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Electronic networks and Information services in South Korean universities

by

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A Doctoral Thesis
Submitted in partial fulfilment of the requirements
for the award of
Doctor of Philosophy
of the
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Dedication

To the loving memory of my father, who encouraged me to finish this
Abstract

Electronic networking is becoming a familiar tool in higher education and research. Because the cost of telecommunications is decreasing, while the power of electronic networks and related computing resources is increasing, the resources and systems of electronic networks can now be used more easily. Access to the new global system of electronic networking has a great potential for the development of information services in South Korea. The principal aim of the research presented here is to determine what campus-wide and nation-wide information system will enable academic and research institutions in South Korea to share their information resources in an effective and efficient way via high-speed networks.

The situation in South Korea has been modelled using Checkland’s soft systems methodology. Data have been collected via both questionnaires and interviews, using a stratified sample of six South Korean universities as the main source. The factors at work have been examined, and the implications for the university system and for electronic networking in South Korea are considered.

Keywords: electronic networks, information services, information management, information system, systems approach, soft systems methodology, higher education, universities
ACKNOWLEDGEMENTS

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I wish to thank Dr. A Booth, who has provided me with valuable comments for developing the idea of soft systems methodology.

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I am also grateful to the staff in the Department of Library and Information Science and the Central Library at Yonsei University, who gave me moral support and encouragement to study in the UK.

Last, but not least, very special gratitude must be expressed to my mother, my wife (Young), and my children (Chisung and Yonsu) for their patience while I was away from them.
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Chapter 1

Introduction and background

1.1 INTRODUCTION

Electronic networking is gradually becoming a familiar tool in the education and research areas. This is because the cost of telecommunication is decreasing and the power of electronic networks and related computing resources is increasing, while the resources and systems of electronic networks are easier to use than previously. So information technology has been widely discussed as having the potential to radically change higher education. Use of mainframe computer systems, microcomputers, Local Area Networks, Wide Area Networks, and personal workstations means that information policies and plans have been discussed increasingly in higher education circles of advanced countries such as the US and the UK. Networking strategy for advanced information technology is perhaps the most recent activity being discussed to integrate higher education aspects of computing with high-speed network performance.

Computers and networks have great potential for initiating revolutionary changes in the working procedures in information services in South Korea. The principal aim of the present research is to investigate what sort of high-speed information network system will enable all academics (mainly in universities) in South Korea to utilize the information resources they have and
need in an effective and efficient way. Electronic network resources and services facilitate both traditional and innovative research and other education activities. Consequently, academic staff are starting to use a variety of local and remote information resources and related research and education tools, such as:

- **Primary information**
  - Resources of academic and R & D organisations: published items from all records of human intellectual activities, i.e., books, journals, reports, audio-visual materials, computer-based electronic data, etc.
  - Software archives: public domain software and shareware.
  - Multimedia applications for teaching and learning

- **Secondary information**
  - Library catalogues and other bibliographic databases

- **Interactive communications**
  - Information and communication facilities: electronic mail and bulletin boards for academics
  - Campus Wide Information Systems

In order to achieve the aim mentioned above, the following objectives were established for the study:

1. To identify whether there are benefits that arise from the current networking mechanisms in the academic environment in South Korea.

2. To analyse current trends and issues in electronic networking as they relate to the research process and academic communication in South Korea.
3. To identify the problems that may be encountered before high-speed network systems can be established among South Korean universities.

4. To identify the co-operation and co-ordination mechanisms needed by Korean universities for sharing information resources in an effective and efficient way through electronic networks.

5. To construct an optimal information high-speed network model for providing easy access to information resources and an easy way of sharing resources among South Korean universities.

6. To explore possible roles for the major information units (university libraries and computing centres) in the development of creative and innovative information services over the evolving high-speed networks in South Korea.

The central topic of this study is the electronic network information services in South Korean universities, which are growing and changing rapidly in their technologies and application. This makes it difficult to define what the problem is, since the situation changes during the course of any research. This is especially true in South Korea, which has been undergoing rapid structural transformations in all its organisations, including universities, since the early 1990s. The approach outlined below has been designed to minimise these problems, so far as possible.
Figure 1.1 Map of the Korean peninsula
1.2 BACKGROUND: INTRODUCTION TO SOUTH KOREA

1.2.1 Geographical environment

Korea is one of the oldest nations in the world. According to the written record of Korea, the earliest state was founded by Tangun in 2333 BC (1). The name, Korea, is derived from the Koryo Dynasty, which ruled the land from 936 AD to 1392 AD as an united kingdom. The Korean peninsula is attached to the north-eastern part of the Asian Continental Mass. The peninsula and all of its associated islands lie between 124°E and 132°E and between 33°N and 43°N. To the north the Yalu River and the Tumen River form the boundary with China and the Soviet Union. To the west, Korea faces China across the Yellow Sea. To the east, Korea faces Japan across the East Sea (Japan Sea), whilst the South Sea, encircling its southern coast, is open to the Pacific Ocean. Such a geographical location has had profound cultural and political implications throughout the ages, with Korea acting as a bridge for cultural transmission from Asia to Japan.

The land area of the Korean Peninsula is 220,000 square kilometres (it is a little smaller than Great Britain), and is divided politically between the People's Democratic Republic of Korea (PDRK) in the north (North Korea) and the Republic of Korea in the south (South Korea). The total land area of South Korea is approximately 99,237 square kilometres, making it slightly larger than Hungary or Portugal. As of 1995, the population in South Korea is about 44,000,000.

1.2.2 History and culture

The Koreans belong to the Northeast Asian branch of the mongoloid race, and their language, Korean, is a member of the Ural-Altaic family of languages. The Koreans are a homogeneous ethnic group speaking one language, whose dialects are mutually intelligible. From the first state, the ancient Tangun Choson in 2333 BC, there were several kingdoms until the Choson Dynasty
began in 1392. During the five hundred odd years until Korea was invaded by Japan in 1910, the Choson Dynasty reigned and the society was rather self-contained and isolated from the outside world. Chinese was the main written language in use at that time. During the Koryo Dynasty and Choson Dynasty period a number of unusual cultural and scientific developments occurred. Two of these are worth noting:

- Firstly, in the 15th century, an alphabet for the Korean language was developed. This was Hangul (Korean alphabet), a 24-character phonetic system and one of the most efficient and scientifically-based alphabets in the world today.

- Secondly, in the 13th century, the art of movable metal type printing was invented. This preceded Gutenberg's invention by 200 years (2).

Between 1910 and the end of World War II in 1945, the Japanese controlled and dominated Korea and attempted, unsuccessfully, to obliterate the Korean culture, language and spirit of independence. Following the victory of the World War II Allies, Korea came under US military governance south of the 38° parallel and under Russian governance north of that line. The U.N.'s call for a free election was ignored by the Russians, so in 1948, when the southern half of the country held elections, the Republic of Korea was born (3). As history notes a bitter war ensued (Korean War: 1950-1953), and even today, following the cease-fire and truce, political and military tension exists between the communist-controlled North and the South.

After the Korean War, Korea's national economy was in a critical condition. But since the 1960s South Korea has shown remarkable economic growth, achieving $10,000 in per capita GNP in 1995 (4). The Korean economy is approaching the threshold of the economic level of an advanced country, and in order to continue its development, Korea is switching her economic attention from labour-intensive industries to a high-technology centred industries.
1.2.3 Development of information technology (especially networks)

Current status and planning for a network infrastructure

During the 1980s, South Korea recognised the important role of telecommunications as a part of an information infrastructure and has made massive investment since. Owing to the growing support of the Korean government for the information industry, information has come to be regarded as an essential form of capital. The government understands that capital-intensive and technology-intensive industries with high added value are particular suited to a country like South Korea with an educated workforce, high population density and scanty natural resources. As a result, noticeable improvements have been made in this area. However, it is often suggested that the current status is not still very competitive as compared with the situation in advanced countries (5).

In 1987, the Korean government launched the first National Backbone Information System (NBIS) project plan (1987 - 1991) for the construction of an information network backbone and associated services. Subsequently, a second project plan (1992 - 1996) for network and service stabilisation was established and is now on going. Five major backbone networks are envisaged, as follows:

- Government administrative network
- Bank and financial network
- National defence network
- National security network
- Academic and research network

In the meantime, the government set up a new three-phase plan in 1995 to construct a national fibre-optical information infrastructure by 2015. Now, for the first phase (1995 - 97), it is laying the foundation for such an information infrastructure by starting with government buildings and research complexes in
the five major cities. In the second phase (1998 - 2002), the government will focus on providing test-services for industries, including small and medium-sized companies, and for populated areas (such as apartment complexes). Finally, from 2003 to 2015, it intends to provide a nation-wide universal service reaching every household. But they plan to implement this phase by 2010 (five years earlier) for public organisations, including universities and research institutions. Academic and research networks will serve as the test beds for application services during each time period.

Table 1.1  Three-step plan for information infrastructure

<table>
<thead>
<tr>
<th>Phases</th>
<th>objectives</th>
<th>speed</th>
<th>services</th>
<th>area coverage</th>
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<td></td>
<td></td>
<td>-user's site: 45 Mbps</td>
<td>-remote education</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>-remote medical diagnosis</td>
<td></td>
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<tr>
<td>2nd: 1998-2002</td>
<td>expand network infrastructure</td>
<td>-backbone: 2.5 Gbps - 10 Gbps</td>
<td>-network stability</td>
<td>networking to houses in the major five cities and adjacent cities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-user's site: 45 - 155 Mbps</td>
<td>-integrated multimedia services</td>
<td></td>
</tr>
<tr>
<td>(test bed: 2003-2010)</td>
<td></td>
<td>-user's site: 155 Mbps</td>
<td></td>
<td>-supply optical fibre cable for every household (public organization by 2010)</td>
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Government intervention at the initial phase is necessary because it is a very large-scale, risky project whose demands and needs are highly unpredictable. The Korean government therefore intends to stimulate private demand by starting to build up a backbone information infrastructure. Also, it plans to activate application services and related technologies by providing test-beds for developing the information infrastructure. As for the national telecommunications networks, the government plans to use funds from Korea Telecom, which is one of the state enterprises with its own budget.

Table 1.2 Funds and budget for the information infrastructure
(unit: one hundred million Won)

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<thead>
<tr>
<th>Contents</th>
<th>Amount (%)</th>
<th>Fund appropriated</th>
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<tr>
<td></td>
<td>Phase 1</td>
<td>Phase 2</td>
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<td>National information network</td>
<td>2,381</td>
<td>2,402</td>
</tr>
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<td></td>
<td>Government budget, stock fund sales by government</td>
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<td>Public Information network</td>
<td>5,677</td>
<td>37,989</td>
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<td></td>
<td>Telecommunications service providers</td>
<td></td>
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<td>Application service and core technology development</td>
<td>7,714</td>
<td>7,630</td>
</tr>
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<td></td>
<td>Stock fund sales by government and telecommunications service providers</td>
<td></td>
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<tr>
<td>Total</td>
<td>15,772</td>
<td>48,021</td>
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</tbody>
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[Note: Exchange rate of Korean Won for British Sterling is around 1200 : 1]
1.2.4 Information and telecommunications industry

Hardware industry

The electronics industry of Korea has been one of its strategic industries since the late 1970s. In 1992, in terms of value of total production, the Korean electronics industry ranked sixth in the world with its 26.3 billion US dollars largely due to components production (12.5 US billion dollars) and the consumer electronics sector (6.8 US billion dollars). However, in the field of information-related hardware, such as high performance computers and advanced telecommunications equipment, the level of technology is still relatively low compared to that of the developed countries. Samsung, Hyundai, Daewoo, Sambo and LG (Lucky-Goldstar) are the five main personal computer manufacturers, while Sun Micro Systems, HP, IBM, DEC and Silicon Graphics have mainly provided the domestic market of workstation computers in South Korea since the early 1990s.

