	0.001	0.020		
21	20	0.037	0.740				
22	21	0.037	0.777				
23	22	0.037	0.814				
24	23	0.037	0.851				
25	24	0.037	0.888				
26	25	0.037	0.925				
27	26	0.037	0.962				
28	27	0.037	0.999				
Average Relay Times		13.986		4.748		2.538	

ANALYTICAL SOLUTIONS FOR THE OBJECTIVE OF  
GEOGRAPHICAL ACCESSIBILITY (EXPECTED DISTANCE)

J = 1

(2)

K	D <sub>Jk</sub>	when m = 15		when m = 20		when m = 25	
		P <sup>1</sup> <sub>Ijk</sub>	P <sup>1</sup> <sub>Ijk</sub> × D <sub>Jk</sub>	P <sup>5</sup> <sub>Ijk</sub>	P <sup>5</sup> <sub>Ijk</sub> × D <sub>Jk</sub>	P <sup>10</sup> <sub>Ijk</sub>	P <sup>10</sup> <sub>Ijk</sub> × D <sub>Jk</sub>
1	0						
2	1	0.556	0.556	0.741	0.741	0.926	0.926
3	2	0.256	0.504	0.199	0.199	0.071	0.142
4	3	0.113	0.339	0.084	0.048	0.003	0.009
5	4	0.047	0.188	0.010	0.040		
6	5	0.018	0.090	0.002	0.010		
7	6	0.003	0.018				
8	7	0.002	0.014				
9	8	0.001	0.008				
10	9						
11	10						
12	11						
13	12						
14	13						
15	14						
16	15						
17	16						
18	17						
19	18						
20	19						
21	20						
22	21						
23	22						
24	23						
25	24						
26	25						
27	26						
28	27						
Average Relay Times		1.717		1.333		1.077	

**7.5. COST ANALYSIS FOR THE OBJECTIVE MEASURE  
OF GEOGRAPHICAL ACCESSIBILITY**

ITEMS	unit value	M = 1	M = 5	M = 10	M = 15	M = 20	M = 25
COST FOR COPIES OF TITLE 1 ( $C_a$ )	2.5	2.5	12.5	25.0	37.5	50.0	62.5
COST OF PROCESSING ( $C_b$ )	0.31	8.37	5.89	3.72	2.48	1.55	0.93
$C_a + C_b$ (C)		10.87	18.39	28.72	39.98	51.55	63.43
RELAY TIMES (r)		13.986	4.748	2.538	1.717	1.333	1.077
WHEN $P_{ijk}^n = 1$							
$D_1^n$		256.928	174.579	74.439	34.786	14.577	5.92
DIFFERENCE WHEN EVERY 5 COPIES ARE INCREASED							
$D^{n+5} - D^n$ ( $D_d$ )			82.349	100.14	39.653	20.209	8.657
$R^{n+5} - R^n$ ( $R_d$ )			8	7	4	3	2
$C^{n+5} - C^n$ ( $C_d$ )			7.52	10.33	11.26	11.57	11.88
$C_d / D_d$			0.091	0.103	0.284	0.573	1.372
$C_d / R_d$			0.940	1.476	2.815	3.857	5.940

## Annexe to Chapter 10

**10.f.(b) Cost Requirement for Each Form  
(after Cost Analysis)**

	CB	FB	CP	FP
Total No. of Items	8,036	3,640	5,927	1,310
Cost	24,108	280,280	61,048.1	222,700
Proportion	4.1%	47.7%	10.4%	37.9%

TOTAL COST = 588,136.1

**10.g.(b) Cost of Acquisition (1987)\***

	CB	FB	CP	FP
Total No. of Items	10,977	2,240	3,699	1,439
Cost	32,931	172,480	38,099.7	244,630
Proportion	6.7%	35.3%	7.8%	50.1%

TOTAL COST = 488,140.7

\* Summary of the Acquisition Costs in 20 Libraries

**e 10.2. Duration of Acquisition Functions per  
Unit Order in Each Staff Grade**

Activity Description	Duration of Activity per Unit Order for each Grade Staff (Time in Minutes)				
	A	B	C	D	Total
Selection	0.12	1.28	0.64		2.04
Ordering Routine	0.15	0.98	2.62	2.58	6.33
Checking Arrivals	0.16	0.16	3.69	2.90	6.91
Fund Accounting		0.96	1.02	3.05	4.98
Book Accessioning					
Book Distribution Routine			0.50	1.00	1.50
<b>Total</b>	<b>0.43</b>	<b>3.33</b>	<b>8.47</b>	<b>9.53</b>	<b>21.76</b>
<b>Labour Cost</b>	<b>0.20</b>	<b>1.33</b>	<b>2.88</b>	<b>2.48</b>	<b>6.89</b>

10.4.

Time Sheet for Random Time Sampling

REQUESTING LIBRARY

NAME \_\_\_\_\_

DATE \_\_\_\_\_

NO. \_\_\_\_\_

ACTIVITY:

OBSERVATION TIMES

Verifying

\_\_\_\_\_

Locating

\_\_\_\_\_

Mailing or telephone enquiry

\_\_\_\_\_

Unpacking

\_\_\_\_\_

Notifying users

\_\_\_\_\_

10.5(a) UNIT COST OF INTERLIBRARY LOAN

(Borrow-in, by Mail)

Request Library

Cost Item	Time Distribution (0.37HR)	Originals (Yen)	Photocopies (Yen)
<b>Processing Cost + Overhead</b>			
Verifying & Consulting UC	20.0%	0.081	0.081
Transmitting the Request	15.0%	0.061	0.061
Unpacking the Loan	10.0%	0.041	0.041
Notifying Users	12.0%	0.049	0.049
Returning the Loan	15.0%	0.061	
Sub-total	72.0%	<u>0.293</u>	<u>0.232</u>
<b>Other Processing</b>			
Referral Routing	8.0%	0.033	0.033
Personal Time	10.0%	0.041	0.041
Others	10.0%	0.041	0.041
Direct Labour Total	100.0%	<u>0.408</u>	<u>0.345</u>
<b>Material &amp; Equipment</b>			
Transmission Machine			
Postage		0.32	0.08
Envelopes, Labels		0.08	0.03
Material Total		<u>0.40</u>	<u>0.11</u>
Fringe Benefits (5%)		0.02	0.02
Total, per request filled		<u>0.828</u>	<u>0.475</u>

10.5(b) UNIT COST OF INTERLIBRARY LOAN

(Borrow-in, transmitted by telephone)

Request Library

Cost Item	Time Distribution (0.33HR)	Originals (Yen)	Photocopies (Yen)
<b>Processing Cost + Overhead</b>			
Verifying & Consulting UC	21.1%	0.081	0.081
Transmitting the Request	13.2%	0.051	0.051
Unpacking the Loan	10.5%	0.041	0.041
Notifying Users	12.5%	0.049	0.049
Returning the Loan	15.7%	0.061	
Sub-total	73.0%	<u>0.283</u>	<u>0.222</u>
<b>Other Processing</b>			
Referral Routing	6.1%	0.023	0.023
Personal Time	10.5%	0.041	0.041
Others	10.5%	0.041	0.041
Direct Labour Total	100.0%	<u>0.388</u>	<u>0.327</u>
<b>Material &amp; Equipment</b>			
Transmission Machine		0.22	0.22
Postage		0.24	
Envelopes, Labels		0.04	
Material Total		<u>0.50</u>	<u>0.22</u>
Fringe Benefits (5%)		0.02	0.02
Total, per request filled		<u>0.908</u>	<u>0.567</u>

10.5. (c) UNIT COST OF INTERLIBRARY LOAN

(Borrow-in, transmitted by telefacsimile)

Request Library

Cost Item	Time Distribution (0.33HR)	Originals (Yen)	Photocopies (Yen)
<b>Processing Cost + Overhead</b>			
Verifying & Consulting UC	20.5%	0.081	0.081
Transmitting the Request	12.2%	0.048	0.048
Unpacking the Loan	10.3%	0.041	0.041
Notifying Users	12.3%	0.049	0.049
Returning the Loan	15.4%	0.061	
Sub-total	70.7%	<u>0.280</u>	<u>0.219</u>
<b>Other Processing</b>			
Referral Routing	8.4%	0.023	0.023
Personal Time	10.3%	0.041	0.041
Others	10.3%	0.041	0.041
Direct Labour Total	100.0%	<u>0.395</u>	<u>0.334</u>
<b>Material &amp; Equipment</b>			
Transmission Machine		0.78	0.78
Postage		0.24	
Envelopes, Labels		0.04	
Material Total		<u>1.06</u>	<u>0.78</u>
Fringe Benefits (5%)		0.02	0.02
Total, per request filled		<u>1.475</u>	<u>1.134</u>

10.5.(d) UNIT COST OF INTERLIBRARY LOAN

(Loan-out, by Mail)

Resource Library

Cost Item	Time Distribution (0.50HR)	Originals (Yen)	Photocopies (Yen)
<b>Processing Cost + Overhead</b>			
Verifying	10.0%	0.061	0.061
Checking shelves	10.0%	0.061	0.061
Paging	15.0%		0.092
Copying	25.0%		0.153
Mailing the Loan	5.0%	0.031	0.031
Recording	5.0%	0.031	0.031
Unpacking the Return	5.0%	0.031	
Reshelving	5.0%	0.031	
Sub-total	80.0%	<u>0.246</u>	<u>0.429</u>
<b>Other Processing</b>			
Referral Routing	5.0%	0.031	0.031
Personal Time	8.0%	0.049	0.049
Others	7.0%	0.043	0.043
Direct Labour Total	100.0%	<u>0.369</u>	<u>0.552</u>
<b>Material &amp; Equipment</b>			
Transmission Machine			
Postage		0.24	0.16
Envelopes, Labels		0.10	0.10
Photocopier, Paper & Toner			0.50
Material Total		<u>0.34</u>	<u>0.76</u>
Fringe Benefits (5%)		0.03	0.03
Total, per request filled		<u>0.739</u>	<u>1.278</u>

10.6.(a) Transmission of Interlibrary Loan Requests

Request Library

Mode of Transmission	Labour time Transmit Per Request	Average Total Turn-around Time Per Request	Transmission Cost Per Request	Accuracy	Reliability of Transmission Mode
Mail	3 min	10 days	0.141	High degree of bibliographic accuracy	High Reliability
Telephone	4.8 min	7 days	0.318	Variable degree of accuracy (related to skill level of staff)	High Reliability (related to skill level)
Telefacsimile	3.3 min	7 days	0.847	High degree of accuracy (variation in readability)	Less reliability (some possibility lost transmission)

10.6. (b) Calculations of Transmission Costs

Request Library

Mode of Transmission	Postage	Labour Cost Per Request	Phone Cost	Telecopier Per Request	Transmission Cost Per Request
Mail	0.08	0.061	--	--	= 0.141
Telephone	--	0.098	0.22	--	= 0.318
Telefacsimile	--	0.067	--	0.78	= 0.847

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OFF-LINE AND ON-LINE SEARCHING

Type of Searching	No. of Topics searched	Response Time	cost (Yen)	Effectiveness (Recall Ratio)
off-line	700	every 2 mnth a batch	30-45	90%
on-line	40-50		100	

IR by Manual (AGRIS & CAB)

Subject	No. of topic Searched in 1987	staff involved	type	time	cost	effectiveness
S1	19				4:1	
S3	7			reserva	5:1	
S4	33		mainly	2-3 mnths	charged by No. of Key words used	3 searches per week
S5	24	5	RS			
S6	31		SDI	Response time		
S8	38			max.0.5 month	100 Yen/day	
Total	153					

### 10.8. Scale Comparison

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favour one activity over another
5	Essential or strong importance	Experience and judgment strongly favour one activity over another
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
9	Absolute importance	The evidence favouring one activity over another is the highest possible order of affirmation
2,4,6,8	Intermediate values between adjacent values	When compromise is needed
Reciprocals of above nonzero	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to span the matrix

Adopted from Saaty

EX 10.9. (a) Judgment Matrices for Benefits

A	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	Eig	B <sub>1</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig	B <sub>2</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig
B <sub>1</sub>	1	2	3	0.54	C <sub>1</sub>	1	1/2	3	0.33	C <sub>1</sub>	1	1/3	1/5	0.11
B <sub>2</sub>	1/2	1	2	0.30	C <sub>2</sub>	2	1	3	0.53	C <sub>2</sub>	3	1	1/2	0.31
B <sub>3</sub>	1/3	1/2	1	0.16	C <sub>3</sub>	1/3	1/3	1	0.14	C <sub>3</sub>	5	2	1	0.58
B <sub>3</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig	C <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig	C <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig
C <sub>1</sub>	1	1/3	1/5	0.11	D <sub>1</sub>	1	1/2	1/3	0.16	D <sub>1</sub>	1	1/3	1/5	0.10
C <sub>2</sub>	5	1	1/2	0.31	D <sub>2</sub>	2	1	1/2	0.30	D <sub>2</sub>	3	1	1/2	0.31
C <sub>3</sub>	3	2	1	0.58	D <sub>3</sub>	3	2	1	0.54	D <sub>3</sub>	5	2	1	0.58
C <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig										
D <sub>1</sub>	1	1/3	1/3	0.14	Total Benefits Hierarchy C.R.H.<0.1 (good)									
D <sub>2</sub>	3	1	1	0.43										
D <sub>3</sub>	3	1	1	0.43										

EX 10.9. (b) Judgment Matrices for Costs

A	B <sub>1</sub>	B <sub>2</sub>	B <sub>3</sub>	Eig	B <sub>1</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig	B <sub>2</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig
B <sub>1</sub>	1	4	4	0.67	C <sub>1</sub>	1	1/3	5	0.28	C <sub>1</sub>	1	5	7	0.73
B <sub>2</sub>	1/4	1	1	0.17	C <sub>2</sub>	3	1	7	0.65	C <sub>2</sub>	1/5	1	3	0.19
B <sub>3</sub>	1/4	1	1	0.17	C <sub>3</sub>	1/5	1/7	1	0.07	C <sub>3</sub>	1/7	1/3	1	0.08
B <sub>3</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Eig	C <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig	C <sub>2</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig
C <sub>1</sub>	1	3	5	0.65	D <sub>1</sub>	1	1/4	1/8	0.07	D <sub>1</sub>	1	1/2	1	0.25
C <sub>2</sub>	1/3	1	2	0.23	D <sub>2</sub>	4	1	1/4	0.22	D <sub>2</sub>	2	1	2	0.50
C <sub>3</sub>	1/5	1/2	1	0.12	D <sub>3</sub>	8	4	1	0.71	D <sub>3</sub>	1/2	1	1	0.25
C <sub>3</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	Eig										
D <sub>1</sub>	1	3	4	0.63	Total Cost Hierarchy C.R.H.<0.1 (good)									
D <sub>2</sub>	1/3	1	2	0.24										
D <sub>3</sub>	1/4	1/2	1	0.14										

AHP-1

ENTER THE# FACTORS IN SECOND HIERARCHY LEVEL:N1= 3

ENTER CRITERION NAME :01

ENTER THE UPPER TRIANGULAR PART OF THE MATRIX, WITHOUT UNITY  
ELEMENTS IN THE MAIN DIAGONAL.