Software industry

Many experts predict that software will have more importance than hardware in the near future. However, the current software industry in South Korea is in its infancy. Total sales of software in South Korea are only about $320 million and the figure is 1:140 compared to that of the U.S. As is indicated in the Table 1.3, the proportion of revenue from software comes to around 5%. The average of annual growth rate during 1987 - 1991 was about 30%, while network or non-network based information services showed an average annual growth of more than 100%.
Table 1.3 Revenues from the information technology industry in S Korea

(*unit: bill. US $)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>2.20</td>
<td>92.9</td>
<td>0.12</td>
<td>5.1</td>
<td>2.37</td>
</tr>
<tr>
<td>1988</td>
<td>3.44</td>
<td>91.6</td>
<td>0.23</td>
<td>6.1</td>
<td>3.76</td>
</tr>
<tr>
<td>1989</td>
<td>4.54</td>
<td>90.1</td>
<td>0.25</td>
<td>4.9</td>
<td>5.0</td>
</tr>
<tr>
<td>1990</td>
<td>4.67</td>
<td>85.2</td>
<td>0.27</td>
<td>4.8</td>
<td>5.48</td>
</tr>
<tr>
<td>1991</td>
<td>4.96</td>
<td>82.8</td>
<td>0.32</td>
<td>5.3</td>
<td>5.99</td>
</tr>
</tbody>
</table>

[Notes] *Unit: exchange rate has applied from the Yearbook of Common Carrier Telecommunications Statistics, 1994, ITU (International Telecommunications Union)

**Info Ser: Information services, such as databases, VANs, etc.

Moreover, if we look into the composition of the revenues from software sales, we find that the proportion accounted for by the sales of imported software increased from 12% in 1987 to 43% in 1991. One of the reasons seems to lie in the dependency of hardware vendors on imported operating systems, such as DOS (6).

Information Index

The gap between South Korea and other information-advanced nations becomes wider when we compare them in terms of an information index. This (7, 8) is a comprehensive index for informatization, and is calculated from an assemblage of relevant factors, including per capita domestic sales of terminals, per capita expenditures for using telecommunications services and per capita charges for providing information-processing services. In terms of this index, South Korea is as much as 4 ~ 7 times behind the advanced nations (Table 1.4).
Table 1.4  National Information Index (S. Korea = 100 in 1993)

In terms of basic telecommunications, telephone lines increased greatly in number during 1986 - 93. As a result, South Korea reached 37.8 lines per 100 persons in 1993 (from 18.4 lines per 100 persons in 1986), a similar rate (77%) to those of the advanced nations (see Table 1.5). The area where South Korea has particular problems is in the high-technology telecommunications, such as cordless and mobile telephones, fax and computers. According to Kim (9), in these areas, South Korea lags behind 2 ~ 5 times compared to the advanced nations. The most vulnerable area relates to computer-related information, such as databases and their applications. In terms of per capita sales for information-processing services, the index for South Korea lags 16 ~ 22 times behind those for the US, Japan and leading European countries (10).
*Table 1.5 Number of lines per 100 population by nation

<table>
<thead>
<tr>
<th>Year</th>
<th>S Korea</th>
<th>U.S.</th>
<th>U.K.</th>
<th>Germany</th>
<th>France</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>28.3</td>
<td>50.6</td>
<td>43.4</td>
<td>47.0</td>
<td>48.0</td>
<td>42.1</td>
</tr>
<tr>
<td>1990</td>
<td>31.5</td>
<td>50.8</td>
<td>44.4</td>
<td>47.5</td>
<td>49.7</td>
<td>43.8</td>
</tr>
<tr>
<td>1991</td>
<td>34.3</td>
<td>51.5</td>
<td>44.6</td>
<td>42.5</td>
<td>50.9</td>
<td>45.1</td>
</tr>
<tr>
<td>1992</td>
<td>36.3</td>
<td>52.3</td>
<td>45.9</td>
<td>43.9</td>
<td>52.1</td>
<td>46.4</td>
</tr>
<tr>
<td>1993</td>
<td>37.8</td>
<td>53.0</td>
<td>47.0</td>
<td>46.2</td>
<td>53.5</td>
<td>47.4</td>
</tr>
</tbody>
</table>

**Table 1.6 Domestic sales of IT equipment per capita by nation**

<table>
<thead>
<tr>
<th>Year</th>
<th>S Korea</th>
<th>U.S.</th>
<th>U.K.</th>
<th>Germany</th>
<th>France</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>241.6</td>
<td>653.8</td>
<td>417.6</td>
<td>343.5</td>
<td>414.6</td>
<td>804.3</td>
</tr>
<tr>
<td>1990</td>
<td>239.6</td>
<td>669.4</td>
<td>451.2</td>
<td>424.6</td>
<td>480.1</td>
<td>804.8</td>
</tr>
<tr>
<td>1991</td>
<td>264.6</td>
<td>634.5</td>
<td>414.0</td>
<td>480.8</td>
<td>451.9</td>
<td>907.5</td>
</tr>
<tr>
<td>1992</td>
<td>271.4</td>
<td>633.9</td>
<td>400.9</td>
<td>472.6</td>
<td>443.2</td>
<td>788.5</td>
</tr>
<tr>
<td>1993</td>
<td>271.5</td>
<td>656.2</td>
<td>411.4</td>
<td>467.5</td>
<td>432.7</td>
<td>720.2</td>
</tr>
</tbody>
</table>

[Note] 1. According to the Elsevier Yearbook of World Electronics Data, the "Information Equipment Index" consists of the number of lines per 100 population (*) and the domestic sales of IT equipment (**). This IT equipment includes computer, telecommunications equipment and their components. The index is regarded as a basic and important scale for comparing information capabilities between countries (11).

2. In Table 1.6, diminishing sales of IT equipment to advanced countries does not mean that the total number of sales of IT equipment is decreasing every year. This table shows the domestic sales of IT equipment for five advanced countries between 1989 and 1993. No officially accumulated data for these countries is available before 1985. Additionally it is not known whether reductions of equipment sales in some advanced countries over the 1989 - 93 period are due to recession or the falling prices of hardware and software in the domestic market.
1.2.5 General higher education system

Modern higher education in Korea started around the early 1900s. There were three basic streams: one introduced by Western missionaries, another initiated by Koreans inspired by nationalism, and the third sponsored by government authorities. At the time of Korean liberation in 1945, there were 19 institutions of higher education in the south. Under the United States military government (1945 - 1948), higher education was reorganised and expanded under the completely new political and socio-cultural conditions of the time. Colleges and universities were turned into four-year institutions. The semester plan for the academic year was introduced.

When the Republic of Korea (South Korea) established a government in 1948, there were four universities (Seoul National, Yonsei, Korea, Ewha), 23 independent colleges (three national, four public and 16 private), four junior colleges (all private) and 11 miscellaneous schools of collegiate standing, with 1,265 teaching members and student enrolment of 24,000.

Nowadays, higher education in South Korea consists of:

- colleges and universities, offering four-year undergraduate programmes, professional programmes, and graduate programmes
- teachers colleges and colleges of education
- two-year junior colleges, and the air and correspondence university (open university)
- others, such as theological colleges and seminaries

As shown in Table 1.7, since 1980 the number of higher education institutions has doubled, and the enrolment reached almost two million students in 1993, of which about 30 percent were female (12). During the past four decades, the Korean higher education system has experienced rapid growth in terms of number of institutions. Out of the 258 existing higher educational
institutions, 207 are private. Most institutions are co-educational, but some are exclusively for women.

Table 1.7 Number of higher education institutions, students and faculty

<table>
<thead>
<tr>
<th>Type</th>
<th>Institutions</th>
<th>Students</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3year Jr.</td>
<td>Public 16</td>
<td>26,959 (8.3)</td>
<td>819 (13.6)</td>
</tr>
<tr>
<td>Vocational College</td>
<td>Private 101</td>
<td>296,866 (91.7)</td>
<td>5,201 (86.4)</td>
</tr>
<tr>
<td></td>
<td>Subtotal 117</td>
<td>323,825 (100.0)</td>
<td>6,020 (100.0)</td>
</tr>
<tr>
<td>4 - year</td>
<td>Public 35</td>
<td>270,708 (25.1)</td>
<td>8,839 (33.7)</td>
</tr>
<tr>
<td>College &amp; University</td>
<td>Private 106</td>
<td>809,365 (74.9)</td>
<td>17,449 (66.3)</td>
</tr>
<tr>
<td></td>
<td>Subtotal 141</td>
<td>1,080,073 (100.0)</td>
<td>26,288 (100.0)</td>
</tr>
<tr>
<td>(Graduate School,</td>
<td>Public 64</td>
<td>25,426 (29.3)</td>
<td></td>
</tr>
<tr>
<td>(attached) Subtotal</td>
<td>234</td>
<td>61,485 (70.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subtotal 298</td>
<td>86,911 (100.0)</td>
<td></td>
</tr>
<tr>
<td>Total Public</td>
<td>51 (19.8)</td>
<td>322,093 (21.7)</td>
<td>9,658 (29.9)</td>
</tr>
<tr>
<td>Private 207</td>
<td>(80.2)</td>
<td>1,167,716 (78.3)</td>
<td>22,650 (70.1)</td>
</tr>
<tr>
<td>Total 258</td>
<td>(100.0)</td>
<td>1,490,809 (100.0)</td>
<td>32,308 (100.0)</td>
</tr>
</tbody>
</table>

[Note] 1) The number in parentheses denotes the percentage distributions between public and private.

2) The Air and Correspondence College and the six open colleges are excluded. In 1993, 148,650 students were enrolled in the Air and Correspondence College and 51,970 students were enrolled in the six open colleges.

3) The number of faculty members excludes assistants and part-time lecturers.

4) The number of graduate schools is not usually included in the total number of higher educational institutions because they are attached to the 4-year institutions.

All higher educational institutions, national, public and private, are subject to control and supervision by the Ministry of Education, although a considerable degree of autonomy is guaranteed. Control is exercised with regard to such matters as student quotas, standards of establishment in terms of personnel and facilities, qualifications of teaching staff, curriculum and degree requirements,
and so on. With regard to other matters, universities comply with decisions made by a consortium called the "Council for Higher Education". Deans and presidents of national and public universities are appointed by the President on the Minister of Education's recommendation. Presidents of private universities are elected by the board of trustees, subject to approval by the Minister of Education. An election system to allow university councils to select their own university presidents has been introduced since a civilian government came into power.

The academic year in South Korea starts on 1st March. Each academic year is divided into two semesters, with long summer and winter vacations. All higher educational institutions must be open for a minimum of 210 days. In a four-year degree-granting institution, 140 credit hours, requiring at least eight semesters' work, has to be earned for the BA. or B.Sc. degree. Generally, two additional years are required for the Master's degree and three to five years for the Doctorate degree.