FRACTIONAL ELEMENTS LIKE 1/3, ARE ENTERED AS -3

ENTER UPPER TRIANGLE

ROW 1 : 2 3

ROW 2 : 2 0

4 ITERATIONS D= 3.263354E-06

CRITERION=01

WEIGHT:

.5396145

.2969615

.1634241

LAMBDER(MAX)= 3.009209 CONSISTENCY INDIX= 4.604221E-03

ENTER THE # OF FACTOR IN LEVEL 3 OR 0 TO END;N2= 3

ENTER # OF FACTORS IN LEVEL 3 RELATED TO ELEMENT 1 OF LEVEL 2 ; 3

ENTER ALL FACTORS IN LEVEL 3 RELATED TO ELEMENT 1 OF LEVEL 2

1 2 3

ENTER CRITERION NAME :02

ENTER UPPER TRIANGLE

ROW 1 :-2 3

ROW 2 : 3 0

6 ITERATIONS D= 2.30968E-06

CRITERION=02

WEIGHT:

.3325158

.5278363

.139648

LAMBDER(MAX)= 3.053617 CONSISTENCY INDIX= .0268085

ENTER # OF FACTORS IN LEVEL 3 RELATED TO ELEMENT 2 OF LEVEL 2 ; 3

ENTER ALL FACTORS IN LEVEL 3 RELATED TO ELEMENT 2 OF LEVEL 2

1 2 3

ENTER CRITERION NAME :03

ENTER UPPER TRIANGLE

ROW 1 :-3 -5

ROW 2 :-2 0

4 ITERATIONS D= 4.842878E-07

CRITERION=03

WEIGHT:

.1094523

.3089957

.581552

LAMBDER(MAX)= 3.003696 CONSISTENCY INDIX= 1.848102E-03

ENTER # OF FACTORS IN LEVEL 3 RELATED TO ELEMENT 3 OF LEVEL 2 ; 3

ENTER ALL FACTORS IN LEVEL 3 RELATED TO ELEMENT 3 OF LEVEL 2

1 2 3

ENTER CRITERION NAME :04

ENTER UPPER TRIANGLE

ROW 1 :-3 -5

ROW 2 :-2 0

4 ITERATIONS D= 4.842878E-07

CRITERION=04

WEIGHT:

.1094523

.3089957

.581552

LAMBDER(MAX)= 3.003696 CONSISTENCY INDIX= 1.848102E-03

LEVER 3 RELATED TO LEVER 2

WEIGHT':

.5396145

.2969615

.1634241

TABLE B  
.33 .1 .1  
.52 .3 .3  
.13 .58 .58

COMPOSITE PRIORITIES FOR LEVEL 3 :

.2298206  
.4270852  
.3430942

ENTER THE # OF FACTOR IN LEVEL 4 OR 0 TO END;N2= 3

ENTER # OF FACTORS IN LEVEL 4 RELATED TO ELEMENT 1 OF LEVEL 3 ; 3

ENTER ALL FACTORS IN LEVEL 4 RELATED TO ELEMENT 1 OF LEVEL 3

1 2 3

ENTER CRITERION NAME :05

ENTER UPPER TRIANGLE

ROW 1 :-2 -3

ROW 2 :-2 0

4 ITERATIONS D= 3.352761E-06

CRITERION=05

WEIGHT:

.1634241  
.2969614  
.5396145

LAMBDER(MAX)= 3.009209 CONSISTENCY INDIX= 4.604459E-03

ENTER # OF FACTORS IN LEVEL 4 RELATED TO ELEMENT 2 OF LEVEL 3 ; 3

ENTER ALL FACTORS IN LEVEL 4 RELATED TO ELEMENT 2 OF LEVEL 3

1 2 3

ENTER CRITERION NAME :06

ENTER UPPER TRIANGLE

ROW 1 :-3 -5

ROW 2 :-2 0

4 ITERATIONS D= 4.842878E-07

CRITERION=06

WEIGHT:

.1094523  
.3089957  
.581552

LAMBDER(MAX)= 3.003696 CONSISTENCY INDIX= 1.848102E-03

ENTER # OF FACTORS IN LEVEL 4 RELATED TO ELEMENT 3 OF LEVEL 3 ; 3

ENTER ALL FACTORS IN LEVEL 4 RELATED TO ELEMENT 3 OF LEVEL 3

1 2 3

ENTER CRITERION NAME :07

ENTER UPPER TRIANGLE

ROW 1 :-3 -3

ROW 2 : 1 0

1 ITERATIONS D= 7.450581E-08

CRITERION=07

WEIGHT:

.1428571  
.4285715  
.4285715

LAMBDER(MAX)= 3 CONSISTENCY INDIX= 0

LEVER 4 RELATED TO LEVER 3

WEIGHT':

.2298206  
.4270852  
.3430942

TABLE B

.16 .1 .14  
.29 .3 .42  
.53 .58 .42

COMPOSITE PRIORITIES FOR LEVEL 4 :

.1333171  
.3472557  
.5194272

ENTER THE # OF FACTOR IN LEVEL 5 OR 0 TO END;N2= 0

##CONSISTENCY OF ALL HIERARCHY= 1.479706E-02

```

100 :LPRINT"AHP-1"
110 :REM X/H/D/Z
120 :DIM A(10),N(10)
121 :DIM B(10,10)
133 :DIM W(10), Q(10)
134 :DIM C(10,10), U(10)
136 :DIM R(10), Z(10), Y(10)
138 :DIM D(10,10)
140 :FOR I=1 TO 10
150 :READ R(I)
160 :NEXT I
170 :DATA 0,0,0.58,0.90,1.12,1.24,1.32,1.41,1.45,1.49
190 :L=2
192 :FOR I=1 TO 10
195 :NEXT I
197 :REM CSIZE 2
198 :REM COLOR 0
200 :LPRINT"ENTER THE# FACTORS IN SECOND HIERARCHY LEVEL:";
210 :INPUT N1
215 :LPRINT"N1="; N1
220 :LET S1=N1
230 :FOR I=1 TO N1
240 :A(I)=0
250 :W(I)=0
260 :U(I)=0
270 :NEXT I
280 :GOSUB 1015
290 :FOR I=1 TO N1
300 :A(I)=W(I)
310 :NEXT I
320 :REM T9=TOTAL RANDOM CONSISTENCY FOR THIS HIERARCHCHY
330 :REM: T3=TOTAL CONSISTENCY OF THIS HIERARCHY
340 :REM R0=RANDOM CONSISTENCY TABLE
342 :T3=0
344 :T9=0
350 :L=L+1
355 :REM COLOR 0
360 :LPRINT"ENTER THE # OF FACTOR IN LEVEL ";L"OR 0 TO END";
370 :INPUT N2
375 :LPRINT ";N2="; N2
380 :IF N2<1 THEN 1000
390 :FOR I=1 TO N2
400 :W(I)=0
410 :U(I)=0
420 :FOR J=1 TO N1
430 :B(I,J)=0
440 :NEXT J
450 :NEXT I
460 :FOR N6=1 TO N1
465 :PRINT
470 :LPRINT "ENTER # OF FACTORS IN LEVEL"; L; "RELATED TO ELEMENT"; N
"OF LEVEL" ; L-1;
480 :INPUT N3
482 :LPRINT "; "; N3
485 :PRINT
490 :LPRINT "ENTER ALL FACTORS IN LEVEL"; L; " RELATED TO ELEMENT";N6
F LEVEL"; L-1

```

```

500 :FOR I=1 TO N3
510 :INPUT N(I)
515 :LPRINT N(I);
520 :NEXT I
525 :LPRINT
530 :IF N3>0 THEN 570
540 :REM ONLY ONE ELEMENT RELATED
550 :B(N(1),N6)=1
560 :GOTO 650
570 :S1=N3
580 :GOSUB 1015
590 :T3=T3+A(N6)*C8
593 :T9=T9+A(N6)*R(N3)
596 :REM ONLY RELATED ELEMENTS HAVE WEIGHTED VALUES
600 :REM COLOR 0
610 :REM CSIZE 2
620 :FOR I=1 TO N3
630 :B(N(I),N6)=W(I)
640 :NEXT I
650 :NEXT N6
660 :LPRINT "LEVER"; L; "RELATED TO LEVER"; L-1
670 :LPRINT "WEIGHT'':"
680 :FOR I=1 TO N1
690 :LPRINT A(I)
700 :NEXT I
704 :REM COLOR 2
705 :LPRINT "TABLE B"
706 :REM CSIZE 1
710 :FOR I=1 TO N2
730 :FOR J=1 TO N1
732 :SUBA=B(I,J)
734 :SUBB=INT (B(I,J)*100)
736 :SUBC=SUBB/100
738 :LPRINT SUBC;
750 :NEXT J
760 :LPRINT
770 :NEXT I
780 :PRINT
790 :REM COMPOSITE
800 :FOR I=1 TO N1
810 :FOR J=1 TO N2
820 :B(J,I)=B(J,I)*A(I)
830 :NEXT J
840 :NEXT I
850 :FOR I=1 TO N2
860 :S9=0
870 :FOR J=1 TO N1
880 :S9=S9+B(I,J)
890 :NEXT J
900 :A(I)=S9
910 :NEXT I
915 :REM COLOR 1
916 :REM CSIZE 2
917 :LF 2
920 :LPRINT "COMPOSITE PRIORITIES FOR LEVEL"; L; ":"

```

```

926 :REM COLOR 3
930 :FOR I=1 TO N2
940 :LPRINT A(I)
950 :NEXT I
960 :PRINT
970 :N1=N2
980 :GOTO 350
983 :REM COLOR 2
990 :REM CONSISENCY OF THIS HIERARCHY
1000 :LPRINT " $$CONSISTENCY OF ALL HIERARCHY="; T3/T9
1005 :PRINT
1010 :STOP
1015 :REM CSIZE 2
1020 :LPRINT "ENTER CRITERION NAME :";
1030 :INPUT CS
1040 :LPRINT CS
1045 :IF L>2 THEN 1070
1050 :LPRINT "ENTER THE UPPER TRIANGULAR PART OF THE MATRIX, WITHOUT
TY";
1055 :LPRINT " ELEMENTS IN THE MAIN DIAGONAL."
1060 :LPRINT "FRACTIONAL ELEMENTS LIKE 1/3, ARE ENTERED AS -3"
1070 :LPRINT "ENTER UPPER TRIANGLE"
1080 :FOR I=1 TO S1-1
1085 :REM COLOR 1
1090 :LPRINT "ROW"; I; ":";
1100 :FOR J=1 TO S1-1
1110 :INPUT U(J)
1115 :LPRINT U(J);
1120 :NEXT J
1125 :LPRINT
1130 :FOR J=I+1 TO S1
1140 :C(I,J)=U(J-I)
1150 :NEXT J
1160 :FOR J=I+1 TO S1
1170 :IF C(I,J)>0 THEN 1190
1180 :C(I,J)=-(1,0)/C(I,J)
1190 :C(J,I)=1!/C(I,J)
1200 :NEXT J
1210 :NEXT I
1215 :PRINT
1220 :FOR I=1 TO S1
1230 :C(I,I)=1
1240 :NEXT I
1270 :T4=0
1280 :FOR I=1 TO S1
1290 :S=0
1300 :FOR J=1 TO S1
1310 :S=S+C(I,J)
1320 :NEXT J
1330 :U(I)=S
1340 :T4=T4+S
1350 :NEXT I
1360 :FOR I=1 TO S1
1370 :U(I)=U(I)/T4
1380 :NEXT I
1390 :K=0

```

```

1410 :T4=0
1420 :K=K+1
1430 :FOR I=1 TO S1
1440 :S=0
1450 :FOR J=1 TO S1
1460 :S=S+C(I,J)*U(J)
1470 :NEXT J
1480 :W(I)=S
1490 :T4=T4+S
1500 :NEXT I
1510 :D=0
1520 :FOR I=1 TO S1
1530 :W(I)=W(I)/T4
1540 :D=D+ABS (W(I)-U(I))
1550 :NEXT I
1570 :IF K>100 THEN 1630
1580 :IF D<.00001 THEN 1630
1590 :FOR I=1 TO S1
1600 :U(I)=W(I)
1610 :NEXT I
1620 :GOTO 1410
1630 :LPRINT K; "ITERATIONS D="; D
1640 :REM CSIZE2
1645 :REM COLOR 3
1650 :LPRINT "CRITERION="; C$
1890 :C8=(T4-S1)/(S1-1)
1900 :LPRINT "WEIGHT:"
1910 :FOR I=1 TO S1
1920 :LPRINT W(I)
1930 :NEXT I
1950 :LPRINT "LAMBDA(MAX)="; T4; "CONSISTENCY INDEX="; C 8
1960 :PRINT
1970 :RETURN
1980 :END

```

# Annexe to Chapter 11

Survey on Library & Information Center Statistics

----- 有关同志,

您好! 本人是公派留学生, 正在研修情报学。博士学位的研究课题是为中国省级农业图书情报系统设计一个网络模型。模型需要大量的数据来评价和描述现系统, 然后检验理论模型并预测发展趋势等。

附表是为以上众目的所设计的, 现寄给贵馆, 恳请贵馆大力协助。填完后, 请于12月10日前寄给中国水稻所科技情报系张巧巧。

此致

敬礼!