The campuses are, with few exceptions, crowded with plenty of students, but there are comparatively, few teaching members : the government plans to reduce the present numbers of students per class, which stand at 39 at junior colleges and 27 at universities, to 25 and 20 respectively by the 2000. The number of Ph.D. holders among faculty increased from only 10 percent in 1967 to 40 percent in 1983; by 1995 a Ph.D. had generally become the minimum prerequisite for teaching in all 4-year institutions of higher education. The quality of education tends to become poorer each year due mainly to unsatisfactory financial support. The most important current issue for South Korean universities is to improve the quality of instruction, personnel and facilities, etc. In order to solve this problem, at least two conditions are necessary: the first is to secure more financial resources for improvements and the second is to provide more autonomy for the university (13).
1.3 COMPUTER NETWORKS AND THEIR DEVELOPMENT

1.3.1 The nature of networks

Over the past 30 years there have been many technological developments which have affected academics' use of computers, or which will affect such use in the near future. One of the major developments has been the advent of cheap microcomputer systems. Another has been the increase in availability of computer-based telecommunications for the storage, dissemination and processing of information. The rapid developments in such telecommunications technology have been an essential component in the growth of the computer network system. Recent trends in the IT environment can be envisioned as follows (14).

Figure 1.2 Recent trends in the information technology environment

- **Value vs. Time**
- **Demand vs. Time**
- **Importance of information**
- **Demand for communication**
- **Cost vs. Time**
- **Cost of technology**
- **Cost**
- **Cost of storage**
Definition and basics of networks

A network can be defined as a group of components, individuals, or organisations that are interconnected to form a system which is intended to achieve some specified goal. Such a network must have a communications mechanism. Martin (15) says that the effective online network must have several characteristics:

- It requires a significant level of financial and organizational commitment from participants.
- It is based on an agreement between the participants that specific tasks should be performed and specific guidelines adhered to.
- It provides an immediate facility for access through computer and communications technologies to other information components, which may originate in either the public or the private sector of the information community.

1.3.2 Computer network technology

There has been a blurring of the boundary between LAN, MAN and WAN technologies since 1990 because the standards which are being developed for MANs and WANs are certainly exploitable in the local area and may be applied there first. However, computer networks are still divided into three by geographical boundaries (LAN, MAN and WAN), following the standards organisations' classification based on the inter-connecting technologies originally (16).

The interconnected computers may be of the same type, or of different types, including microcomputers, workstations and mainframes in the same system. Networks also differ in the type of protocols used, and in their topologies. In order to allow computers to communicate successfully with each other, a standard framework of routine and rules (i.e., a set of protocols) is required. Some common protocols are X.25 protocols on the original JANET services,
TCP/IP (transmission control Protocol/Internet Protocol) protocols for the Internet and IBM's System Network Architecture (SNA). The OSI (Open Systems Interconnection) reference model, first proposed by the CCITT (the Consultative Committee on International Telephone and Telegraphy) was an attempt to impose international standardisation, but has not achieved universal acceptance as yet. Various protocols continue to proliferate, although more and more users are moving to TCP/IP (17).

Local Area Network

A Local Area Network is a system connecting computers in a small geographical area, with less than 10 kilometres between the points (18). LANs contain the connected machines, the software and cabling to support the transportation of data over the network and a Network Operating System (NOS) to manage the overall system and facilitate its extension and further interconnection. A LAN can be distributed or centralized. It is often served by a central machine - usually a faster machine than the others - which is referred to as the network server.

In connecting devices together to form a network, the cable layout (topology) is important. Its logic is a key element in supporting the different LAN approaches, such as the Ethernet and the token ring. There are three normal types of LAN topology: bus network topology, ring network topology and star network topology.

- Bus topology
The bus topology is the most heavily used network topology. A bus is a single linear communications medium (e.g. coaxial cable, etc.) that can begin at any location and end node connected by cable taps or similar devices. Ease of installing a bus and adding nodes to, or removing nodes from, a bus are important points when a topology is chosen. Much of popularity of the bus topology is due to the existence of the Ethernet which can be used with a range of links - telephone line, coaxial cable and optical fibres. All stations are
attached through appropriate hardware, interfacing directly to a linear transmission medium or bus; there are no switches and no repeaters.

- **Ring topology**
  Marks and Neilsen (19) says that the ring topology is often considered to be nothing more than a bus that has the last node connecting back to the first node, so completing the ring configuration. In fact, there are other distinctions. The nodes in the ring are linked in a point-to-point fashion through which all transmissions on the network must pass until they reach their destination. Either separately, or as part of the PC or workstation, there must be repeaters to amplify the transmission on its journey around the ring. The data is transmitted in one direction only, clockwise or counter-clockwise, in packets.

- **Star topology**
  In this technique, all nodes are connected to the central switch system (a single hub or server) by a point-to-point link. Thus the station has to first send a request to the central switching system asking for a connection to some destination station. Therefore the central hub controls all routing of network traffic. The following diagrams show these three typical topologies (20).

![Figure 1.3: Typical Topologies](image)
CHAPTER 1
INTRODUCTION & BACKGROUND

Metropolitan Area Networks

A CCTA report (21) notes that the concept of metropolitan area networks (MANs) became established in the early 1980s as a means of interconnecting ‘islands’ of computers across entire towns or cities, typically spanning distances of up to 50 Km. New technologies were required to transport LAN-to-LAN and packet-based communications more effectively due to the inadequacy of the existing Public circuit-Switched Telecommunications Network (PSTN). X.25 was created to form the basis for dedicated packet switched networking; however, this is now suffering from bandwidth exhaustion, high cost and lack of flexibility.

LAN interconnection is now imposing significant demands on bandwidth, flexibility and cost, and several US Telecommunications Operators (TOs) are responding with a Switched Multimegabit Data Service (SMDS) which is often referred to as a fast packet service. The first public broadband service in UK was launched in 1994 by BT under the name of SMDS. SMDS is expected to be widely used by telephone companies as the basis for their data networks. It is a high-speed public data network service developed by Bellcore company. This provides a high-speed connectionless data service with access rates of from 2 Mbps to 34 Mbps, based on the use of ATM cell switching and metropolitan area network (MAN) technology (22). SMDS is being used by British universities as an operational network, to support new applications, typically multi-media. GMING MAN for the Greater Manchester Education Community, London MAN, MANs in Scotland and the South Wales MAN are recent developments in this network. Figure 1.4 shows the layout of one of the Scottish MAN sites recently developed (23).
Wide Area Networks

Wide Area Networks (WAN) cover a large area, such as a whole nation or even a worldwide area through the use of different approaches to interconnection. In the wide area setting, the communications process encompasses several stages. Therefore, management and control of the network is scattered, and not fixed in a single central unit.

Harries (24) says that there are three types of telecommunications network presently available for use for computer-based information networking. Each of these represents a phase of the developmental efforts to improve services, using quite different technology and approaches. These are the public switched telephone network (PSTN), packet switched data networks (PSDN) and the integrated services digital network (ISDN, B-ISDN). They can be differentiated as follows.

- **PSTN (Public Switched Telephone Networks)**
  Public switched telephone networks form an extensive network of cabling reaching into almost all inhabited areas of developed countries, and providing
international connections worldwide. This made it attractive as an immediately available option for computer networking in its early stages. The network is designed for voice communications, and therefore requires the use of an interfacing device, usually a modem. The network makes use of circuit switching technology, and is a rather noisy and unreliable channel, prone to errors and miss-connection. Since a switched phone line is charged on a time and distance basis, it is not ideal for inter-computer communication over long distances.

- **PDN (Public Data Networks)**
The Public Data Networks (PDN) have been established specifically for the transmission of computer information, but cannot be used for voice conversation. They provide fast and reliable data transfer, with more flexibility and international communications at a reasonable cost, since they are charged for by the amount of data transferred. The X.25 protocol set is the standard for this networks.

The public data network is essentially a store and forward network which operates at speeds fast enough to give the impression of a direct connection to the end user. The end systems can be connected as follows:

- directly to the network through an X.25 interface
- to a local PSE (packet switching exchange) via a device called a packet assembler/disassembler (PAD), which divides the data into X.25 packets for transmission; a PAD device can be installed in the end system premises
- through a local telephone network link to the nearest PAD device provided by the network operator

- **Integrated Services Digital Networks (ISDN)**
ISDN is a public network providing end-to-end digital connectivity which is capable of supporting a range of digital devices and services, both voice and non-voice, on the same basis. This allows users to send and receive data, text
and image from computer systems as well as offering an enhanced telephone service. This is achieved over a single ISDN connection, so that one network may be used for all applications, at the same time as providing higher transmission speeds.

- **Integrated Broadband Networks (B-ISDN)**

Harries (25) notes that narrowband ISDN circuits do not have a high degree of flexibility in adjusting to varying demands: for instance, a voice call does not use the full capacity of a 64 Kbps channel, but the spare capacity cannot be made available for use by others during a session. So Broadband ISDN (B-ISDN) has been introduced to overcome such problems by using a universal fast packet switching technique for all information streams, and allocating 'bandwidth on demand' rather than relying on fixed bandwidth channels. Two rates have been proposed for B-ISDN: a basic service with a digital access rate of 155 Mbps, and a primary rate service at 622 Mbps.

Asynchronous Transfer Mode (ATM) technology has been chosen by the CCITT as the basis for its broadband ISDN (26). This divides the data stream into cells, which are smaller than X.25 packets in size, and can travel through the network at a faster rate. Since the channel is more reliable, quality control is performed only at each end of the link and not by each intermediate network switch as well, therefore, ATM technology allows the fast delivery of high definition images, and then frees the channel for other uses. This technology permits the development of multimedia information services.

- **Radio microwave and satellite networks**

At present the two types of channels in use are local radio microwave (covers distances up to a few hundred kilometres) and satellite channels (span very large distances). Microwave transmission offers an alternative to a physical point-to-point link. Data is conveyed on radio waves through free space, and is normally used in conjunction with geostationary satellites. The data is transmitted from a ground station, called an uplink, to an orbiting satellite which is in direct line-of-sight, and the signal is bounced back to a receiving
station (the downlink) at some different geographical ground location (27). These re-transmissions can be broadcast over a wide area for receiving by many destinations simultaneously, or can be highly focused onto a single site. Satellite relay is commonly used to leap across long distances, such as in establishing connections between the UK and the Far East, or where the laying of a physical cable would be costly or impossible across difficult geographic terrain.

In the past 20 years, wireless communication has become increasingly important as cellular systems have been developed. A recent report (28) says that digital cellphones have been launched recently, making mobile communications fully compatible with computer data transmission. Currently data capacity is limited - analogue cellphones can provide around 2.4 Kbps, while digital mobilephone allow 9.6 Kbps and 64 kbps (potentially allowing up to 1 Mbps). The European Telecommunications Standards Institute is now discussing the HyperLAN standard, for wireless computer connections in an office environment (i.e. within a range of 50 m and up to 400 m in the near future). These will offer 10-25 Mbps capacity. In the future, the Third Generation Mobile System (TGMS), which is under discussion by various standard bodies, will provide up to 2 Mbps bandwidth on demand, from anywhere in the world, using a combination of telepoint, cellular and satellite technologies.