中国水稻所科技情报系张巧巧

1987年10月

Qiaoqiao Zhang  
Dept. of Sci-tech Information  
China National Rice Research  
Institute  
Hangzhou

10 October 1987

Dear Sir/Madam,

I am reading for Ph.D in the Dept. of Information Science, The City University London. My research project is to design and plan a provincial library and information network model for China. The project requires a large amount of data first to assess and describe the present system(s), then to test the theoretical model constructed, and finally to predict and propose the future development. It would be very appreciated if you could fill in the questionnaire enclosed and send me back by 10 December to the above address.

Sincerely Yours,

Qiaoqiao Zhang

## 图书馆、资料室基本情况调查表

一、图书馆(资料室)名称: \_\_\_\_\_

二、图书馆(资料室)类型:

- 1) 学校(院)图书馆      2) 研究所图书馆(资料室)  
3) 公共图书馆          4) 其他

三、图书馆数据:

### A 馆藏

- a 图书共\_\_\_\_\_册, 1987年增加\_\_\_\_\_册。  
其中中文图书共\_\_\_\_\_册, 外文图书\_\_\_\_\_册。  
b 期刊共\_\_\_\_\_种, 1987年增加\_\_\_\_\_册。  
其中外文期刊影印\_\_\_\_\_种, 原版\_\_\_\_\_种,  
合订本\_\_\_\_\_册。  
c 报刊\_\_\_\_\_份, 资料\_\_\_\_\_种。

### B 工作人员数

合计\_\_\_\_\_人, 其中流通(外借)\_\_\_\_\_人,  
采编\_\_\_\_\_人, 管理\_\_\_\_\_人, 阅览室\_\_\_\_\_人,  
情报\_\_\_\_\_人, 资料\_\_\_\_\_人, 其他\_\_\_\_\_人。

### 人员结构

#### a 文化程度

研究生\_\_\_\_\_人, 大专\_\_\_\_\_人, 中专\_\_\_\_\_人,  
高中\_\_\_\_\_人, 高中以下\_\_\_\_\_人。

b 专业

图书情报\_\_\_\_\_人， 农业\_\_\_\_\_人， 计算机\_\_\_\_\_人，  
文科\_\_\_\_\_人， 其他\_\_\_\_\_人。

c 年龄结构

20—39岁\_\_\_\_\_人， 40—59岁\_\_\_\_\_人，  
60岁以上\_\_\_\_\_人，

C 图书馆(资料室)收支(1986或1987)

经费来源

a 上级政府\_\_\_\_\_元， b 本单位\_\_\_\_\_元，  
c 其它收入(复印等)\_\_\_\_\_元，

支出

a 购书刊费，书\_\_\_\_\_元， 期刊\_\_\_\_\_元，  
装订\_\_\_\_\_元， 复印\_\_\_\_\_元，  
b 管理费\_\_\_\_\_元。

D 资料交换情况

与国内\_\_\_\_\_个单位每年交换书刊\_\_\_\_\_种  
\_\_\_\_\_册

与国外\_\_\_\_\_个国家\_\_\_\_\_单位每年交换书刊  
\_\_\_\_\_种\_\_\_\_\_册

E 图书馆(资料室)现代设施

复印机\_\_\_\_\_台， 缩微阅读机\_\_\_\_\_台，  
缩微照相机\_\_\_\_\_台， 声像系统\_\_\_\_\_套，  
计算机终端\_\_\_\_\_台， 其他\_\_\_\_\_。

F 图书馆内联合目录保存与参与种类

保存 a \_\_\_\_\_

b \_\_\_\_\_

c \_\_\_\_\_

参与 a \_\_\_\_\_

b \_\_\_\_\_

四、读者需求(流通、馆际互借、情报检索等)

共计读者数 \_\_\_\_\_ 人次;

A 每年流通 \_\_\_\_\_ 册次; \_\_\_\_\_ 人次;

B 馆际互借, 与 \_\_\_\_\_ 馆开展互借, 每年本馆读者  
外借需求 \_\_\_\_\_ 种 \_\_\_\_\_ 册, 借进 \_\_\_\_\_ 种  
\_\_\_\_\_ 册, 每年外馆借阅需求 \_\_\_\_\_ 种 \_\_\_\_\_ 册,  
借出 \_\_\_\_\_ 种 \_\_\_\_\_ 册;

馆际借阅所需时间大约 \_\_\_\_\_ 天。

C 情报检索需求, 每年检索课题数 \_\_\_\_\_ 个;

其中, 计算机检索 \_\_\_\_\_ 个;

手工检索 \_\_\_\_\_ 个。

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SURVEYS ON LIBRARY AND INFORMATION CENTRE STATISTICS

1. Name of Library or Information centre: \_\_\_\_\_

2. Type of Library or Information Centre

a. University and College

b. Research

c. Public

d. Others

If 'others', please specify \_\_\_\_\_

3. Stock of library or Information centre

a. Book, \_\_\_\_\_ copies; Book added in 1987, \_\_\_\_\_ copies

of which,

Chinese book, \_\_\_\_\_ copies; Foreign Language book, \_\_\_\_\_ copies.

b. Periodicals, \_\_\_\_\_ titles; Periodicals added in 1987, \_\_\_\_\_ title.

Of which,

Chinese periodicals, \_\_\_\_\_ titles;

Foreign language periodicals, \_\_\_\_\_ titles

Bound back issue, \_\_\_\_\_ copies

c. Newspapers, \_\_\_\_\_ types.

d. Internal publications, \_\_\_\_\_ types

4. No. of staff and structure of staff

a. Total No. of staff, \_\_\_\_\_ persons

Of which,

Administration, \_\_\_\_\_; Acquisition and Cataloging, \_\_\_\_\_;

Circulation,\* \_\_\_\_\_; Information work, \_\_\_\_\_;

Internal publication & Archives, \_\_\_\_\_, Other, \_\_\_\_\_.

\*including issue desk & reading room

b. Structure of staff

i. Education

Postgraduates, \_\_\_\_\_ persons; University graduates, \_\_\_\_\_ persons

Vocational school graduates, \_\_\_\_\_ persons

Highschool graduates, \_\_\_\_\_ persons; Lower than highschool, \_\_\_\_\_ persons

ii. Speciality

Information science or Librarianship, \_\_\_\_\_ persons;

Agricultural Science, \_\_\_\_\_ persons;

Computer science, \_\_\_\_\_ persons; Social science, \_\_\_\_\_ persons;  
Others, \_\_\_\_\_ persons.

iii. Age

20--39 years old, \_\_\_\_\_ persons; 40--59 years old, \_\_\_\_\_ persons;  
Over 60 years old, \_\_\_\_\_ persons.

5. Expenditure and Income of services (1986 or 1987)

Source of budget:

Local Government, \_\_\_\_\_ Yen; Parent Body, \_\_\_\_\_ Yen;

Other Income, \_\_\_\_\_ Yen.  
(such as photocopying, please specify)

Expenditure:

Acquisition of book, \_\_\_\_\_ Yen; Subscription of periodicals, \_\_\_\_\_ Yen;

Binding, \_\_\_\_\_ Yen; Photocopying, \_\_\_\_\_ Yen;

Overheads, \_\_\_\_\_ Yen.

6. Exchange of Internal Publications

a. Exchange internal publications, \_\_\_\_\_ titles, \_\_\_\_\_ copies  
with \_\_\_\_\_ organisations nation-wide, p.a.

b. Exchange materials, \_\_\_\_\_ titles, \_\_\_\_\_ copies with \_\_\_\_\_  
organisations internationally, p.a.

7. Modern Facility and Equipment owned by Library and Information Centre

a. Photocopying machine, \_\_\_\_\_; b. Microform reader, \_\_\_\_\_;

c. Computer and terminals, \_\_\_\_\_; d. Audio-visual system, \_\_\_\_\_;

e. Others, \_\_\_\_\_ (please specify).

8. Types of Union Catalog kept and participated

Keeping a. \_\_\_\_\_; b. \_\_\_\_\_.

Participating, a. \_\_\_\_\_; b. \_\_\_\_\_.

9. User needs(including circulation, ILL, and IR)

a. Total No. of potential users, \_\_\_\_\_;

Total No. of cards issued, \_\_\_\_\_.

b. Circulation,

\_\_\_\_\_copies.times circulated, p.a.

\_\_\_\_\_persons.times served, p.a.

c. See separate pages

d. Information Retrieval

No. of topics searched, p.a. \_\_\_\_\_:

Of which,

On-line, \_\_\_\_\_ topics:

Off-line, \_\_\_\_\_ topics

Manual, \_\_\_\_\_ topics

Please return to Qiaoqiao Zhang, China National Rice Research Institute

Hangzhou, P.R. China

## 11.2. ZHEJIANG AGRICULTURAL LIBRARY STATISTICS (1)

NODES	Type	No. of Users	No. of Staff	Book C	Stock F	Periodical		Budgets	
						C	F	Total	LM*
CNRRI	R	266	7(10)	5,945	3,373	273	378	57,000	47,000
HAHS	E	328	3	4,500	1,125	236	30	8,000	7,700
HARI	R	147	2	12,750	900	210	35	6,500	6,000
HAS	E	450	4	14,500	2,125	363	45	9,000	8,550
JARI	R	89	2	2,841	450	135	49	3,000	2,000
JAS	E	505	4	43,250	1,750	470	22	15,000	13,500
JCRI	R	50	2	3,500	521	231	40	4,500	3,700
JHARI	R	68	1	13,000	1,012	225	21	6,000	5,570
JHAS	E	297	6	13,200	1,389	410	35	8,000	7,350
LARI	R	76	2	2,600	471	155	20	4,000	3,760
LAS	E	400	3	6,125	926	218	25	6,000	5,700
HARI	R	103	4	16,000	4,000	270	30	3,500	3,000
HAS	E	1308	12	136,831	1,517	938	104	58,000	55,977
SARI	R	47	1	2,421	516	200	28	3,500	3,100
SAS	E	625	10	9,500	1,529	655	52	9,000	8,300



OVERLAP OF FOREIGN PERIODICALS  
BETWEEN SIX BIG LIBRARIES

## 1. English

	CNRRI	ZAAS	ZAU	TRI	ZL	ZISTI
CNRRI	--	160 (58.0%)	229 (67.0%)	72 (26.1%)	88 (31.9%)	106 (38.4%)
ZAAS	160 (56.7%)	--	173 (45.8%)	82 (32.5%)	125 (44.3%)	147 (52.1%)
ZAU	229 (18.6%)	173 (14.1%)	--	79 (8.7%)	135 (14.8%)	158 (11.3%)
TRI	72 (45.9%)	82 (52.2%)	79 (50.3%)	--	72 (45.9%)	54 (34.4%)
ZL	88 (38.9%)	125 (55.3%)	135 (59.7%)	72 (31.9%)	--	160 (70.8%)
ZISTI	106 (32.8%)	147 (45.5%)	158 (48.9%)	54 (16.7%)	160 (49.5%)	--

## 2. Russian

	CNRRI	ZAAS	ZAU	TRI	ZL	ZISTI
CNRRI	--	9 (60.0%)	11 (73.3%)	6 (40.0%)	5 (33.3%)	10 (66.7%)
ZAAS	9 (25.7%)	--	37 (88.6%)	7 (20.0%)	10 (28.6%)	25 (71.4%)
ZAU	11 (7.3%)	31 (20.7%)	--	6 (40.0%)	15 (10.0%)	30 (20.0%)
TRI	6 (37.5%)	7 (43.8%)	6 (37.5%)	--	3 (18.8%)	6 (37.5%)
ZL	5 (16.7%)	10 (33.3%)	15 (50.0%)	3 (10.0%)	--	3 (10.0%)
ZISTI	10 (22.2%)	25 (55.6%)	30 (66.7%)	6 (13.3%)	3 (6.7%)	--

### 3. Japanese

	CNRRI	ZAAS	ZAU	TRI	ZL	ZISTI
CNRRI	--	26 (51.0%)	28 (55.0%)	15 (29.4%)	11 (28.2%)	14 (27.5%)
ZAAS	26 (38.2%)	--	40 (58.8%)	22 (37.9%)	12 (30.8%)	24 (35.3%)
ZAU	28 (16.6%)	40 (23.7%)	--	20 (11.8%)	18 (46.2%)	26 (15.4%)
TRI	15 (55.6%)	22 (81.5%)	20 (74.1%)	--	8 (20.5%)	12 (44.4%)
ZL	11 (28.2%)	12 (30.8%)	18 (46.2%)	8 (20.5%)	--	21 (53.8%)
ZISTI	14 (20.0%)	24 (34.3%)	26 (37.1%)	12 (17.1%)	21 (30.0%)	--

### 4. Summary:

	CNRRI	ZAAS	ZAU	TRI	ZL	ZISTI
CNRRI	--	195 (57.0%)	268 (78.4%)	93 (27.2%)	104 (30.4%)	130 (38.0%)
ZAAS	195 (21.8%)	--	250 (66.1%)	111 (29.4%)	147 (38.9%)	196 (51.9%)
ZAU	268 (21.8%)	250 (20.3%)	--	105 (8.5%)	168 (13.6%)	216 (17.5%)
TRI	93 (46.5%)	111 (55.5%)	105 (52.5%)	--	83 (41.5%)	72 (36.0%)
ZL	104 (35.3%)	147 (49.8%)	168 (57.0%)	83 (28.1%)	--	184 (62.4%)
ZISTI	130 (32.2%)	196 (48.5%)	216 (53.5%)	72 (17.8%)	184 (45.5%)	--

图书馆(情报所)名称: \_\_\_\_\_

一、馆际互借规模:

与 \_\_\_\_\_ 个图书馆有馆际互借关系,

借出: 每年收到求借要求 \_\_\_\_\_ 种 \_\_\_\_\_ 册,

共满足 \_\_\_\_\_ 种 \_\_\_\_\_ 册

借进: 每年本馆需外借要求 \_\_\_\_\_ 种 \_\_\_\_\_ 册,

共满足 \_\_\_\_\_ 种 \_\_\_\_\_ 册

二、人力与费用:

每年约需 \_\_\_\_\_ 人时处理馆际互借工作

是专职还是兼职?

每年化费在馆际互借上 \_\_\_\_\_ 元(邮费等)

每年收入 \_\_\_\_\_ 元(复印收费等)

三、馆际互借方式(可多次打勾):

借进时

a 由图书馆工作人员查联合目录, 与藏书图书馆联系, 最后由图书馆转交图书(复印件).

b 由用户、读者自己查联合目录, 自己联系.

c 由用户、读者自己查联合目录, 图书馆联系.

邮寄? \_\_\_\_\_, 电话? \_\_\_\_\_,

通用借书证 \_\_\_\_\_

※共发 \_\_\_\_\_ 通用借书证。

四、满足一个需求所需时间：

借进，一般从收到要求到获得图书(期刊、复印件)

所需时间\_\_\_\_\_天；

处理所需时间

借进：核对与查联合目录\_\_\_\_\_ (分)

    邮寄要求\_\_\_\_\_ (分)    拆包\_\_\_\_\_ (分)

    通知读者\_\_\_\_\_ (分)

借出：核对与找到所需图书或期刊\_\_\_\_\_ (分)

    包装、邮寄\_\_\_\_\_ (分)    记录\_\_\_\_\_ (分)

五、馆际互借中所遇到情况的处理：

A 当所需外借的图书或期刊等馆内未藏时

    a 回绝需求     b 送到别馆以求援助

B 当所需外借的图书或期刊等已被读者所借时

    a 排队等待     b 回绝需求

    c 催本馆读者归还

C 在办预订情况下，当同时具有本馆读者与外馆需

求时

    a 一视同仁     b 本馆优先

    c 外馆优先

SURVEYS ON INTERLIBRARY LOAN IN THE LIBRARY

Name of the Library: \_\_\_\_\_

1. The Scale of the Interlibrary Loan Network

With how many \_\_\_\_\_ libraries and information centers, there are ILL agreements?

Loan:

Requests received, \_\_\_\_\_ titles \_\_\_\_\_ items

Requests handled, \_\_\_\_\_ titles \_\_\_\_\_ items

Borrowing:

Request sent, \_\_\_\_\_ title \_\_\_\_\_ items

Requests satisfied, \_\_\_\_\_ titles \_\_\_\_\_ items

2. Resources involved

a. Manpower involved, \_\_\_\_\_ manhours

part-time, \_\_\_\_\_ manhours

full-time, \_\_\_\_\_ manhours

b. Other cost of ILL, \_\_\_\_\_ Yen (including photocopying, postage, paper and envelop etc.)

c. Income of ILL services, \_\_\_\_\_ Yen

3. Ways of ILL (Please tick one)

a. The whole process carried out by Library Staff   
(such as consulting UC, contacting with resource library and conveying documents to user, returning documents to resource library)

b. The whole process completed by users themselves

c. Users consult UC and library contact with resource library

4. Channels of ILL transaction

a. mailing

b. telephone

c. interchangeable library card issued

If 'c', please give the number of interchangeable library card issued \_\_\_\_\_

5. Average turn-around time of an ILL transaction

Average time to satisfy a request, \_\_\_\_\_ days

Of which, processing time

a. borrowing-in:

verifying and consulting UC, \_\_\_\_\_ minutes

mailing request, \_\_\_\_\_ minutes

unpacking document, \_\_\_\_\_ minutes

notifying users, \_\_\_\_\_ minutes

b. loan-out

verifying, \_\_\_\_\_ minutes

packing and mailing, \_\_\_\_\_ minutes

recording, \_\_\_\_\_ minutes

If a reproduction is offered,

paging, \_\_\_\_\_ minutes

copying, \_\_\_\_\_ minutes

6. Response to the cases when handling ILL requests

a. when the items required by request library are not in collection

i rejecting the request  ii relaying the request

b. when the items requested are on-loan by local user

i waiting in queue  ii rejecting the ILL request  iii recalling

c. when both local request and ILL request for a specific item are posed (under the circumstance of reservation)

i treating equally (First-coming, First served)

ii local user priority

iii ILL request priority

NAME OF LIBRARY	NO. OF LIBRARY ILL WITH	LOAN		BORROWING		RESOURCE INVOLVED		WAYS OF ILL	CHANNELS OF ILL	AVERAGE TURN-AROUND TIME (DAYS)	RESPONSES TO THE CASES			CHARGE
		No. of requests received	No. of request handled	No. of request sent	No. of request satisfied	man-power	others				a	b	c	
ZAU	20	89	68 (76.4%)	25	16 (64%)			b	a & c	20	ii	ii	iii	
ZAAS	15	8	7 (87.5%)	138	113 (81.9%)			c	a & c	24.8	i	ii	iii	
XAU	20	20	15 (75%)	225	200 (88.9%)			a	a	30	ii	i	ii	
DA (3 year)	46	2864	2067 (72.2%)	2568	2002 (77.9%)			a	a & c (15)	22	i	ii	i	
WARI	5	60	50 (83.3%)	30	20 (66.7%)			c	a	30	ii	i	ii	
WAS	4	40	15 (37.5%)	50	15 (30.0%)			b	a	7	i	ii	ii	
TAS	3			45	36 (80%)			a	a	3	i	ii	ii	

11.6. Results of Survey on ILL in ZAAS

Satisfaction Rate

No. of Requests Handled	No. of Requests Satisfied		No. of Requests Dissatisfied		No. of Requests Cancelled		Place to Satisfy			
							B	S	H	O
51*	46	90.0%	4	7.8%	1	2.0%	36.3%	45.5%	18.2%	0%
87**	67	77.0%	19	21.8%	1	1.1%	10.0%	65.0%	20.0%	5%

Time Duration of Two Samples

\* Nov.86-Aug.87

\*\* Jan.84-June 84

B: Beijing H: Hangzhou

S: Shanghai O: Others

Average Turn-around Time

Samples	<5 Days	5-10	10-15	15-20	20-25	25-30	30-35	35-40	>40	Average (days)
15		1	1		5	7	1			21.3
17			1	1	7	1		2	6	29.4
Sum		1	2	1	12	8	1	2	6	24.8

Proportion Satisfied/Days

Samples	1-5	1-10	1-15	1-20	1-25	1-30	1-35	1-40
(1)	6.7%	13.3%	53.3%	93.3%	100%			
(2)		3.0%	5.9%	11.8%	52.9%	58.8%	70.6%	100%
(1)+(2)	3.0%	9.1%	12.1%	48.5%	72.7%	75.8%	81.8%	100%

Costs of Photocopying

Samples	0-0.50	0.51-1.00	1.01-1.50	1.51-2.00	2.01-2.50	2.51-3.00	Average (Yen)
51	2 (3.9%)	7 (13.7%)	19 (37.3%)	12 (23.5%)	9 (17.6%)	2 (3.9%)	
87	8 (9.2%)	14 (16.1%)	20 (32.2%)	20 (23.0%)	9 (10.3%)	8 (9.2%)	
51+87	10 (7.2%)	21 (15.2%)	47 (34.1%)	32 (23.2%)	18 (13.0%)	10 (7.2%)	
Average	0.018	0.114	0.426	0.406	0.293	0.198	1.46

## 11.7 联合目录编辑情况调查表

编辑牵头单位名称：\_\_\_\_\_

联合目录名称：A \_\_\_\_\_

B \_\_\_\_\_

### 一、目录种类：

- A 期刊      原版
- 原版+影印
- 中文
- a 卡片式            b 书本式
- B 图书      西文(外文)
- 中文

### 二、成员馆范围：

共计成员馆 \_\_\_\_\_ 个，到 \_\_\_\_\_ 级

### 三、目录条数：

共报导期刊 \_\_\_\_\_ 种，图书 \_\_\_\_\_ 种

### 四、费用：

总投资 \_\_\_\_\_ 元

人力：

编目 \_\_\_\_\_ (人时)      编辑 \_\_\_\_\_ (人时)

其它 \_\_\_\_\_ (人时)

材料与设施：

卡片或书本式 \_\_\_\_\_ 元， 出版费 \_\_\_\_\_ 元，

共出版 \_\_\_\_\_ 本， 每本售价 \_\_\_\_\_ 元

### 五、化费时间：

共 \_\_\_\_\_ 年

SURVEYS ON THE COMPILATION OF UNION CATALOGUE

Name of Organisation in Charge : \_\_\_\_\_

Name of the Union Catalog compiled : \_\_\_\_\_

1. Types of Union Catalogue

Periodicals a. Foreign   
b. Chinese

Book a. Foreign   
b. Chinese

Forms:

a. cards   
b. books   
c. microforms   
d. losen-files   
e. others (Please specify)

2. How many participating libraries and to what level were included?

\_\_\_\_\_ libraries, up to \_\_\_\_\_ level

3. How many items are covered in the Union Catalogue?

Periodicals, \_\_\_\_\_ titles; Book, \_\_\_\_\_ titles;

Proceedings, \_\_\_\_\_ titles; Report, \_\_\_\_\_ titles.

Others, \_\_\_\_\_ items (Please specify)

4. How much investment (including money, manpower, and other resources) has been made for it/them?

Money, \_\_\_\_\_ Yen;

Manpower,

Cataloging, \_\_\_\_\_ man-hours

Compiling, \_\_\_\_\_ man-hours

Others, \_\_\_\_\_ man-hours

material,

Cards, \_\_\_\_\_ Yen

Paper, \_\_\_\_\_ Yen

Printing cost, \_\_\_\_\_ Yen

5. How many copies have been sold? And how much does each cost?

Number of copies sold, \_\_\_\_\_

cost, \_\_\_\_\_ Yen

6. How long does it take to complete the Union Catalogue?

Time spent, \_\_\_\_\_ (months/years)

Please return to Qiaoqiao China National Rice Research Institute, Hangzhou, P.R. CHINA

MATERIAL INVOLVED	PRINTING COST (Yen)	NO. OF COPIES PUBLISHED	COST FOR EACH COPY (Yen)	TIME SPENT TO COMPLETE
	1,000		5-10	several years
	20,000		50-60	6 months
			50-60	2 years

NAME OF UNION CATALOGUE COMPILED	NAME OF ORGANISATION IN CHARGE	TYPES OF UC	FORMS OF UC	NO. OF PARTICIPATING LIBRARIES	NO. OF ITEMS LISTED	COST	
						MONEY	MANPOWER
UC OF CHINESE PERIODICALS	BEIJING LIBRARY	PERIODICALS	BOOK	400		15-16	
UC OF WESTERN LANGUAGE PERIODICALS	BEIJING LIBRARY	PERIODICALS	BOOK	400		15-16	
UC OF FOREIGN AGRICULTURAL PERIODICALS (CURRENT ISSUES)	AGRICULTURAL INFORMA -TION & DOCUMENTATION CENTRE	PERIODICALS	BOOK	94	3297	4	
UC OF AGRICULTURAL COLLECTION	AS ABOVE	BOOKS	BOOK	94	6000-7000	4	15000
ZHEJIANG UC OF FOREIGN PERIODICALS (For subscription)	ZHEJIANG LIBRARY	PERIODICALS	BOOK	11		2	10000
ZHEJIANG UC OF FOREIGN BOOKS	ZHEJIANG LIBRARY	BOOKS	BOOK	11		2	
ZHEJIANG RETROSPECTIVE UC OF FOREIGN PERIODICALS	ZHEJIANG LIBRARY	PERIODICALS	BOOK	11		4	30000



何原因你未借到?