1.3.3 National academic network development in advanced countries

National academic network in the UK : JANET

The Joint Academic Network (JANET) in the UK was inaugurated in April 1984 by the Computer Board for Universities and Research Councils. At that time, a variety of networks served the scientific community. The Science and Engineering Research Council Network, SERCnet was the direct fore-runner of JANET. Now JANET is a wide area network serving the UK academic community as follows:
- All universities and some colleges of Further Education
- Research Council establishments and other national bodies such as the British Library, the National Library of Wales and Scotland and the Imperial Cancer Research Fund
- A few commercial organisations which collaborate with academic institutions such as Blackwells, Oxford University Press and OCLC

• **Structure of JANET**

JANET is a British national wide area network which serves to interconnect the local area networks at each connected site: it acts as a 'bearer' network between local area networks. Originally, JANET was a packet-switching network largely running over 2 Mbits/sec lines, uses eight separate switching centres in the country as the principal nodes. Each switching centre was connected to several other centres by 'trunk' connection, each site was connected to one of the switching centres by a 'link' connection (29). These Network Operation Centres were located at: Bath (Bath University Computer Centre), Belfast (Queen's University Belfast), Cambridge (University of Cambridge Computer Laboratory), Daresbury (Daresbury Laboratory), Edinburgh (Edinburgh University Computing Service), London (University of London Computing Services), Manchester (Manchester University Computing Centre) and Rutherford (Rutherford Appleton Laboratory).

The JANET bearer network used X.25 protocol to interconnect the campus networks at linked sites. This protocol was the dominant protocol in Europe, as it was recommended by international standards bodies, before the Internet Protocol (IP) became almost totally dominant. Due to the benefit from services on the worldwide Internet, JANET IP Service (JIPS) has been introduced since 1991 to universities. Now many universities provide a full TCP/IP service with JIPS traffic. The sites are connected using leased lines from British Telecom or Mercury (30).
• Management of the network

The Joint Network Team (JNT), based at the Rutherford Appleton Laboratory near Oxford, was the main management body for JANET. The JNT was in charge of campus network facilities in the universities and facilities on sites funded by the Computer Board (at that time independent of the UFC). In April 1991 the Computer Board became the Information Systems Committee of the Universities Funding Council. The development of policy and the general management of the networking programme is now the responsibility of the Joint Information Systems Committee (JISC) of the Higher Education Funding Councils and managed by the UK Education and Research Networking Association (UKERNA), which has taken over the responsibilities of JNT (31). The running costs of JANET are primarily covered by the main grant from the UK Higher Education Funding Councils. There is no direct charge to individuals. (32)

• SuperJANET

Just as the USA is upgrading its networks for high performance computing, so the UK is preparing SuperJANET, a high performance academic network. However, there are no plans to make SuperJANET a commercial venture like the US at the moment. Harries (33) mentions that parts of the JANET network are to be upgraded to a substantially higher speed and capacity in the SuperJANET project. SuperJANET is a co-operative project with British Telecom, which is supplying resources to the new network.

The network, using optical fibres, will upgrade the bandwidth available to a maximum of 155 Mbps (up to 622 Mbps depending on the sites users) using ATM packet switching techniques. Working at a speed some 1000 times faster than the original JANET, this will enable the development of a range of applications and information services not previously feasible. Funding for SuperJANET was announced at the end of 1992 (5 million UK pounds per year
for four years), to upgrade from the maximum 2 Mbps on the JANET X.25 network to between 10/34 Mbps and 155 Mbps in subsequent stages (34).

- **Pilot phase**
  A six-site PDH (Plesiosynchronous Digital Hierarchy) backbone network was implemented in March 1993 and the sites connected at 140 Mbit/s. The six sites were Cambridge, Edinburgh and Manchester Universities, Imperial College, Rutherford Appleton Laboratory and University College London and they were selected partly because of their geographic spread, but also because of their existing networking expertise. In addition, Hammersmith Hospital and University of London Computer Centre have been connected to this pilot network by 34 Mbps leased lines.

- **Phase one**
  During this phase the six-site pilot network was expanded to serve an additional six sites (the universities of Birmingham, Cardiff, Glasgow, Leeds, Newcastle and Nottingham) connected at 140 Mbps. These twelve base network sites were also connected to the pilot SMDS (Switched Multimegabit Data Service) network by the end of August 1993. It was hoped that all old universities would be connected to the SMDS service by the end of 1995 at speeds of between 2 and 10/34 Mbps. It was at this stage that BT would offer a commercial SMDS service to its commercial customers.

- **Phase two**
  This phase covers the transition of the base network from PDH technology to SDH (Synchronous Digital Hierarchy) technology. A five-site SDH network was installed in 1994, with the full twelve site networks to be available by mid-1995. The aim is to establish SuperJANET as a network based on ATM (Asynchronous Transfer Mode) technology. The history of the original JANET network shows that in a few short years, the available facilities were being used for
applications never imagined in the early stages. It is expected that a similar turn of events will overtake these initial ideas for SuperJANET as well. The number of sites connected by links of various speeds are listed as follows.

**Table 1.8: Academic sites connected via JANET and SuperJANET**

<table>
<thead>
<tr>
<th>No. of insts.</th>
<th>Speed of Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>9.6 - 64Kbps (old JANET network)</td>
</tr>
<tr>
<td>81</td>
<td>between 9.6/64 Kbps and 2 Mbps (old JANET)</td>
</tr>
<tr>
<td>63</td>
<td>2 Mbps (upgraded JANET network)</td>
</tr>
<tr>
<td>38</td>
<td>10 Mbps (BT's SMDS: up to 25Mbps; BT's MAN up to 34Mbps)</td>
</tr>
<tr>
<td>9</td>
<td>140 Mbps (PDH links)</td>
</tr>
<tr>
<td>5</td>
<td>155 Mbps (SDH links)</td>
</tr>
</tbody>
</table>

[Note: Some sites have both JANET and SuperJANET connections. The total number of academic centres connected to either network is 203 (35, 36).]

**National academic network in the USA: Internet**

The Internet is a product of the American economic system, part planned and part unexpected (37). It has its roots deep in the military - industrial complex of the Cold War era. For 30 years, the principal users of the various networks that collectively form the Internet were scientists and engineers. This original user community gradually expanded into the broader academic community. Today the Internet has reached a global audience, something its designers never envisaged.

- **Background of the Internet**

Some important research concerning the advantages of packet switched networks led the ARPA (Advanced Research Projects Agency) of the
Department of Defence (later DARPA) to develop plans for a packet switched network in the late 1960s. This was called ARPANET. While the ARPANET was intended as a research project for packet switched networks, it spontaneously became a service utility to the telecommunication research area. Due to its strong economic basis, it was able to install one or two big computers nationally, and to share them over the network, rather than to purchase machines for each area. Thus the some advantage of the ARPANET was its capability for resource sharing.

Due to the scarcity of information resources on the early network, sharing of databases occurred very little throughout the 1970s. By the mid-1970s major changes had happened in the ARPANET: the TCP/IP network protocols had replaced the earlier Network Control Program (NCP) protocol, a host-based transport protocol that operated only across the communication sublet created by the Interface Message Processors (IMPs).

In 1986, NSFNet was established to connect supercomputer centres as network operation centres. With the huge growth of the Internet, the US Government decided to set up the NREN (National Research and Education Network) as an electronic superhighway system that would allow researchers, business people, educators, and students around the country to communicate with each other and to access a broad range of research tools and information resources (38). Network operation centres of NSFNet and NREN are as follows:

NSFNet network operation centres in US, 1989 (T1, 1.544Mbps)

Alabama, Alabama University  
Colorado, Colorado State University  
Illinois, University of Illinois  
Indiana, Purdue University  
Minnesota, Minnesota University  
New Jersey, John von Neumann Centre  
New York, Cornell University  
Ohio, Ohio State University  
Pennsylvania, Pittsburgh University  
San Diego, University of California
Texas, Texas University

NREN supercomputer network operation centres in US, 1994 (150 Mbps)

Alabama, Alabama University
Colorado, Colorado State University
Illinois, University of Illinois
Indiana, Purdue University
Minnesota, Minnesota University
New Jersey, John von Neumann Centre
New York, Cornell University
Ohio, Ohio State University
Pennsylvania, Pittsburgh University
San Diego, University of California
Texas, Texas University
Illinois, Argonne Centre
New York, Ithaca Centre
California, Palo Alto Centre
Massachusetts, Cambridge, MIT

Tillman and Ladner (39) state that 1991 was a momentous year for Internet development: on December 1991 President Bush signed the High-Performance Computer Act. This is officially known as PL 102-194 (NREN Bill). The Bill is already having a profound impact on schools of all types and it has opened the Internet to essential information resources. The plan to establish NREN postulated three phases as follows:

- Firstly, upgrading and interconnecting existing agency networks into a 1.5 Mbps national networking testbed.
- Secondly, integrating national networks into a 45 Mbps backbone by 1993.
- Finally, implementing a technological leap to a 2-3 Giga-bps speed from the mid-1990s.

In general, there are currently three different speeds of backbone connection in US higher education as follows (40, 41).
- Small sized teaching colleges and universities: 1.5 Mbps, T1 (or plans to upgrade upto T1)
- Teaching / Research universities: 45 Mbps, T3
- NREN operating universities: 150 Mbps

In its early stage, the Internet consisted of government-sponsored networks. However, over time, privately owned and operated networks have become an important part of the Internet architecture (42). In April 1995, the NSFNet backbone was decommissioned, entirely replacing the government-sponsored service with a fully commercial system of backbones. This happened one year after awarding contracts to commercial telecommunications companies to operate four new Network Access Points (Pacific Bell, Sprint, Ameritech and MFS ) on the high speed backbone.

BITNET (Because It's Time Network) is the other major academic network. It was established in 1981 under the auspices of EDUCOM, a higher education association concerned with the effective use of information technology. It provides interactive electronic mail and file transfer services, using a store-and-forward protocol, based on IBM Network Job entry protocols. This is an academically oriented, international computer network, which uses a different set of computer instructions to move data. It is becoming less important as more sites link with the Internet (43).
The history of the Internet in the USA is as follows (44).

Table 1.9 The history of the Internet in the USA

<table>
<thead>
<tr>
<th>Years</th>
<th>Contents : changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>ARPANET by DoD (56Kbps)</td>
</tr>
<tr>
<td>1979</td>
<td>USENET established</td>
</tr>
<tr>
<td>1980/81</td>
<td>CSNET (Computer Science Network) and BITNET established</td>
</tr>
<tr>
<td>1983</td>
<td>split of the original ARPANET into two parts: ARPANET (for R &amp; D) and MILNET (for military operation)</td>
</tr>
<tr>
<td>1986</td>
<td>NSFNet established to link six NSF funded supercomputer Centres (56Kbps), started to replacing ARPANET</td>
</tr>
<tr>
<td>1989</td>
<td>NSFNet backbone upgraded to 1.5 Mbps(T1)</td>
</tr>
<tr>
<td>1990</td>
<td>ARPANET finally devoted to research &amp; educational purposes</td>
</tr>
<tr>
<td>1991</td>
<td>NREN (high speed network) Bill : High Performance Computer Act, enacted</td>
</tr>
<tr>
<td>1992</td>
<td>NSFNet (NREN) backbone upgraded to 45 Mbps (T3). ANS, Advanced Network Services Inc. established</td>
</tr>
<tr>
<td>1994</td>
<td>Upgraded to 150 Mbps</td>
</tr>
<tr>
<td>1995</td>
<td>NSFNet (NREN) backbone transformed to commercial services (ANSnet)</td>
</tr>
<tr>
<td>1996-7</td>
<td>NREN backbone upgraded to 650 Mbps</td>
</tr>
<tr>
<td>late 1990s</td>
<td>NREN aims to develop a national 2-3 Giga bps network</td>
</tr>
</tbody>
</table>

- **Organisation and management**

The National Science Foundation Net (NSFNet), which was funded by the US government from 1985 to April 1995, provided the high speed links between the various regional and local networks. The regional networks then connected to the local sites - each site had its own network of hundreds or even thousands
of computers. The main backbone NSFNet is, currently, managed by more than 100 international commercial network providers, such as American ANS, SPRINT, European Eunet, South Korean Korea Telecom and Japanese KDD, since April 1995.