- |       |                          |     |                          |
|-------|--------------------------|-----|--------------------------|
| 已被人借走 | <input type="checkbox"/> | 不出借 | <input type="checkbox"/> |
| 馆内无收藏 | <input type="checkbox"/> | 遗失了 | <input type="checkbox"/> |
| 其他    | <input type="checkbox"/> |     |                          |

四、如馆内无收藏，是否想通过馆际借阅获取?

- 是  否

五、如不打算，是何原因? (可重复打勾)

- (1) 此文献并不重要
- (2) 所需时间太长
- (3) 太麻烦
- (4) 没有可查的联合目录
- (5) 无馆际借阅服务
- (6) 联合目录上查不到
- (7) 钱无处开支

INSTANT QUESTIONNAIRE

December, 1987

Dear sir/madam,

Would you please complete the questionnaire when you leave the library so that we could get some knowledge of what your needs are? Thanks for your co-operation.

Yours faithfully

Library of ....

1. Name: \_\_\_\_\_  
Job Title : \_\_\_\_\_  
Subject area : \_\_\_\_\_

2. How many items have you borrowed and read during this visit?

Borrowed,

book \_\_\_\_\_ items Back issue of periodicals \_\_\_\_\_ item

Read,

Book \_\_\_\_\_ items periodicals \_\_\_\_\_ items

others \_\_\_\_\_ items (please specify)

3. ... Have you borrowed or read what you initially intended to?

Yes

No

Partially failed to

(Please give the number \_\_\_\_\_)

4. For what reasons did you fail to get those?

On-loan

Not for loan

Not in collection

Missing

Mis-shelving

others   
(Please specify \_\_\_\_\_)

5. If they are not in collection, do you want to acquire them via

*ALL if not why*  
Intrlibrary LOan? (You may tick more than one box)

The material is not so important.

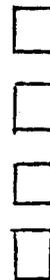
It takes too long time to get it.

It is too troublesome.

There is no Union Catalogue to find out the location information

Interlibrary loan service is not available.

The item can not be located in the Union Catalogue.



Please return to the library staff. Thanks again.

11.10 DATA SUMMARISED FROM THE INSTANT QUESTIONNAIRE

1.

Library	No. of Response	No. of Book Borrowed		No. of Periodicals Borrowed		No. of Books Read only		No. of Periodicals Read only		Other
		Total	Average	Total	Average	Total	Average	Total	Average	
1	20	61	3.1	16	0.8	114	3.4	46	2.3	19
2	20	34	1.7	34	1.7	38	1.9	40	2.0	3
3	34	45	1.3	5	0.2	103	3.0	24	0.7	5
4	25	52	2.1	10	0.4	85	3.4	32	1.3	12
5	48	79	1.6	25	0.5	156	3.3	52	1.1	29
6	15	30	2.0	8	0.5	28	1.9	30	2.0	2
7	42	58	1.4	39	0.9	98	2.3	46	1.1	28
8	25	38	1.5	14	0.6	42	1.7	24	1.0	15
Total	229	397		151		664		294		111
Average	28.6	49.6	1.8	18.9	0.7	83	2.6	36.8	1.3	13.9

Library	No. of Books fail to borrow or read	Of Which							No. of Items On-loan	No. of items Not in Collection	No. of Items Not for Loan	No. of items Missed	No. of Items Mis-shelved	No. of Items in bindery	Other
		No. of Items On-loan	No. of items in Collection	No. of Items Not for Loan	No. of items Missed	No. of Items Mis-shelved	No. of Items in bindery	Other							
1	17	6	7	1	1	1	1	1					1	1	1
2	28	7	15	1	2	1	1	1				1	1	1	1
3	16	4	10	1	1	1	1	1				1			
4	20	5	11	2	2	2	2	2						2	
5	30	11	13	3	1	3	1	1				1		1	
6	12	5	4	1	1	1	1	1							1
7	25	9	12	4											
8	15	4	9					1						1	
Total	163	51 (31.3%)	81 (49.7%)	13 (8.0%)	6 (3.7%)	3 (1.8%)	6 (3.7%)	3 (1.8%)	6 (3.7%)	3 (1.8%)	6 (3.7%)	3 (1.8%)	6 (3.7%)	3 (1.8%)	3
Average	20.4	6.4	10.1	1.6	0.8	0.4	0.8	0.4	0.8	0.4	0.8	0.4	0.8	0.4	0.4



同志们，您们好！

为了使我所的图书、情报工作朝着更好地满足大家的各类文献需求这一目标努力，我们欲通过对读者阅读兴趣、文献利用情况的调查来作为研究工作改进时的参考。以下的询问表便是为该目的所设计的，务请大家予以协助！填写完表后，请于1月1日前交回我系。谢谢大家！

所科技情报系

1987年12月

职称：

专业：

※注：答第一至六问题时，请按使用多少排队标号。

(1)为最多，不使用者请勿标号。

一、在下列文种的文献中，哪些您曾使用？(请按使用多少排队)

中文 英文 日文 俄文 德文 法文 其它

二、下列文献类型中，哪些您曾使用？(不包括文艺书刊)

中文期刊 中文图书 国内资料 外文期刊

外文图书 专利文献 字典 手册

会议文献 科技报告 标准文献

三、下列专业的文献中，哪些你曾使用？

本专业 相关专业 综合性 情报性资料 其它

四、下列年代的文献中，哪些你曾使用？

80年代      70年代      60年代      50年代

40年代      40年代以前

五、你一般通过下列哪些方法途径得到文献线索？

查文献索引(文献、题录)      阅读文后引文参考

专题目录      参加学术会议

新书新刊通告      私人通信交往

图书馆目录卡片      图书馆员推荐

阅览新书、新刊      其它

六、是什么原因使得你经常得不到你想要的文献、情报？

查不到有关课题的对口文献

本馆未入藏

语言困难

国内各大馆均没有收藏

无从知道何处收藏

无馆际借阅服务

七、您一般使用百分之几的科研时间来查阅文献？

10% 以下    10—20%    20—30%    30—40%    40%以上

八、当借不到本馆收藏的书刊时，您打算怎么办？

完全放弃借阅要求

希望图书馆办预订

希望图书馆催促归还

其他

九、当得知所要借书刊本图书馆未收藏时，您有何要求？

建议图书馆增购增订

要求馆际借阅服务

放弃借阅要求

托别人设法借阅

其他

QUESTIONNAIRE ON INFORMATION NEED AND BEHAVIOUR OF USERS

1. Name: \_\_\_\_\_; Title: \_\_\_\_\_;  
Speciality: \_\_\_\_\_.

\*  
Please note that when you answer the questions from 2 to 7, you are suggested to rank the items listed in accordance with the frequency or degree of usage. (1) is the most frequent used item. You need not mark any symbols on the items you do not use.

2. Languages of Documents

Please rank the following languages you use

Chinese  English  Japanese  Russian   
Germany  French  other   
If 'other', please specify \_\_\_\_\_

3.

3. Types of documents

Please rank the following types of documents you read

Chinese Periodicals	<input type="checkbox"/>	Chinese Books	<input type="checkbox"/>
Internal Publications	<input type="checkbox"/>	Foreign periodicals	<input type="checkbox"/>
Foreign Books	<input type="checkbox"/>	Patent Document	<input type="checkbox"/>
Reference books	<input type="checkbox"/>	Proceedings	<input type="checkbox"/>
Reports	<input type="checkbox"/>	Standards	<input type="checkbox"/>

4. SUBJECTS & ORIENTATION OF DOCUMENTS

Please rank the following subjects and orientations of document you read

Your own subject  Please specify, \_\_\_\_\_  
Relevant subject  Please specify, \_\_\_\_\_  
Comprehensive material  Informational material

5. Decades of Documents published

Please reank the following decades of documents you have read

80'S	<input type="checkbox"/>	70'S	<input type="checkbox"/>	60'S	<input type="checkbox"/>
50'S	<input type="checkbox"/>	40'S	<input type="checkbox"/>	before 40'S	<input type="checkbox"/>

6. Approaches to find a CLUE to the documents you need (please rank the following)

- |                                    |                                   |                                   |                          |
|------------------------------------|-----------------------------------|-----------------------------------|--------------------------|
| a. Abstracts & Indexes             | <input type="checkbox"/>          | b. Subject Catalog                | <input type="checkbox"/> |
| c. Current Awareness               | <input type="checkbox"/>          | d. Library Card Catalog           | <input type="checkbox"/> |
| e. New Books & New Periodicals     | <input type="checkbox"/>          | f. Citation & Reference of Papers | <input type="checkbox"/> |
| g. Academic Conferences            | <input type="checkbox"/>          | h. Private Correspondence         | <input type="checkbox"/> |
| i. Recommendation by Library Staff | <input type="checkbox"/>          |                                   |                          |
| j. Other <input type="checkbox"/>  | If "other", please specify, _____ |                                   |                          |

7. Causes to make you fail to obtain the documents you need

Please rank the following causes

- |   |                          |
|---|--------------------------|
| a. Failure in finding the documents of specific subjects and relevant subjects    | <input type="checkbox"/> |
| b. Not in the collection of the local library                                     | <input type="checkbox"/> |
| c. Language barrier in understanding the clues                                    | <input type="checkbox"/> |
| d. Not in the collection of some central library and big libraries                | <input type="checkbox"/> |
| e. No way to know where the documents are collected, i.e. no location information | <input type="checkbox"/> |
| f. No Interlibrary Loan services provided   | <input type="checkbox"/> |

8. What is the percentage of research or teaching time you spent consulting and reading documents?

- |               |                          |          |                          |        |                          |
|---------------|--------------------------|----------|--------------------------|--------|--------------------------|
| less than 10% | <input type="checkbox"/> | 10-20%   | <input type="checkbox"/> | 20-30% | <input type="checkbox"/> |
| 30-40%        | <input type="checkbox"/> | over 40% | <input type="checkbox"/> |        |                          |

9. When you fail to borrow the documents collected by the local library, what will you response?

- |  |                          |
|--|--------------------------|
| a. Giving up entirely  | <input type="checkbox"/> |
| b. Wishing the library to make a reservation for you               | <input type="checkbox"/> |
| c. Wishing library to recall the users who is holding the document | <input type="checkbox"/> |
| e. Other   | <input type="checkbox"/> |
| If 'other', please specify, _____                                  |                          |

10. When you find out that the documents you need are not in the collection of the local library, what will you response?

- a. Suggesting the library to acquire or subscribe the documents
- b. Requiring the library to carry out ILL service
- c. Giving up
- d. Asking friends to borrow the documents from other library
- e. Other,   
 If 'other', please specify, \_\_\_\_\_

11.12

Time period fo response	No. of Questionnaire sent	No. of Questionnaire Responed	Response Rate
20th Dec. 1987	85	48	56.5%
-- 10 Jan. 1988			

1.

DISTRIBUTION OF TITLES (PROFESSION)

Biophysiolo -gy Biochemistry	Agricultur -al Engineering	Cereal Chemistry	Genetics & Plant breeding	Varietal Resources	Phathology	Agronomy	Soil Science	Computer	Bio- technology	Agricultur Economy
5 (10%)	4 (8%)	1 (2%)	7 (14%)	3 (6%)	4 (8%)	5 (10%)	5 (10%)	4 (8%)	4 (8%)	4 (8%)

Title	Junior	Middle- rank	Senior
46	13 (28%)	22 (48%)	11 (24%)

2.

Language Rank	Chinese	English	Japanese	Russian	Germany	French	Other
1	39	11					
2	7	32	4	1			
3	1		14	4			
4			1				
5					1		
6							
7							
Total	47	33	19	5	1		



4.

Subjects Rank	One's Own Subject	Relevant Subject	Comprehensive Material	Informational Material	Others
1	38	1	1	1	
2		20	8	6	
3		8	18	6	
4		4	4	13	2
5			2	1	15
Total	38 (10)	33 (7)	32 (7)	27 (4)	17 (2)
Rank					

5.

Decades Rank	80'S	70'S	60'S	50'S	40'S	Before 40'S
1	40					
2		33		1		
3		1	26	3		
4			15	10		
5					1	
6						
Total	40 (10)	34 (7)	41 (5)	14 (3)	1	
Rank						



**Text cut off in original**

7.

Causes Rank	Failure in Finding	Not in the Collection of the Local Library	Language Barrier in searching References	Not in the Collection Of the Central Library	No Way to know the location Information	No Inter-library Loan Services Provided
1	12	21			2	2
2	6	5	2		5	5
3	2				5	5
4			1		2	2
5			1			
6						
Total	20 (3)	26 (3)	4 (2)		14 (1)	14 (2)
Rank						

8.

Time Persons	10%	10-20%	20-30%	30-40%	Over 40%
	16 (39%)	12 (29%)	9 (22%)	4 (9.8%)	2 (4.9%)

9.

Rank \ Responses	Giving up Entirely	Wish to make a reservation	Wish the Library to Recall	Others
1	4	19	16	1
2	1	2	4	1
3	1			14
4				
Total	6	21	20	16
Rank				

10.

Rank \ Response	Suggesting the Library to Acquire or Subscribe	Requiring the library to provide an ILL services	Giving up	Asking friends to borrow from other library	Others
1	24	22	1	9	1
2	3	5		3	
3				2	
4	1	3			
5					
Total	28	30	1	14	1
Rank					

11.13 LIST OF QUESTIONS FOR INTERVIEW

\*Summary from the interviews with ten library directors

1. As we well know, with the rapid growth of publications and inflation, two conflict trends, tighted budgets of information services and increased demand on information have made library directors seek for the way of relief. What do you think are the efficient ways and measures to buffer the conflicts and to improve the effectiveness of services?

- a. It is necessary to have careful consideration in acquisition work and well-planned budget allocation.
- b. It is important to set up multi-channel in checking work, contacting with and getting feedback from other department.
- c. Acquisition work should not be limited to few staff. It should be open to users.
- d. There is a demand on carrying out some reform in traditional circulation methods in order to increase the usage (e.g. Current Awareness, Multi-entries Catalog).
- e. It is urgent to solve the problems of money, manpower and other resource shortage.
- f. It is imperative to establish various types of co-operative and resource-sharing network.

2. Don't you think that networking is one of the best ways of relief?

Yes. 6

No. 2

3 persons have not answered

3. Do you think that it can be expected in the near future to establish some library and information network on a large

scale?

Within the Seventh-Five-Year Plan(1986-90)

Within the Eighth-Five-Year Plan(1990-95)

\*5 people are not so optimistic, they think that it is not realistic to expect such formal and well organised network in the near future.

\*2 people think that it will be possible to build such network soon if the government urges upon the government officers, library directors and library staffs the importance of networking. And all make a common effort to fulfil the objective.

\*3 people have no responses

4. What do you think are the favourable conditions of and constraints to establishing an Agricultural Library and Information Network under the circumstance of the present library and information system?

FAVOURABLE CONDITIONS:

Our social system are based on public ownship, which is a condition of great advantage in building library networks to share the resources.

CONSTRAINTS:

A. Realisation Constraints

Some do not realise the importance of networking;

Some insist on developing the libraries into a "Big and Complete" or "Small but Comprehensive" ones and trying to satisfy all the demand of their users by their own collections( it is impossible!). So they show indifference towards the co-operative acquisitions and interlibrary loan etc.

B. Technological Constraints

a. Lack of modern technology e.g. computer system, telecommunication and photographic

system are not so developed.

b. Technical incompatibility between the libraries and information centres, and other systems

c. Imbalance of technological development among the libraries and information centres

#### C. Funding Constraints

Tighted budgets in individual information services. Even some increase in funds can not catch up with the inflation.

#### D. Administration Constraints

The relationship between each level of nodes are not rigid hierarchical in terms of administrative supervision.

The structure of the libraries in China is basically vertical-oriented, i.e. the libraries are classified into four types: Public Library System, under the administration of Ministry of Culture; University and College Library System, under the administration of Commission of Education; Academic Library(Research) System, under the Academy of Science (or Agricultural Science); And Technial Library System. The libraries are also administrated by local governments. So the libraries usually get the technical supervision and administraive supervision from different bodies. The disadvantage of the overall system can be seen that the libraries are treated as an administrative units, which confines the libraries to exert a multi-functional effect. Futhermore, because there are little connections among libraries of various systems, those divisions of libraries according to the administrative ares seem to be not suitable at all for the country with such big population.

General speaking, the attitudes towards the networking from various level of libraries are somewhat different. They can be summarised as follows:

- a. The libraries possessing big collections are afraid of being taken advantages. They intend to close the door to other small libraries.

b. Some middle-size libraries have the concept of "small-scale peasant economy" in management. They are only willing to co-operate with bigger libraries and get more benefit from them.

c. Some small-size libraries put too much dependence on the big libraries without trying their own best to satisfy their own users.

5. What influences do you think the network will have upon your libraries or information centers and could you rank them?

1) putting on too much work-load on library staff

\* 5 people think so (1)

2) increasing the probability of user satisfaction

\* 2 people think so (2)

3) increasing the usage of library collection

\* 2 people think so (4)

4) buffering the economic difficulties of library

\* 2 people think so (5)

5) putting an economic burden on library

\* 1 people thinks so (2)

6) improving the effectiveness of library or information centres

\* 3 people think so (6)

7) encouraging and stimulating the staffs

\* 1 people thinks so

8) others, please sepecify

6. Which of the following network scales and configurations(structures) do you prefer?

TYPES:

1) Comprehensive Sci-tech Information Network

(including all subjects, e.g. provincial Sci-tech Information Network)

- 2) Subject Information Network  
(e.g. Agricultural Library and Information Network, including Agri.Research, Education, Administration, Production and Marketing)

\* 2 people think so

- 3) Information Network in a System  
(e.g. University and College Library and Information Networks)

\* 3 people think so

- 4) Subject within same System  
(e.g. Agricultural University Library and Information Network)

\* 5 people think so

ADMINISTRATIVE & GEOGRAPHIC SCALE:

- 1) nation-wide \* 2 people think so
- 2) region-wide \* 5 people think so
- 3) province-wide ↓
- 4) parts of province \* 3 people think so
- 5) prefecture-wide

LEVELS:

- 1) national, provincial, prefectural, and county  
----- Four Level
- 2) Provincial, prefectural, and county

---- Three Levels

\* 5 people think so

- 3) provincial, and prefectural

---- Two Levels

\* 2 people think so

- 4) national, provincial, and prefectural

---- Three Levels

- 5) provincial

---- One Level

\* 2 people think so

- 6) national and provincial

---- Two Levels

\* 1 people think so

- 7) others, If "other", please specify

CONFIGURATIONS:

- 1) hierarchical  
\* 7 people think so

- 2) ring  
\* 2 people think so

- 3) star  
\* 1 people think so

- 4) other

If "other", please specify

7. As far as a provincial Agricultural Library & Information Network (including the libraries in Agri. Education, Research, Administration, Production and Marketing of provincial, prefectural and county levels) is concerned, which of the following organisations do you think is/are

ideal co-ordinating organisation(s)?

(1) Agricultural Department of Provincial Government

----- Administration

\* 3 people think so

(2) Agricultural University(College)

----- Education

(3) Academy of Agricultural Science

----- Research

\* 1 people think so

(4) Provincial Central Commission of Library Association

----- Comprehensive

(5) Provincial Association of Agricultural Libraries and  
Information Centres

----- Subject(suggest to establish)

\* 1 people think so

(6) Executive Group, with Full time staff in charge;

Committee, consisting of the Directors of big libraries

----- Subject(suggest to establish)

\* 4 people think so

(7) National Research Institute, or Institute of Chinese  
Academy of Agricultural Science

----- Research

\* 1 people think so

(8) Agricultural Information and Documentation Centre

----- Subject(suggest to establish)

(9) Others, please specify

8. What co-operative activities do you think should be  
carried out in the network?

- (1) Co-operative Acquisition
  - \* 6 people think so
- (2) Interlibrary Loan
  - \* 7 people think so
- (3) Compilation of Union Catalogue
  - \* 7 people think so
- (4) Establishment of Agricultural Information Retrieval System(including publishing Agri.Secondary Sources, building Agri. Bibliographic Databases and Databanks)
  - \* 4 people think so
- (5) Widespreading Exchange of Material
  - \* 5 people think so
- (6) Editing and Translating Foreign Agri. Literature on a co-operative basis
  - \* 3 people think so
- (7) Compilation of Agri. Reference Book on a basis of co-operation
  - \* 1 people think so
- (8) Other, Please specify

9. Where do you think the funds for co-operative activities should come from?

- (1) participating libraries only
  - \* 2 people think so. They think the big libraries should pay more.
- (2) government investment
  - \* 2 people think so

(3) from both above sources (please suggesting a proportion)

\* 4 people think so

(4) Funds from Provincial Central Commission of Libraries and Cultural Department of Provincial Government

\* 2 people think so

(5) other, Please specify

10. How do you think the nodes should contact with each other?

(1) free flow of information and transaction among the nodes

\* 2 people think so.

(2) cross the systems when nodes are at same levels

\* 2 people think so.

(3) lower level nodes cross the system through the centres of the same system

\* 2 people think so.

(4) establishing centres throughout national, provincial, prefectural levels, contacting with nodes in other prefecture, provincial through the centres

\* 4 people think so

11. How do you comment on the present status of ILL services in nation-wide or regionally?

ILL started in 1956 in China. In 1957, the Government launched "National Co-ordinating Programme of Libraries", which promoted the development of this co-operative activity. Nevertheless, it was impeded a great deal during the Culture Revolution. Now it is at a stage of recovery. Comparing ILL in China with that in USA, UK and other advanced countries, we are

admittedly left behind. The present status can be summarised as follows:

- a. The scale of ILL are rather small. It is only carried out in partial areas. There have not formed a large-scale, saying provincial, ILL system, nor ILL Network.
- b. There lack of necessary plan and co-ordinating organisation for ILL. So it is in a loose and disorder structure.
- c. There lack of strict rules to follow. People ignore the effectiveness of ILL. So, ILL is quite superficial.

11.14 REQUEST DISTRIBUTION OF CHINESE BOOKS IN JHAS

(1)

STATUS	S		S1		S2		S3		S4		S5	
	ITEM TIMES	PROPOR -TION										
NA	7	12.7%	19	11.0%	6	4.9%	13	10.4%	12	12.0%	16	10.1%
0	18	32.7%	39	22.7%	82	66.7%	49	39.2%	32	32.0%	67	42.1%
1	18	32.7%	57	33.1%	22	17.9%	40	32.0%	33	33.0%	48	30.2%
2	5	9.1%	26	15.1%	10	8.1%	14	11.2%	15	15.0%	12	7.5%
3	3	5.5%	18	10.5%	2	1.6%	6	4.8%	5	5.0%	10	6.3%
4	2	3.6%	8	4.7%	1	0.8%	2	1.6%	2	2.0%	5	3.1%
5	2	3.6%	5	2.9%			1	0.8%	1	1.0%	1	0.6%
Sample Total	55		172		123		125		100		159	
Population Total	275		862		616		625		502		795	
Average	1.20		1.50		0.52		1.00		1.20		1.00	

HEADER DATA FOR: C:RCBM LABEL: rb  
 NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

	s	s1	s2	s3	s4	s5	s6	s7	s8	s9	f3
1	.62	.70	.72	1.50	2.00	2.50	.82	.46	.88	.52	1.80
2	.83	.83	.92	1.20	1.20	1.24	.80	.50	1.00	.40	1.00
3	.75	.88	.98	1.50	1.50	2.00	.00	.00	.00	.00	1.20
4	.95	1.50	.65	1.00	1.50	1.80	.88	.00	.86	.82	1.50
5	.62	.79	1.00	1.00	1.20	.83	.78	1.30	.00	.00	.88
6	.82	1.50	1.20	.88	1.20	1.00	1.20	.10	.44	.20	2.00
7	.56	.72	.66	1.50	1.20	1.50	.86	.00	.66	.38	1.20
8	1.20	1.60	.44	1.00	1.20	.88	.82	.25	.72	.66	1.00
9	1.50	2.00	.70	1.50	1.00	1.00	1.30	.00	1.20	.90	.96
10	.84	.87	.60	1.50	2.00	1.20	1.33	.00	.00	.00	1.00
11	1.20	2.50	.64	1.20	1.50	.88	1.50	.99	1.20	.72	1.80
12	.85	.86	.82	1.80	1.50	2.00	1.50	.00	.96	.58	.90
13	1.00	2.00	1.30	.78	1.00	1.00	.88	.44	.63	1.00	.60
14	.77	.82	.56	2.00	1.80	1.50	1.20	.00	.88	.96	.88
15	1.00	1.20	.34	1.20	1.51	1.20	.98	.00	.92	1.50	.79
16	1.00	2.00	.80	.88	1.00	1.20	1.20	1.20	.88	.45	1.00
17	.65	.68	.67	1.20	1.80	1.20	1.20	1.54	.00	.00	1.00
18	1.00	1.30	.52	1.00	1.20	.88	1.20	1.30	.72	.00	1.00
19	.80	1.00	.40	1.00	1.20	.85	1.10	.00	.60	1.20	.88
20	.92	.82	.66	1.50	1.51	1.50	1.50	.78	1.20	.66	1.18
21	1.20	1.50	.52	1.00	1.20	1.00	1.40	.80	1.60	.20	.77
22	.73	.82	.56	1.55	1.50	1.10	1.60	.62	1.20	.40	1.21
23	1.21	1.80	.66	1.20	1.00	1.00	.89	.60	1.00	.40	1.00
24	.80	.66	.63	1.00	1.73	.51	1.80	1.50	.00	.00	1.00
25	.88	1.00	.75	1.00	1.20	1.00	.86	.22	.86	.25	1.50
26	.70	.80	.38	1.80	1.20	1.00	1.50	.92	.89	.35	1.00
27	.90	.90	.99	1.50	1.20	1.80	1.40	.63	.53	.00	1.19
28	.64	.62	.62	.62	1.50	.72	1.00	1.80	.00	.00	1.20