The future policy and governance of NREN is as yet unresolved. It does seem likely, however, that commercial influences will tend to predominate more and more, and that the academic influences which have fuelled the development of the Internet so far will tend to diminish (45). It is believed that the Internet will have an ever-increasing impact not only on the academic and business worlds but also on the life-style at home.

The main decision-making body for the Internet is the Internet Society, originally a voluntary organisation, which aims to promote Internet technology and developments. A sub-group of this, the Internet Architecture Board (IAB), is responsible for approving new and upgraded standards and for allocating resources such as IP addresses. The Internet Engineering Task Force (IETF) is another voluntary body, with open membership, which represents the user voice in Internet debates. The Internet depends to a large extent for its success on willing co-operation among its participants, and conformity to the spirit of the network culture and etiquette. The following figures show the organisational structure of the Internet and the administrative organisation of the co-ordinating committee of the Internet (46).
Figure 1.5 Administrative organization of Co-ordinating Committee

![Diagram of the administrative organization of the Co-ordinating Committee]

Figure 1.6 Administrative organisation of Coordinating Committee of the Internet

![Diagram of the administrative organisation of the Coordinating Committee of the Internet]
Academic networks in other countries: Germany and Sweden

- German research network

In order to organise and control the German Research Network (DFN: Deutsche Forschungsnetz) the DFN Association was founded in 1984 by universities and non-university institutions. As of mid-1994, there were about 330 members, among them more than 30 members from private enterprises. DFN aims at enabling all colleagues from research and teaching to participate in an open communication system which satisfies high demands. It is based on international standards, and is offered at reasonable prices (47).

At the same time, the association offers industry the chance to gain experience with new types of communication and thus to more effectively organise the transfer of knowledge through online communication. In order to perform its task, DFN closely co-operates with the committee of university rectors, the federal science ministries that are joined together in the committee of ministers of education and the arts, and with the relevant ministries, particularly with the ministry of research and technology, and the ministry of education and science. After ten years work by DFN, the academic community disposes of an infrastructure that provides all connected institutions with basic telecommunication services.

The association receives financial contributions from the Federal Ministry of Research and Technology (BMBF - Bundesministerium fur Bildung, Wissenschaft, Forschung und Technologie) for the establishment and development of the data communication system. DFN offers its members a special wide area network, the "Wissenschaftsnetz WiN" as well as gateways into foreign science networks for the transfer of digitized information among the participating organisations. According to their specific needs, they can choose between different transfer speeds up to 2 Mbps (as of 1994). A rapid move of the WiN to higher speed classes (up to 140 Mbps) started in 1995.
Based on the WiN, DFN provides for transmission of information between government authorities, universities, libraries, database operators, major research institutes, federal and regional institutes, Fraunhofer Institutes, Max-Planck Institutes, enterprises, European science networks and US science networks.

- **Swedish University Computer Network**

SUNET (The Swedish University Computer Network) links together Sweden's universities with similar institutions in other countries. The backbone has at present a capacity of 34 megabits a second. The backbone network connects the following places: Lulea; Umea; Uppsala; Stockholm; Linkoping; Gothenburg; Lund (48).

Small and medium-sized universities are also connected to SUNET via these places: the connections have a speed of 2 Mbps. SUNET is also a part of the Nordic computer network, NORDUnet. The connections to Norway, Denmark and Finland have a speed of 8 Mbps. The connection to Iceland has a speed of 1 Mbps. The NORDUnet connection to North-America has a speed of 34 Mbps.

SUNET is operated jointly by the country's universities. The SUNET board is appointed by the vice chancellors of the Swedish universities. A technical reference group is also linked to the board. The National Agency for Higher Education has administrative responsibility for SUNET. Umea University has responsibility for co-ordination and development, while the Royal Institute of Technology is responsible for operation. Up and down the country there are also universities that have a regional and operational responsibility for operation. SUNET is financed by the Ministry of Education and Science and Swedish universities. Researchers and teachers can exploit the potential of the computer network without personally having to pay. Tests with ATM are already in progress for transferring data at very high speeds (over 140 Mbps).
As the examples of Germany and Sweden reflect, the development of high-speed networking is regarded as essential in all developed countries. In all cases, this now involves academic institutions.
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Chapter 2

Information technology in higher education

2.1 INFORMATION TECHNOLOGY (ESPECIALLY NETWORKING) IN UNIVERSITIES

2.1.1 Introduction

Like it or not, prepared or not, higher education is entering the information age. We have experienced more than a decade of proliferation of personal computers on the desks of staff, students and administrators, and of widely extended access to research resources, teaching techniques, administrative databases, and to colleagues across the campus and the world. Many universities are in a transitional stage in terms of using networks. A report (1) describes their environment as follows:

- increased diversity of computing use by staff and students.
- increasing emergence of information exchanges between staff, students, and administrators through networks.
- widespread use of online bibliographic databases to identify the existence, content, and whereabouts of information.
emergence of limited full-text electronic resources and electronic imaging for non-character-based information resources.

• a plethora of network databases and independent protocols and applications beginning to converge in common digital formats and processes and respond to the evolution of national standards.

• continued reliance on labour-intensive distribution channels for the delivery of instruction and paper-based information resources.

• a perceived shortage of information management generalists to support staff, librarians, administrators, audio-visual service specialists, and students.

• various levels of competition and cooperation between organizational groups which are being drawn together by overlapping technology-based concerns - librarians, computer centre staff and lecturers, etc.

It has been suggested that it is time for the revolutionary fervour which greeted the new technology to subside for a while in higher education (2, 3, 4). It is time to resolve some of the confusion, and to effect the real IT evolution, by adjusting organisational structures to accommodate and exploit what is valuable in these technological developments.

As Frankmann (5) remarked, university education is an information-intensive industry. Those involved in higher education are directing their efforts towards collecting, using, processing and delivering information as follows:

• **Research:** Information is the raw material, intermediate, and final product of research processes. Research input and output need to be communicated. Communication is an inherent component of research. Information technology in higher education supports, influences and changes the research-related production process.

• **Teaching and learning:** Teaching and learning are based on the transfer and processing of information. Information technology may support and increase the efficiency of this process of information
transfer and information handling or even modify the educational processes.

- **Information and library services:** Researchers, teachers and students depend heavily on ease of access to information, be it in printed, audio-visual or electronic form: books, journal articles, bibliographic data, facts, software or other media. Libraries currently support teaching, learning and research processes through the provision of information using traditional media (typically print), but must also now reflect the changing products of the research and scholarly processes the output from which are delivered in electronic form.

- **Administration and management:** As in other organisations, be they in the business world or in the public services, higher education deals with information for the purpose of its administrative processes as well as for institutional management and decision making. To make information processing in administration and management more efficient and effective, university administration and management may be supported by IT.

Subsequently more detailed discussion below concentrates especially on developments in UK universities, because they will act as the baseline for comparing with South Korean universities in this research.

### 2.1.2 IT in research

It is not effective, or even possible to do much research in the universities nowadays without using computers. However, as Epelboin (6) has pointed out, the penetration of computers is not equal in the different fields of study. Roughly, the hard sciences, such as mathematics, computing, physics and chemistry, have a greater use of IT than soft sciences such as literature, sociology, human sciences, law and economics. The situation for biology or medicine is somewhere in between. When researchers already use computers
in their daily work, they also do in the area of administration and management. This explains why computers are somewhat less common on the desks of people working in most of the soft sciences, although they make great use of the facilities provided by the electronic office. This is expected to change rapidly over the next few years. The greater the use of IT for research work, the greater the penetration of all aspects of IT in the universities. For instance, medicine and economics now have a need for powerful workstations and supercomputers. This means that such researchers need the services of a sophisticated network and the gap between hard sciences and soft sciences will vanish very soon.

Meadows (7) mentioned that 'research' can be divided into a number of stages, starting with the generation of new ideas, progressing through experimentation or other kinds of testing/development, and ending with the discussion and dissemination of results. Some studies (8, 9, 10, 11, 12) carried out recently show the following sorts of computer involvement in their research (Table 2.1). With the growth of networking, electronic information exchange between academic sites relating to research has expanded rapidly in recent years.
Table 2.1 Computer involvement in research work

Tasks for research work

- Collection of data from experiments
- Statistical analysis of data
- Graphical display of data (CAD/CAM, modelling, etc.)
- Word-processing
- Managing personal database / index
  (bibliographic or non-bibliographic)
- Controlling systems / equipment
- Sending / receiving messages to individuals (E-mail)
- Electronic bulletin boards, mailing lists, discussion groups
- Group messages (BBS, Computer forum, etc.)
- Transferring data files (FTP) between computers
- Remote logging-in (Telnet) between computers
- Online library catalogue searching (OPAC)
- Online CD-ROM bibliographic database searching
- Searching campus-wide online database
- Searching nation-wide and international online database

As an example of computer-related research in the different faculties and schools, the University of Geneva describes its applications as follows (13):

"If the Law school is interested in accessing Legal Databases and the School of Architecture in Computer Aided Design, the other units have wider interests. Humanities and Theology have needs for different alphabets for ancient and modern languages. Psychology and Education uses the same statistical analysis packages as Economics and Social Science. Researchers in Sciences and Medicine have in common data acquisition and analysis, image processing, molecular modelling, etc. Most of the pure informatics activities are conducted in the Centre Universitaire d'Informatique with strong groups in Artificial Intelligence, Computer Animation, Computer Based Learning, Databases, Image Processing, Object oriented systems, Programming environment, Telematics and Theory. School of Translation and Interpretation is active in what is now called Language Industry and includes knowledge representation, automatic translation, terminology and linguistics."
2.1.3 IT in teaching and learning

The use of IT in the support of teaching and learning is often described as computer assisted learning (CAL). Computer Assisted Learning (or Teaching) is the use of computer systems to assist directly in the learning or teaching process. Various terms are current, each with its own acronym; some examples are given in figure below. Meadows (14) views 'Computer-assisted learning' (CAL) as probably the commonest, but 'aided', 'based', or 'enhanced' may replace 'assisted' - similarly, 'instruction', 'education', 'training', or 'teaching' may occur instead of 'learning'. CBT(Computer-based training) is the term often used for CAL in commerce and industry. Table 2.2 shows the variety of terms for CAL (15,16).