HEADER DATA FOR: C:RCBM LABEL: rb  
 NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

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NO.	NAME	N	MEAN	STD. DEV.	MINIMUM	MAXIMUM
1	s	28	.8818	.3154	.4400	1.8000
2	s1	28	1.1971	.6313	.5200	3.0000
3	s2	28	.6304	.2687	.2800	1.5000
4	s3	28	1.2275	.3221	.6200	2.0000
5	s4	28	1.3943	.2862	1.0000	2.0000
6	s5	28	1.1789	.4645	.5100	2.5000
7	s6	28	1.1450	.3915	.0000	2.0000
8	s7	28	.5668	.6075	.0000	1.8000
9	s8	28	.6914	.4495	.0000	1.6000
10	s9	28	.4257	.4678	.0000	1.8000
11	f3	28	1.1507	.3549	.7700	2.2000

HEADER DATA FOR: C:RCBFM1 LABEL: rc  
 NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

	s	s1	s2	s3	s4	s5	s6	s7	s8	s9	f3
1	.55	.60	.65	1.00	1.20	1.50	1.00	.35	.82	.55	1.20
2	.44	.55	.64	1.00	.98	1.00	1.00	.40	1.00	.44	1.00
3	.38	.42	.70	1.00	.80	1.00	.88	.25	.88	.55	1.20
4	.88	1.00	.75	1.00	1.20	1.00	.86	.22	.86	.25	1.50
5	.47	.52	.88	1.20	1.00	1.20	1.20	.00	.00	.00	1.23
6	.76	.56	.36	1.00	.88	1.00	1.20	.00	.72	.25	1.20
7	.50	.44	1.00	1.00	1.20	.60	1.00	1.20	.00	.00	.88
8	.82	1.00	.82	.52	.62	.88	1.20	.62	.55	.44	.90
9	.38	.42	.33	1.00	1.00	1.00	.60	.00	.40	.22	.75
10	1.00	.88	.33	.90	.88	1.00	.98	.00	.92	.55	.82
11	.88	.76	.40	1.00	1.00	1.00	1.00	.00	.00	.00	.76
12	1.00	.88	.50	1.00	.76	.88	1.00	.50	.77	.33	1.50
13	.50	.54	.33	.88	1.00	1.00	.90	.00	.40	.89	1.00
14	.88	1.00	1.20	.88	.90	.88	.72	.33	.33	.78	.60
15	.50	.36	.40	1.00	1.21	1.21	.86	.00	1.00	1.00	.75
16	.80	.88	.22	.88	1.00	1.00	.72	.00	.50	1.00	.52
17	.86	1.00	.40	1.00	.88	.90	1.00	.70	.67	.50	.88
18	.88	1.00	.10	1.00	.82	.76	1.00	.68	.50	.05	.70
19	.40	.33	.50	1.00	1.52	.90	1.00	.88	.00	.00	1.00
20	1.22	.20	.87	1.00	.72	.88	1.00	1.20	.50	.00	1.00
21	.50	.67	.20	.85	1.00	.78	1.00	.00	.33	1.00	.67
22	.43	.41	.29	.88	1.19	.88	1.00	.36	.88	.33	.87
23	.87	1.00	.24	.83	1.00	.82	1.20	.67	1.19	.10	.44
24	.44	.52	.29	1.20	1.00	.85	1.18	.22	1.00	.00	1.00
25	.92	1.21	.20	1.00	.85	.88	.59	.12	.76	.14	.76
26	.50	.44	.20	1.00	1.55	.63	.39	1.20	.00	.00	.75
27	.40	.56	.33	1.19	1.21	1.50	.88	.20	.50	.00	.75
28	.44	.62	.33	1.00	1.20	.50	.82	1.50	.00	.00	.52

----- DESCRIPTIVE STATISTICS -----

HEADER DATA FOR: C:RCBFM1 LABEL: rc  
 NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

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NO.	NAME	N	MEAN	STD. DEV.	MINIMUM	MAXIMUM
1	s	28	.5643	.2443	.3800	1.2200
2	s1	28	.6704	.2670	.2000	1.2100
3	s2	28	.4807	.2800	.1000	1.2000
4	s3	28	.9718	.1281	.5200	1.2000
5	s4	28	1.0204	.2173	.6200	1.5500
6	s5	28	.9439	.2203	.5000	1.5000
7	s6	28	.9529	.1653	.5900	1.2000
8	s7	28	.4143	.4434	.0000	1.5000
9	s8	28	.5529	.3673	.0000	1.1000
10	s9	28	.3346	.3450	.0000	1.0000
11	f3	28	.8982	.2701	.4400	1.5000

11.17 PROBABILITY OF UNSATISFACTION

Library	Probability of Unsatisfaction				Return Rate( $U_{ij}$ )			
	CB	FB	CP	FP	CB	FB	CP	FP
CAAS	10%	40%	5%	30%				
ZAAS	20%	45%	10%	45%	2	2	4	4
ZAD	25%	50%	25%	50%	24	24	18	18
ZAU	15%	30%	10%	35%	3	3	6	6
CNRRRI	20%	20%	10%	25%	4	4	6	6
ZAB	25%	45%	15%	45%	4	4	6	6
TRI	15%	40%	10%	35%	6	6	8	8
ZL	5%	25%	15%	25%	8	8	12	12
HARI	15%	45%	20%	45%	4	4	6	6
HAS	10%	40%	20%	45%	12	12	24	24
HAHS	20%	50%	25%	50%	12	12	24	24
JARI	25%	50%	15%	40%	3	3	6	6
JAS	15%	40%	10%	50%	24	24	48	48
NARI	15%	35%	15%	40%	24	24	48	48
NAS	10%	35%	10%	30%	12	12	24	24
WARI	15%	45%	15%	35%	4	4	8	8
WAS	10%	40%	10%	40%	12	12	24	24

PROBABILITY OF UNSATISFACTION

(2)

Library	Probability of Unsatisfaction				Return Rate( $U_{ij}$ )			
	CB	FB	CP	FP	CB	FB	CP	FP
TARI	15%	40%	20%	40%	3	3	6	6
TAS	10%	35%	10%	35%	6	6	6	6
LARI	15%	50%	15%	45%	4	4	6	6
LAS	10%	45%	10%	45%	12	12	24	24
ZARI	20%	50%	20%	50%	6	6	12	12
JHARI	15%	45%	15%	45%	6	6	6	6
JHAS	10%	40%	20%	45%	8	8	8	8
SARI	15%	45%	15%	45%	3	3	6	6
SAS	20%	35%	15%	35%	12	12	12	12
JASO	15%	35%	15%	30%	6	6	6	6
ZTCRI	10%	40%	10%	30%	4	4	8	8
JCRI	10%	35%	15%	35%	8	8	12	12
Average	15%	40%	15%	39%	8	8	14	14

MATERIAL ACCESSIBILITY

PARAMETERS TO BE ESTIMATED	RAW DATA TO BE COLLECTED
<p>VARIABLES</p>	
<p>GOALS OR CONSTRAINTS</p>	<p><math>\sum_{j=1}^J C \times \bar{O}_j</math> NO. OF UNIQUE TITLES AVAILABLE IN THE NETWORK OPTIMAL CRITERIA <math>M_a^k</math>.</p>
<p><math>u_j(\lambda_j)</math> &amp; <math>\bar{u}_a^k</math> AVERAGE NO. REQUEST FOR A TITLE IN CLASS K.</p>	<p>REQUEST FOR DIFFERENT CLASS WITHIN A PERIOD OF TIME (DATA FROM DATE DUE LABEL)</p>
<p>I + I'</p>	<p>DATA FROM PUBLISHER DATA &amp; BIBLIOGRAPHIC DATA (NO. OF PUBLISHER HOUSE X AVERAGE OUTPUT ON AGRICULTURAL BOOKS PER YEAR) PERIODICALS (ABSTRACTS, BIBLIOGRAPHIES, BRADFORD LAW.)</p>

PROBABILITY OF UNSATISFACTION

PARAMETERS TO BE ESTIMATED	RAW DATA TO BE COLLECTED
<p>VARIABLES</p>	
<p>AVERAGE ARRIVAL RATE <math>\lambda_{ij}</math></p> <p>RETURN RATE <math>\mu_{ij}</math></p>	<p>REQUESTS FOR DIFFERENT CLASSES WITHIN A PERIOD OF TIME (THREE MONTHS OR SO)</p> <p>SAMPLING FROM SEVERAL NODES; DIFFERENT LEVELS OF NODES</p>
<p><math>\bar{P}</math> PROBABILITY OF UNSATISFACTION</p>	<p>SAMPLES: TO CHECK THE AVAILABILITY OF DIFFERENT CLASSES <math>\Rightarrow</math> AVERAGE NO. OF COPIES.</p>

ILL PROCESSING TIME AND COST

PARAMETERS TO BE ESTIMATED	RAW DATA TO BE COLLECTED
<p>VARIABLES</p>	
<p><i>t</i> AVERAGE UNIT TIME PER REQUEST AT EACH NODE</p>	<p>MAN-HOURS (FOR ONE BATCH) <i>PER YEAR</i> * SELF-OBSERVATION? TIME SAMPLING NO. OF BATCH X NO. OF REQUESTS FILL IN TIME SHEET FOR A PERIOD OF TIME</p>
<p>UNIT COST PER REQUEST SATISFIED (LABOUR COST)</p>	<p>CONVERT STAFF TIME INTO LABOUR COST BY DIVIDING SALARY RATE (AVERAGE STAFF SALARY AT EACH NODE)</p>
<p>STAFF CONSTRAINTS FOR ILL PROCESSING</p>	<p>INTERVIEW THE DIRECTORS FOR INFORMATION ABOUT STAFF &amp; ARRANGEMENT</p>

UC AVAILABILITY

PARAMETERS TO BE ESTIMATED		RAW DATA TO BE COLLECTED
VARIABLES OR CO-EFFICIENCY	GOALS OR CONSTRAINTS	
SETTING-UP COST AT DIFFERENT NODES		MATERIAL & EQUIPMENT COST, PROCESSING COST *INTERVIEW & OBSERVATIONS
STAFF COST FOR UC CONSULTING AT DIFFERENT NODES		*TIME SAMPLING SELF-OBSERVATION (FILL IN TIME SHEETS FOR A PERIOD OF TIME)
UNIT COST FOR A REQUEST SATISFIED (LABOUR COST)		STAFF TIME SPENT DURING A PERIOD/NO. OF REQUEST HANDLED =STAFF TIME/PER REQUEST  UNIT COST = STAFF TIME/PER REQUEST X SALARY RATE/ PER STAFF HOUR
NO. OF UC CONSULTING REQUEST AT DIFFERENT NODES		*INTERVIEW & QUESTIONNAIRE
	STAFF & BUDGET LIMIT	INTER-VIEW LIBRARY DIRECTORS
	HANDLING EFFICIENCY	TIME SAMPLING SELF-OBSERVATION AVERAGE LEVEL & HIGH LEVEL (UPPER AND LOWER BOUNDS)

INFORMATION RETRIEVAL

PARAMETERS TO BE ESTIMATED		RAW DATA TO BE COLLECTED
VARIABLES (CO-EFFICIENCY)	GOALS AND CONSTRAINTS	
$C_1$ AVERAGE UNIT STAFF TIME PER SEARCH		TIME SPENT ON SEARCHING DURING A PERIOD OF TIME  NO. OF SEARCHES HANDLED  *SELF-OBSERVATION TIME SAMPLING FILL IN TIME SHEETS FOR A PERIOD OF TIME
UNIT LABOUR COST PER SEARCH		CONVERT STAFF TIME INTO COST BY DIVIDING HIS ANNUAL SALARY
$C_2$ SETTING-UP COST FOR DIFFERENT MODE		INTERVIEW LIBRARY DIRECTORS
	TOTAL BUDGETS FOR SETTING UP OF IR CENTERS  STAFF LIMIT FOR IR	INTERVIEW LIBRARY DIRECTORS





## ----- FREQUENCY DISTRIBUTIONS -----

HEADER DATA FOR: C:ROBFmt LABEL: rc  
 NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

VARIABLE: 1. s

p

====CLASS LIMITS====	FREQUENCY	PERCENT	....CUMULATIVE...	FREQUENCY	PERCENT
.00 < .20	0	.00	0	.00	
.20 < .40	2	7.14	2	7.14	
.40 < .60	13	46.43	15	53.57	
.60 < .80	1	3.57	16	57.14	
.80 < 1.00	9	32.14	25	89.29	
1.00 < 1.20	2	7.14	27	96.43	
1.20 < 1.40	1	3.57	28	100.00	
TOTAL	28	100.00			

====CLASS LIMITS====	FREQUENCY	.....
.00 < .20	0	
.20 < .40	2	====
.40 < .60	13	=====
.60 < .80	1	==
.80 < 1.00	9	=====
1.00 < 1.20	2	====
1.20 < 1.40	1	==

AGREGATIVE FREQUENCY DISTRIBUTION

VALUE	CHINESE BOOKS		FOREIGN BOOKS		TOTAL	
	FREQUENCY	PROBABILITY	FREQUENCY	PROBABILITY	FREQUENCY	PROBABILITY
.00 < .20	25	8.4%	25	8.0%	50	8.2%
.20 < .40	9	3.0%	21	6.7%	30	4.9%
.40 < .60	19	6.4%	40	12.8%	59	9.6%
.60 < .80	45	15.1%	43	13.7%	88	14.4%
.80 < 1.00	59	19.7%	80	25.6%	139	22.7%
1.00 < 1.20	34	11.4%	53	16.9%	87	14.2%
1.20 < 1.40	48	16.1%	23	7.3%	71	11.6%
1.40 < 1.60	34	11.4%	27	8.6%	61	10.0%
1.60 < 1.80	4	1.3%			4	0.7%
1.80 < 2.00	11	3.7%			11	1.8%
2.00 < 2.20	9	3.0%	1	0.3%	10	1.6%
2.20 < 2.40	0					
2.40 < 2.60	2	0.7%			2	0.3%
<b>TOTAL</b>	<b>299</b>	<b>100.0%</b>	<b>313</b>	<b>100.0%</b>	<b>612</b>	<b>100.0%</b>

11.21

----- ANALYSIS OF VARIANCE -----

HEADER DATA FOR: C:RCBM LABEL: rb  
NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

RANDOMIZED BLOCKS ANOVA

rcbmn

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
TREATMENT	27.133	10	2.713	17.665	.000E+00
BLOCK	4.275	27	.158	1.031	.4267
ERROR	41.472	270	.154		
TOTAL	72.880	307			

----- ANALYSIS OF VARIANCE -----

HEADER DATA FOR: C:RCBM LABEL: rb  
NUMBER OF CASES: 28 NUMBER OF VARIABLES: 11

TWO-WAY ANOVA

rcbmn

SOURCE	SUM OF SQUARES	D.F.	MEAN SQUARE	F RATIO	PROB.
COLS	22.747	10	2.275	14.676	.000E+00
ROWS	1.742	10	.174	1.124	.3502
INTERACTION	15.073	100	.151	.972	.5556
ERROR	18.755	121	.155		
TOTAL	58.316	241			

## SUMMARY OF THE RESULTS BY ANALYSIS OF VARIANCE

	REQUEST ON CHINESE BOOK	REQUEST ON FOREIGN BOOK
ONE-WAY ANOVA		
$U_1$	10	10
$U_2$	297	297
$F_{RATIO}$	17.615	17.538
$F_{0.05}$	1.83	1.83
RANDOMISED BLOCK ANOVA		
TREATMENT		
$U_1$	10	10
$U_2$	270	270
$F_{RATIO}$	17.665	19.845
$F_{0.05}$	1.83	1.83
BLOCK		
$U_1$	27	27
$U_2$	270	270
$F_{RATIO}$	1.031	2.447
$F_{0.05}$	1.52	1.52

## POISSON DISTRIBUTION

MEAN RATE OF OCCURRENCE = 1.04

X	P(X)	CUMULATIVE PROBABILITY
0	.35345	.35345
1	.36759	.72105
2	.19115	.91220
3	.06626	.97846
4	.01723	.99569
5	.00358	.99927
6	.00062	.99989
7	.00009	.99999
8	.00001	1.00000
9	.00000	1.00000

$E(X) = 1.04000$   
 STD. DEV. = 1.01980  
 VARIANCE = 1.04000

## POISSON DISTRIBUTION

MEAN RATE OF OCCURRENCE = .75

X	P(X)	CUMULATIVE PROBABILITY
0	.47237	.47237
1	.35427	.82664
2	.13285	.95949
3	.03321	.99271
4	.00623	.99894
5	.00093	.99987
6	.00012	.99999
7	.00001	1.00000
8	.00000	1.00000

$E(X) = .75000$   
 STD. DEV. = .86603  
 VARIANCE = .75000

## POISSON DISTRIBUTION

MEAN RATE OF OCCURRENCE = .35

X	P(X)	CUMULATIVE PROBABILITY
0	.70469	.70469
1	.24664	.95133
2	.04316	.99449
3	.00504	.99953
4	.00044	.99997
5	.00003	1.00000
6	.00000	1.00000

$E(X) = .35000$   
 STD. DEV. = .59161  
 VARIANCE = .35000

## ----- CROSSTAB / CHI-SQUARE TESTS -----

## GOODNESS OF FIT TEST

printer

CLASS	FREQUENCIES		PROPORTIONS	
	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	57.00	48.00	.5229	.4404
2	22.00	39.37	.2018	.3612
3	25.00	16.14	.2294	.1481
4	3.00	4.41	.0275	.0405
5	2.00	.90	.0183	.0083
6	.00	.15	.0000	.0014
TOTALS	109.00	108.99	1.0000	.9999

CHI-SQUARE= 16.142, D.F.= 3, PROB.= 1.060E-03

KOLMOGOROV-SMIRNOV GOODNESS OF FIT TEST

CLASS CORRESPONDING TO LARGEST DIFFERENCE: 1

D MAX = .0825

## ----- CROSSTAB / CHI-SQUARE TESTS -----

## GOODNESS OF FIT TEST

printer

CLASS	FREQUENCIES		PROPORTIONS	
	OBSERVED	EXPECTED	OBSERVED	EXPECTED
1	62.00	50.40	.4526	.3679
2	30.00	50.40	.2190	.3679
3	32.00	25.19	.2336	.1839
4	5.00	8.40	.0365	.0613
5	8.00	2.10	.0584	.0153
6	.00	.42	.0000	.0031
7	.00	.07	.0000	.0005
TOTALS	137.00	136.99	1.0000	.9999

CHI-SQUARE= 31.263, D.F.= 4, PROB.= 2.706E-06

## 11.2(b) CHI-SQUARE TESTS FOR THE REQUEST DATA

(INCLUDING ZERO GROUP ESTIMATION)

Tests Data Set	Chinese Book			Foreign Book		
	Chi-Square	D.F.	Prob.	Chi-Square	D.F.	Prob.
CNRRI	1.326	6	.9322	4.432	6	.6184
HAHS	7.545	6	.2734	2.566	6	.6329
HARI	1.441*	5	.8370	10.093	6	.1230
HAS	8.267	6	.0823	8.305*	5	.0810
JARI	3.178	6	.5286	9.364	6	.0526
JAS	5.409	6	.3680	9.218	6	.0559
JCRI	3.066*	5	.8005	3.423	6	.4897
JHARI	2.949*	5	.7078	10.261*	5	.0362
JHAS	3.811	6	.4323	3.685*	5	.4503
LARI	3.174*	5	.6732	6.650*	5	.2480
LAS	6.654*	5	.2477	6.354*	5	.1742
HARI	10.174*	5	.0704	2.853*	5	.7226
NAS	4.610	6	.3297	13.014*	5	.0232
SARI	12.643*	5	.0132	3.385*	5	.6408
SAS	8.295*	5	.01300	6.979*	6	.1370

\* THE ASTERISK MEANS THE ZERO-TRUNCATED POISSON DISTRIBUTION

CHI-SQUARE TESTS FOR THE REQUEST DATA

(2)

(INCLUDING ZERO-ESTIMATION GROUPS)

Tests  Data Set	Chinese Book			Foreign Book		
	Chi-Square	D.F.	Prob.	Chi-Square	D.F.	Prob.
TARI	8.285*	5	.0817	3.312*	5	.5070
TAS	11.100*	5	.0494	5.322*	5	.3778
TRI	3.629	6	.4586	2.575*	5	.6313
WARI	10.543*	5	.0612	6.077*	5	.1935
WAS	4.916*	5	.4262	6.082	6	.1931
ZAAS	6.043*	5	.1960	5.379*	5	.2506
ZAB	3.840	6	.4281	3.750	6	.4410
ZARI	6.656*	5	.1552	5.657*	5	.2263
ZASO	3.694*	5	.5942	8.703*	5	.1215
ZAU	8.365*	5	.1372	6.990	6	.1364
ZICRI	3.854	6	.5706	2.373*	5	.7955

\* THE ASTERISK MEANS THE ZERO-TRUNCATED POISSON DISTRIBUTION

11-25

NONPARAMETRIC TESTS

KOLMOGOROV-SMIRNOV TWO GROUP TEST

ZAU CHINESE (EXAMPLE OF KOLMOGOROV-SMIRNOV TEST)

CLASS	OBSERVED FREQUENCIES		CUMULATIVE RELATIVE FREQUENCIES	
	GROUP 1	GROUP 2	GROUP 1	GROUP 2
1	477	437	.2627	.2395 *
2	601	625	.5936	.5819
3	394	447	.8106	.8268
4	239	213	.9422	.9436
5	85	76	.9890	.9852
6	20	22	1.0000	.9973
7	0	5	1.0000	1.0000
TOTALS	1816	1825		

\* D MAX = .0232

CRITICAL VALUE AT .05 LEVEL = .0451

CRITICAL VALUE AT .01 LEVEL = .0557

CHI-SQUARE = 1.962, D.F. = 2, PROB. = .3749

11.25(b) KOLMOGROV-SMIRNOV TEST FOR THE REQUEST DATA

Tests  Data Set	Chinese Book			Foreign Book		
	D <sub>Max</sub>	Critical Value at 0.05 Level	Critical Value at 0.01 Level	D <sub>Max</sub>	Critical Value at 0.05 Level	Critical Value at 0.01 Level
CHRR1	.0101	.1109	.1369	.0312	.1451	.1793
HAHS	.0255	.1074	.1327	.0429	.2030	.2570
HARI	.0649	.0656	.0810	.0552	.1860	.2298
HAS	.0208	.0590	.0728	.0288	.1555	.1920
JARI	.0166	.1288	.1592	.1211	.2484	.3069
JAS	.0065	.0573	.0708	.0494	.1434	.1771
JCRI	.0314	.0882	.1089	.0495	.2225	.2749
JHARI	.0785	.0724	.0895	.0766	.1521	.1879
JHAS	.0255	.0587	.0725	.0412	.1404	.1734
LARI	.0210	.1150	.1420	.0462	.2193	.2709
LAS	.0416	.1423	.1758	.0294	.0901	.1113
NARI	.0256	.0709	.0876	.1141	.1690	.2088
NAS	.0140	.0553	.0683	.0277	.1033	.1276
SARI	.0332	.0943	.1165	.0309	.0922	.1139
SAS	.0204	.0621	.0767	.0407	.1184	.1463

KOLMOGOROV-SMIRNOV TEST FOR REQUEST DATA

(2)

Tests	Chinese Book			Foreign Book		
	D <sub>Max</sub>	Critical Value at 0.05 Level	Critical Value at 0.01 Level	D <sub>Max</sub>	Critical Value at 0.05 Level	Critical Value at 0.01 Level
TARI	.0358	.0731	.0903	.0222	.1541	.1903
TAS	.0156	.0608	.0751	.0821	.1282	.1584
TRI	.0183	.0714	.0882	.0146	.1012	.1251
WARI	.0362	.0831	.1026	.0367	.1924	.2377
WAS	.0155	.0839	.1036	.0913	.1503	.1856
ZAAS	.0316	.0556	.0687	.0886	.0565	.0698
ZAB	.0123	.0636	.0785	.0136	.1081	.1335
ZARI	.0381	.1031	.1274	.0607	.1944	.2401
ZASO	.0203	.0976	.1206	.0336	.0797	.0984
ZAU	.0372	.0450	.0556	.0065	.0573	.0708
ZTCRI	.0585	.0811	.1001	.0746	.1716	.2120

11.2 (a) Observed Working Time(ZAAS)

(Two Weeks, 90 Observations)

Activity Description	Time Duration Observed (Min)
Selection	2.04 + 4.8%
Ordering Routine	6.33 + 2.5%
Checking Arrivals	6.91 + 5.9%
Fund Accounting	4.98 + 3.5%
Book Accessioning	
Book Distribution Routine	1.50 + 4.2%

11.2 (a) Observed Working Time of ILL (Borrow-in, Mail)  
(Two Weeks, 50 Observations)

Activity	Percentage of Time Observed
Processing Cost	
Verifying & Consulting UC	20.0% + 3.9%
Transmitting the Request	15.0% + 1.0%
Unpacking the Loan	10.0% + 1.5%
Notifying Users	12.0% + 2.0%
Returning the Loan	15.0% + 3.0%
Other Processing	
Referral Routing	8.0% + 2.5%
Personal Time	10.0%
Others	10.0% + 3.0%

11.2 (b) Observed Working Time of ILL (ZAAS)  
(Loan-out, by Mail)

(Two Weeks, 50 observations)

Activity	Percentage of Time Observed
Processing Cost	
Verifying	10.0% + 4.2%
Checking shelves	10.0% + 5.2%
Paging	15.0% + 3.2%
Copying	25.0% + 5.9%
Mailing the Loan	5.0% + 0.9%
Recording	5.0% + 3.8%
Unpacking the Return	5.0% + 1.2%
Reshelving	5.0% + 3.2%
Other Processing	
Referral Routing	5.0% + 2.7%
Personal Time	
Others	7.0% + 3.2%