<table>
<thead>
<tr>
<th>Computer</th>
<th>Assisted</th>
<th>Aided</th>
<th>Based</th>
<th>Enhanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instruction</td>
<td>Learning</td>
<td>Education</td>
<td>Training</td>
</tr>
</tbody>
</table>

In the 1970s, use of computers was seen as the way forward and considerable effort was devoted, particularly in the USA, to the development of a wide range of CAL systems. As Bull (17) notes these ranged from rote learning systems through to sophisticated training packages. It soon became apparent that the cost of development for many CAL applications was so high that it was difficult to recover the investment. However, in spite of the concern over costs, research has continued into such aspects of CAL as intelligent tutoring systems, interactive multi-media systems and other elaborate IT-based systems. From the 1980s, there has been a gradual increase of interest in applications of IT as a learning resource.

Meadows (18) points out two major reasons why CAL is not yet being extensively applied on campus.
• The first is a fairly conservative attitude to teaching methods on the part of teachers.

• The second is a lack of useful software for teaching purposes because:

  – it is evident that development of software for teaching purposes is still often an activity of the individual enthusiast. The teaching packages produced by such enthusiasts are often little publicised, poorly documented and may well not be upgraded as time passes.

  – at the same time, commercial educational software, where it exists, may be too costly to purchase for use with large classes.

  – in addition, often little staff time is available to explore the software and to learn how to use it to maximum advantage.

Despite this range of problems, an increasing amount of effort is being put into supporting the application of CAL to university teaching. One important reason is because of its value both for students and teaching staff in higher education. The potential advantages of a campus-wide system of CAL may be summarised as follows (19):

• A greatly increased flexibility of delivery of interactive learning material to the student: eventually leading to a genuine individualisation of many areas of learning through choices in the timing and sequencing of elements of the curriculum.

• The liberation of academic staff from repetitive teaching duties involving the more 'mechanical' aspects of their subjects (use of, e.g. drill and practice courseware).

• Offering students the opportunity to experiment with models of situations too dangerous or expensive for real-life experience (discovery and simulation programs for chemical experiments, machinery operation, etc.).

• The involvement of academic staff in high-level curriculum development work as an integral part of their career activity.
• The integration of CAL development and delivery facilities with managing facilities for the monitoring of student performance, administration of assessment and keeping of records.
• The eventual accumulation of a large body of expertly-structured and immediately accessible courseware, either developed in-house or bought-in.
• Other important benefits within the institution relate to the integration, at appropriate levels, of CAL facilities with facilities for CAD (computer-aided design), communications, electronic publishing, etc.

CAL developments have to be seen within the context of a university which has thought through a comprehensive IT strategy and has invested in the network and workstation infrastructure to support this. Without the backing of a high level policy commitment and the provision of large-scale campus resources, no strategy to develop an integrated CAL system can succeed.

In order to stimulate the use of computers in teaching and learning, the CTI (Computers in Teaching Initiative) Support Service was established at the end of the 1980s as part of the University Grants Committee's (the precursor to the Higher Education Funding Councils) and the Computer Board's joint initiative on computers in university teaching (20). The aims of the Computers in Teaching Initiative (CTI) are currently to:

• encourage the development of computer-assisted teaching and learning in UK universities.
• evaluate the educational potential of IT.
• promote an awareness of the potential of IT among lecturers and students in all disciplines.
• disseminate information about software that has been developed, or is emerging.

The fourth aim (concerning software distribution) was introduced after 1992 when the TLTP (Teaching and Learning Technology Programme, see below)
was launched and the CTI started to cooperate with the TLTP. The UK experience of computer use in teaching and learning can be divided into the following stages:

- The first stage of the CTI in the 1980s was concerned with software creation, mainly by individuals.
- The second stage in the 1990s was concerned with dissemination of software and information developed elsewhere.
- The TLTP was concerned with software creation, mainly by consortia, and began to produce its products in the mid-1990s.

Under the auspices of the original CTI, 139 pilot projects on the use of computers in teaching were established in British universities. These projects, which collectively covered almost every academic discipline taught at undergraduate level in the UK, explored innovative applications of IT in teaching and learning. The second stage of the CTI established 21 Centres. These were given the responsibility for supporting and promoting the use of computers in teaching within specific disciplines ranging from textual studies to engineering studies. Darby (21, 22) states that each Centre is providing a range of services to their clients in pursuit of their mission. The chief ones of these are:

- producing regular newsletters.
- publishing resource guides and reviewing courseware.
- providing on-line information servers via JANET and Web pages.
- running workshops and conferences.
- visiting university departments to demonstrate software and advise on computers in teaching.
- answering individual enquiries.
- cooperating with the TLTP (Teaching and Learning Technology Programme, see below) consortia: co-ordinating the TLTP activities within disciplines; disseminating information about the TLTP and the software emerging from it; and directing projects.
The CTISS (the CTI Support Service) co-ordinates the work of the Centres and seeks to disseminate the work of the Initiative both in the U.K. and overseas. The CTI centres (some new ones have been established) including CTI Support Service are listed in Table 2.3.

Table 2.3 List of CTI Centres

<table>
<thead>
<tr>
<th>CTI Centres</th>
<th>Universities</th>
<th>CTI Centres</th>
<th>Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting, Finance &amp; Management</td>
<td>East Anglia</td>
<td>Medicine</td>
<td>Bristol</td>
</tr>
<tr>
<td>Biology</td>
<td>Liverpool</td>
<td>Modern Languages</td>
<td>Hull</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Liverpool</td>
<td>Music</td>
<td>Lancaster</td>
</tr>
<tr>
<td>Computing</td>
<td>Ulster</td>
<td>Physics</td>
<td>Surrey</td>
</tr>
<tr>
<td>Economics</td>
<td>Bristol</td>
<td>Psychology</td>
<td>York</td>
</tr>
<tr>
<td>Engineering</td>
<td>Queen Mary &amp; Westfield College</td>
<td>Sociology, Politics &amp; the Policy Sciences</td>
<td>Stirling</td>
</tr>
<tr>
<td>Geography</td>
<td>Leicester</td>
<td>Textual Studies</td>
<td>Oxford</td>
</tr>
<tr>
<td>History</td>
<td>Glasgow</td>
<td>Statistics</td>
<td>Glasgow</td>
</tr>
<tr>
<td>Human Services</td>
<td>Southampton</td>
<td>Art &amp; Design</td>
<td>Brighton</td>
</tr>
<tr>
<td>Land Use</td>
<td>Aberdeen</td>
<td>Built Environment</td>
<td>Wales, Cardiff</td>
</tr>
<tr>
<td>Law</td>
<td>Warwick</td>
<td>Nursing and Midwife</td>
<td>Sheffield</td>
</tr>
<tr>
<td>Library and Information</td>
<td>Loughborough</td>
<td>CTI Support Service</td>
<td>Oxford</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Birmingham</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The TLTP (Teaching and Learning Technology Programme) is a recent initiative to develop the application of computers to make teaching and learning more productive and efficient. The TLTP was launched by the UFC (University Funding Council) in 1992, when universities were invited to submit bids to the 7.5 million pounds per year initiative. Of the 160 projects submitted, 43, which would assist academic staff in meeting the new challenges of a changing higher education sector, were selected. These were funded at a total cost of 22.5 million pounds over three years: this was the first phase (23).
In April 1993 the four new funding bodies, the successor Councils to the UFC - the Higher Education Funding Council for England (HEFCE), the Scottish Higher Education Funding Council (SHEFC), the Higher Education Funding Council for Wales (HEFCW) and the Department of Education for Northern Ireland (DENI) - jointly agreed to fund a second phase of the programme. The second phase was launched with the same aim as the first, but with the intention of building on the work already being undertaken by the Phase 1 projects. The funding bodies were impressed by the response to the call for the second phase, with 367 bids being received. In August 1993 it was announced that a further 43 projects were to be funded at a cost totalling 3.75 million pounds in their first year (1993 - 94).

It was always envisaged by the funding bodies that the first and second phases of the programme should run for up to three years, with most institutions submitting bids for funding over a two to three year period. The HEFCE, HEFCW and DENI agreed, in principle, to fund the programme for the full term subject to a review of the funds available in 1994-95 and 1995-96 (24). The Review Group for computer teaching in higher education encouraged a close interworking between the TLTP and CTI, with the intention that, as the TLTP projects neared completion, the CTI would review and evaluate them.

The funded projects included approximately one quarter which were based at a single institution. They are addressed problems of culture change and the integration of learning technology into the teaching and learning strategy of the institution along with staff development. The remainder of the projects were concerned with courseware development and involved academic staff from different institutions working in consortia. The size of the consortia ranged from two to as many as fifty institutions and covered almost every subject discipline. A TLTP project involving Loughborough was concerned less with creating material than with structuring online resources - a matter which is relevant to the present project. An outline of STILE (Students' and Teachers' Integrated Learning Environment) is therefore given below in Figure 2.1 (25).
Students’ and Teachers’ Integrated Learning Environment (STILE)

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**Title of Material**
IT-based Learning Resource for Students and Teachers

**COURSE AND LEVEL**
Various

**DESCRIPTION**
STILE is a joint project bringing together the expertise of the University of Leicester and Loughborough University of Technology. We were later joined by the Open University. STILE aims to develop a rich and flexible learning resource covering a range of different subject areas and available across computers and institutions. It provides information in the form of text, images, and bibliographic material. It allows students to enter information, ideas, questions and comments that will be available to other students and to lecturers. STILE is a topic-driven data retrieval system, allowing the user to explore the links between a range of disciplines and ideas.

**HOW IS MATERIAL INTENDED TO BE USED?**
As support for a variety of pedagogical approaches within an integrated scheme. To release lecturers and tutors from managing resources thus facilitating more face to face contact with students. To increase students’ power to discover and assess materials relevant to their current learning needs. To facilitate a rich variety of communication between teacher and student and student and student.

**NUMBER OF HOURS OF TEACHING MATERIAL**
N/A

**AVAILABILITY OF TOOLS/UTILITIES**
Available now over the World Wide Web

**ANTICIPATED DELIVERY DATE(S)**
Ongoing. Resource base will continue to grow and develop.

**MINIMUM HARDWARE & SOFTWARE REQUIREMENTS**
Any graphical Web Browser.

**DISTRIBUTION MEDIA**
Via ftp and World Wide Web over the Internet.

**DOCUMENTATION**
Available now. Introduction to the STILE project. What can STILE do for you? Getting information from STILE. Communication within STILE. The STILE model. Starting a new resource base.

---

**Figure 2.1** STILE: Students’ and Teachers’ Integrated Learning Environment

**2.1.4 IT in administration**

Administrative information systems in higher education institutions are similar to those of commercial firms. As in any business, educational administrators have data requirements, which include (26):

- Data on markets - prospective students, funding, competitors.
- Data on products - students, research, inventions, technology transfer.
- Data on finances - accounts payable, receivable (e.g., tuition, fee), endowment.
- Data on personnel - academic staff, administrative and clerical staff.
- Data on physical assets - real estate, equipment, animals.

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**54**
University administrative computing generally follows, with some time lag, the state of the art of operational data processing in commerce and industry. Frankmann (27) and King (28) note that there have been four generations of computer systems for higher education administration as follows:

- **The 1960s: the batch systems generation.** The systems operated usually on the central academic mainframes, and they supported (replaced) the 'mass data processing tasks' of the administration.

- **The 1970s: the dialogue systems generation.** The systems operated on central administrative mainframes, and provided the users with a considerable functionality, but limited user-friendliness.

- **The 1980s: the departmental computer systems.** The systems were implemented on departmental computers, i.e. computers which served only one administrative department or even only one computer-supported task within an administrative department. The systems were user-friendly and supported many details of institutional administration. Increasingly, the standard operating systems UNIX and MS-DOS were the base of these systems; in addition, they often made use of relational databases.

- **The 1990s (from late 1980s): integrated systems.** The departmental computer systems were networked. The data transfer between the administrative units, between decentralised and central administration, and between administrative computing and office automation increasingly became computerised. The most advanced institutions or system developers now focus their efforts on the development and implementation of the 'integration generation' with graphical user interfaces.

Many of American universities started to use network facilities for administrative systems when their campus wide network was installed. For example, administrative personnel of the Appalachian State University have had access to all administrative systems, for which they have authorisation,
since 1986 through an office automation system called ALL-IN-1 available from the Digital Equipment Corporation (29). This system provides electronic messaging, time management, information management, business applications and other functions. The users include about 95% of all managerial personnel and their secretaries (currently 419 users of the system). The system is menu driven and easy to use, with features allowing each user to customise how they access and use the available functions. There are user-set parameters, a private filing subsystem, personal directories, calendar/meeting scheduling, distribution lists, nickname assignment and other features controlled by the user.

In the UK, however, IT support for administration in universities still seems to be the least developed area, in spite of some encouraging developments. Many institutions still rely on out-dated batch systems for some of these functions, running on central mainframes, and requiring time-consuming maintenance by computer centre staff. Renewal and development of administrative computing systems takes place at a relatively slow pace. The potential of administrative computing systems for management information is not fully used.

As Frankmann (30) points out, there are a number of possible reasons for the problems of administrative computing in higher education as follows:

- In the case of public financing of higher education, institutional administration is part of public administration in general. It, thus, has to apply public administration rules and regulations as well as being bound to share the problems of public administration. It relies more on personnel (i.e. civil servants) fulfilling their duties than on support from IT.
- IT investments are never devoted to administration with high priority. Administrative computing is rather a 'stepchild' of institutional IT investment policy.
- Academics seem to apply their scientific methods and expertise far too seldom to their own institution and their own societal context in general. Very few examples of computer science or business administrative
departments with enduring efforts to develop and implement their own institutional or departmental administrative computing systems exist.

- An overemphasis on security and privacy aspects in public administration seems to serve as a vehicle to prevent rather than promote innovation through IT.
- Those who have decided to devote their efforts to the development of administrative computing systems have some difficulties in coping with the idiosyncrasies of higher education administration personnel.
- Higher education is characterised by a flat organisation. Many administrative tasks are undertaken in a decentralised way. Only with the advent of PCs have certain administrative domains been identified for support by IT.

The MAC (Management and Administrative Computing) initiative of the University Funding Council was established in 1989 to overcome the obstacles mentioned above. The basic concept was that all institutions should be brought within cooperative groups (families), with the aim that all members of each family would eventually use the same administrative computing software and jointly develop and maintain it. This is based on the assumption that administrative processes and data requirements are similar in all institutions.

As a result of the initial funding and the prospect of on-going funding, four families were set up based on different relational database systems and their software development environment: two Oracle families, one Ingres and one Power House family. UK universities expected the future of their administrative services to be provided mainly by common software with further systems developed to meet the special needs of each university. However, the MAC initiative was stopped recently due to growing delays in the software development. This had progressed so slowly that, in the meantime, individual universities had started to develop their own software and buy improved software from the commercial sector.
2.1.5 IT for information and libraries services

Arms (31) describes traditional patterns of library organisation and operation that have developed over centuries of experience with the storing and disseminating of information in printed form. Within this framework, libraries first used computers for 'library automation' - that is, to automate traditional internal operations. The computers were kept in the back room, and academic libraries could choose not to automate, or to automate gradually. As more and more faculty and students use personal computers for writing papers, sending e-mail, and other routine tasks, they have become aware of the computer's remarkable utility as a tool for retrieving and managing information. As a result, university libraries are under increasing pressure to provide access to information in electronic form and to integrate their services with other aspects of academic life that take advantage of the same technology.

With regard to library automation, Frankmann (32) distinguishes cases where IT supports the improved efficiency of library staff work and where it directly benefits library end-users on, or off, the campuses as follows:

- **Purchasing and cataloguing**

  The data needed for the purchase order is usually already available electronically, in files made available by the publishers or new publication information services, in national libraries and catalogues, or in the catalogues of other libraries within the country. Thus, in many cases, it is not necessary to enter such data in order to make it available for future use.

- **Circulation**

  Computer support of the circulation process saves time for the end-user and the library staff equally, by preventing the repeated input of data on the book and on the lender for the circulation administration.
Access to catalogue information

Catalogue searching is the first step to finding a required piece of information (the book, the journal, the article or paper).

- online catalogue access might be provided within the library only, or from everywhere on campus, based on the campus network.
- remote catalogues could be available as well.
- lending status information and ordering facilities for local or remote sites can be provided.
- publications might be linked to the online catalogue search services.

Access to publications

The final access to the 'physical' publication still takes place by issuing it at the library's counter or mailing it from remote libraries and stocks. Online public access catalogues (OPACs) are the focus of the current stage of IT support in the majority of libraries. If such use of technology is to succeed it implies:

- user-friendly interfaces for the end-user.
- accessibility from many places on campus, i.e. from PC pools as well as from the scholars' workstations through the campus network and, ultimately, access from the homes of students and faculty members.
- integration of online functions, i.e. catalogue search, lending status information, ordering or pre-reservation of publications, purchase suggestions.
- online access to other librarians' catalogues and national and international catalogues through the external network.

Information services

Libraries have to extend their services to the provision of non-printed information as well. Three types of electronic information needed and used
frequently by university members are for research, teaching and reference. Information services for these needs are accessible both through the national research network, as well as via CD-ROMs within the libraries and computing services on the campuses.

It is the task of university libraries to be responsible for access to information files and services, such as commercial databases (bibliographic and text), external OPACs, and electronic journals, nationally and internationally. However, there are reasons why universities are not making as extensive and appropriate use of these services as they might:

- Information retrieval is expensive for the individual student or researcher. In many cases charges are taken over centrally rather than individually (libraries tend to keep control of the search process for their budgeting). Universities or governments need to negotiate for special higher education prices or lump sum payments to cover all accesses for a given institution.
- Access to information files in most institutions is still partly centralised in libraries. Specialised library staff have access to the national information centres and have the 'retrieval expertise' needed, in order not to waste time and money in obtaining information on behalf of their users. If greater use is to be made of these services, a decentralisation of access is needed. The national information centres are intending to deliver PC-based software for easy end-user access and retrieval support as well.

Electronic handling is increasingly penetrating the world of journals. At present electronic journals are often not easy to use due to access problems, response times and user interface problems. However, electronic journal collections in the library will be growing in the new digitalising environment (33, 34).
2.2 INFRASTRUCTURE FOR INFORMATION SERVICES

2.2.1 Computer Centre

The early computing technology was huge, highly complex and facilities usually had to be housed in a centre to which staff and students brought data to be processed, a task which initially was undertaken on their behalf. Computing staff were able to play out the role of the high priest interceding with the computing deity on behalf of the lesser mortals - staff and students. However due to technological developments (e.g. the advent of the micro-computer, the developing communication technologies, the growth in multi-user online capability to mainframes and the availability of increasingly powerful software), mainframe systems have benefited from the miniaturisation of components producing very powerful computing engines which are capable of performing increasingly complex functions. University computing services have evolved rapidly over recent years from a position when their main function was the management of large central mainframe computers, used by a few specialist users, and accessible only to the initiated, to one where they are supporting complex data networks, distributed facilities and a variety of networked services through personal computers for the university community as a whole (35).

Though most universities in the UK still run large central systems, there has also been a growth in distributed systems for teaching, research, information services and administration. In some cases these are linked into the central facility through networking, whilst in others they may be free-standing superminis or personal computers. Client and server architectures exploit cheap processing power in PCs and workstations by placing the application as close to the end user as possible, typically within a powerful campus network server. Any use of a network involves at least two computers: the one the user (the client) is on, and another one (the server) that is being accessed for some purpose via the network (36).
The powerful network server overcomes some of the problems of delay, or contention for bandwidth, associated with earlier system architectures, and provides a solid foundation for distributed applications between university buildings and departments (users). Client-server computing will enable computing resources (e.g., printers, e-mail and fax facilities, and softwares: word processors, spreadsheets, databases, statistical packages, mathematical packages, graphic packages, etc.) to be shared within a work group via the local area (department, faculty, or university campus) network (37).

Increasingly, staff in computer centres have had to cope with a bewildering variety of hardware and software. The technology has become more accessible to the non-expert, whose needs are often modest and can be met through word processing, spreadsheet and database management software, though with this has come the expectation of increased accessibility of facilities and a demand for staff development and training in basic computer literacy. The role of computing staff is changing from that of intermediary to that of consultant and adviser on a wide range of systems and software.

The general role of computing centres (services) in UK universities are as follows:

- Provision of services over a campus wide network; including support of the network infrastructure and the provision of open access personal computers, networked printing, etc.
- Provision of central multi-user UNIX hosts and UNIX workstations.
- The purchase and support of specific items of general purpose and widely used software for academic use.
- Communications, electronic mail, etc., via JANET and the Internet.
- User training and documentation for staff and research students covering the main items of supported software.
- Provision of advice to departments running their own computing systems (Novell servers, UNIX systems, etc.).
In order to support members of staff undertaking management and administrative tasks, administrative computing services (MAC Service) exist separately: they cover the areas of finance, students, staff and payroll, physical resources, research and consultation, and management information systems.

The heart of the electronic revolution is the network, the telecommunication system which makes it possible for users to locate information or make use of specific services at remote locations. The structure of the network enables the user to call up information from both internal and external sources anywhere and anytime. The concept of an electronic or networked campus has caused computer centres to re-examine both the function and structure of their services, and their relationship to other institutional services. Providing services at a single location is no longer appropriate. Therefore it is necessary to examine the total information strategy of an institution, and the implications that it has, not just for central support services, but also for all aspects of the institution's activities. A survey of information policies and strategies at British universities (38) showed that 21% had an information policy; 44% were currently developing an information policy; 35% did not have an information strategy among 89 universities and university colleges (as of August 1994).

2.2.2 University Library

Basic roles

As one report (39) has pointed out, universities are knowledge engines: information is the fuel they consume, knowledge the product they produce. The library is where we find the thoughts that people, over thousands of years and from all over the world, have found worth saying and recording. In addition, librarians provide the expertise needed to intelligently navigate these vast seas of knowledge and thought. Despite what one hears, the problem of 'information overload' is not something new and peculiar to modern information technology; it is in a sense the fundamental and permanent subject matter of
academic librarianship which supports teaching and learning, research and information resources on the campus.

New roles

The library of the future will differ greatly from the libraries of today. It will continue to provide access to information and guidance for navigating the informational seas - but it will no longer do this solely by acquiring and archiving information. The library of the future will not only be a place where information is kept, but a portal through which students and faculty will access the vast information resources of the world. To provide information and services effectively, libraries must bring together users and information resources without the constraints of a physical environment. The scholar may be at home, in a laboratory, or in a classroom and the information may be in London or Seoul. Librarians of the future will have the daunting task of helping scholars discover relevant information anywhere in the world, in any format.

The library of the future will be about access and knowledge-management as well as about the acquisition, organisation and preservation of scholarly information. The development of networked CD-ROMs, the BIDS service, together with other national datasets initiatives, have already radically altered access to remote information sources, and enabled many institutions to take the first tentative steps in delivering information services to the desktop (40). Nowadays it is possible to access over 1,000 library catalogues on the Internet.

Historically, university libraries have been early adopters of new information technology. Certainly the vast complicated - and very effective - structure of global bibliographic networks (such as OCLC) and data format standards (such as MARC) could not have been designed, implemented and maintained by techno-phobes. Moreover, today librarians are visibly in the forefront of exploring the frontiers of these new technologies, leading the development of information processing standards. Major library conferences, such as those of
the Library Association (in the UK) and the Institute of Information Scientists (American Society for Information Science in the US), as well as specialist meetings on manuscripts, rare books and so on, in both the UK and the US all devote enormous attention to developing the potential of the new information technologies.

As we look at recent experience in advanced countries, such as the US and the UK, and look ahead to the year 2000, it is clear that information has become increasingly diverse and complex, and that this trend is unlikely to change. Scholars will continue to work with information in a multitude of formats, supported by a variety of technologies. In this environment of choice and complexity, computing centres and libraries must work closely together to ensure that students and staff are provided with the technological tools and information resources needed to support education and research.

Responsibility of librarians

University library directors are committed to this vision and are surprisingly consistent about the direction in which library services must develop (41). This degree of agreement about goals is quite striking and decidedly contrary to some of the popular myths about librarians' intransigence and techno-phobia. University libraries show a strong preference for a future in which there is universal access by staff and students to multiple information sources in all possible media via a single multifunctional workstation. It is believed that this will maximise the use of all information resources, not only traditional library media, but also electronic information, as the library remains the institution's most significant information provider. Access and preservation of library information sources has became the major two responsibilities for university librarians.
2.2.3 Audio-Visual Services

Until now we have focused on libraries and computing centres. In some institutions, there has been a third support unit which has also been concerned with the development of new methods of teaching and learning. Audio-Visual Services, or educational technology units, are probably the titles understood by most people. Their functions vary, but, in general, they have been concerned with the development and production of audio-visual materials, both as an aid to the teacher and as a medium for learning, and with the development of new educational delivery systems particularly in the context of the needs of open and distance learning (42).

Most university Audio-Visual Services provide not only audio-visual support for teaching, but also production services, covering everything from graphic design to souvenirs, from photography to print, and from video programme-making to vinyl signs. In addition, Audio-Visual Services also provide a comprehensive and professional conference and exhibitions service, with everything from equipment hire to exhibition panels, stage-sets to name badges, and plant pots to delegate wallets. As well as providing services to their own university, some university Audio-Visual Services also operate as a limited company, selling audio-visual services to business and commerce throughout the UK and Europe (43).

Audio and video systems were among the earliest products of information technology, dating back to the late 19th century and mid 20th century, respectively (44). However, it is now almost true to say that multi-media computers, mainly in the form of personal computers, are an essential component of most aspect of audio-visual presentation and production. Within the business use of audio-visual, it could soon be the case that computers will be the most widely used delivery platform for audio-visual programmes (45). Figure 2.2 shows how audio-visual programmes are being distributed by computers and networks.
2.3 IMPLICATIONS OF IT IN UNIVERSITIES

2.3.1. Convergence and interdependence between organizations

Universities in the UK and the US have invested significant research and resources in an effort to re-engineer their business and academic processes to take full advantage of new technologies. There have been similar responses throughout higher education: many, if not most, colleges and universities either already have or are in the process of investing in voice, data and image networks, institutional information systems, personal computers and workstations for students, faculty, and staff. They have also developed strategic plans for information technology and recognise data as a significant institutional resource. Campuses are focusing on the development of partnerships within the institution, with other institutions, and with government, business, and community entities (46).

The power of technology to distribute information widely, quickly, and easily enables these changes to take place. However, success in using technology
requires a vision of an IT infrastructure which is integrated, efficient and functional. Any such system needs to fuse three elements:

- **Content**: the volume, diversity, and accuracy of machine-readable primary materials. This may be scholarly research, bodies of academic knowledge, student and alumni records, operational databases, etc.
- **Access**: the network through which the content is distributed, and the platforms through which users reach it. Considerations here are capacity, reliability, connectivity, ease of use, and seamless levels of technical integration.
- **Guidance**: training, education, and ongoing support of users at all levels.

In order to exploit IT, universities in advanced countries have made a conscious decision to use computing and telecommunications. Their approach to policy assumes certain guiding principles (47, 48, 49, 50).

- An assumption that the real revolution in IT is about communication, not computation.
- A commitment to providing a basic level of resources and services to all members of the university community, which means, among other things, that there is no charge to individuals or academic units for any computing or networking services. IT is regarded as a basic feature of university life.

If computing and information services are to exploit IT to best effect there needs to be a recognition by senior management. The staff will need support in adapting to the provision of new services. Institutional management will need to consider the range of information services to be provided via the campus network. Decisions will have to be made about who is responsible for information generation, management and access. Some of this will naturally fall to the library, some to the computer centre, and some to other parts of the university. Computer centres traditionally are responsible for the technological infrastructure, while libraries are more concerned with information, and Audio-Visual Services for aids to teaching and presentation in the classroom. Merging
of these separated services under the joint responsibility of a 'Chief Information Officer' (or Vice-President for Information Services) is a new trend in academic communities.

A great deal has been written about the convergence of the library and the computer centre since the late 1980s in US and UK universities (51, 52, 53, 54, 55, 56, 57). This reflects the growing overlap in missions as computer centres evolve from hardware to services, and libraries from books to information. The convergence becomes an important campus issue where computer centres redefine themselves, as some already have, as being the switchboard for the campus digital networks, and begin to think of the library as the 'prime node' on the network (58).

As technology changes and new patterns of learning and teaching develop, it seems inevitable that the responses will cast doubt on the adequacy of traditional service structures to respond to demand, and all institutions will be forced to reassess how all services operate and relate to each other. According to one recent paper (59), there is no ideal structure, no single model, for converged services between libraries and computer centres. What works for some universities may not be appropriate elsewhere. Each university must examine its own organisational needs, its own focus in teaching, learning and research, and the appropriateness of its support service structure to meet its aims. Many will eventually remodel their core services, some will realign service responsibilities, and some will converge.

2.3.2 Awareness and training

The emergence of the electronic campus and the widespread availability of electronic information provides many opportunities to enhance the role of staff for teaching, and librarians in the support of learning and research. The development of new skills is particularly important where information is provided through electronic services accessible over networks. Teaching members, librarians and staff in Audio-Visual Services and other departments
must take advantage of appropriate in-service training, and they in turn also need to train their users to cope with the vast amount of digital (networked) resources that is now available. They will need to develop information handling skills and, in particular, to make effective use of the tools available for their own services.

For any of the above IT developments in universities to take place successfully, one of important things is the attitude of staff. The academic staff will both have to adopt new technology as appropriate, and change their attitude to sharing teaching material and the development of the curriculum. The key to all these change is training. Without an investment in training, the full benefits will not be achieved.

A recent university report (60) proposes that, since appropriate training is clearly of central importance, so it must be made available at more than one level and in more than one way. The basic requirement is to inculcate the skills necessary to mount material according to the guidelines, whilst explaining the limitations - legal and other - on what can be mounted. This will have to be presented at different levels according to the backgrounds and needs of the groups concerned. Up-dating sessions will also be required at intervals. Apart from face to face sessions, it will be necessary to provide appropriate online self-tuition packages, whilst the process of mounting information will, itself, be increasingly automated via the use of templates, etc. One or more central contacts will continue to be necessary to provide back-up information for people with specific inputting problems.

The ITTI (Information Technology Training Initiative) is one national effort to train academic users and enhance their IT skills. In 1991 the University Funding Councils funded a 3 million pound initiative, over a three year period, to improve the availability of training materials for the use of IT in UK Higher Education Institutions. The initiative funded 29 projects at Universities throughout the UK. These projects are, in the main, producing quality paper-based and computer-based (CBT) products in areas such as:
• IT application skills training (e.g. data services and text retrieval: BIDS, BRS/Search, relational database, Geographic Information Systems, Graphics, C for FORTRAN, LaTex )
• Basic IT skills (e.g. Word Processing, Spreadsheet, Database, Graphics, PC based presentation, Multimedia Authoring systems)
• Multimedia and Hypertext courseware development tools and training
• Training for IT staff: personal and professional skills development product for networking, UNIX and X Windows.

[Products and purchasing details are available on the Internet at URL: http://www.icbl.hw.ac.uk/itti/ittiprod.html]

Alongside this national programme, each university has its own programme to support computer training for its users. UK universities provide general hands-on session courses for staff and students each term. These courses consist especially of wordprocessing, spreadsheets, presentation, programming languages, e-mail system, statistics, authoring and operating systems etc. Other means of delivering IT skills are offered through video training courses, computer-based training packages and self-paced tutorial documentation (workbooks, booklets and handouts etc.). In addition, some UK universities have installed Help Desks and/or Help Service Lines which are the initial point of contact for users' queries about their services. They are usually staffed during working hours Monday to Friday. During periods when the Service Line is unstaffed, calls to the direct line are transferred to a voice-mail system where users may leave details of their query which is dealt with the following working day. The University of London Computer Centre provides an urgent networking service: if the problem requires immediate attention, an on-call engineer is contacted and calls the user back.
2.3.3 Legal issues: copyright and proper use

Copyright law is recognised in almost every country in the world as an essential protection for authors and publishers (or software makers), and the principles it embodies and the benefits it brings are widely accepted (61). Electronic copying (electrocopying) of text and software and other electronically held material is potentially the most contentious issue. It is perceived to create threats and opportunities for owners of the information, both concerning their ability to control distribution, and to preserve the integrity of the material. Publishers and software package makers have traditionally controlled the distribution of their works through agency agreements and other contracts.

The academic sector has first to recognise that authors' and publishers' interests in copyright protection (qualified by 'fair dealing' provisions) are legitimate and that copyright is a defensible means of protecting their investment and intellectual property rights. At the same time, publishers need to recognise that the use and manipulation of copyright material is inevitable in higher education, and that it is by no means always unreasonable or illegitimate. They must be pragmatic and recognise that new technology will inevitably alter the means whereby information is disseminated. The way forward is to agree a basis for the use of the technology.

Any software and/or hard copy of data or information which is not provided or generated by the user personally, and which may become available through the use of computing or communications resources, should not be copied or used without the permission of the university, or the provider of the software. The provisions of the Data Protection Act (1984), the Computer Misuse Act (1990) and the Criminal Justice and Public Order Act (1994) need to be considered when storing and disseminating data on a computer in the UK. This has been the norm in UK universities. Software and/or information provided by the university should only be used as part of the user's duties as an employee or student of the university, or for educational purposes (62). The user should
agree to abide by all the licensing agreements for software entered into by the university with other parties.

The UKERNA (United Kingdom Educational and Research Networking Association) produces an acceptable use policy for computers and network resources (Acceptable use policy, version 4.0). An university report (63) summarises it for application to campus computing as follows:

- Unacceptable use:
  - the retention or propagation of material that is offensive, obscene or indecent, except in the course of supervised recognised research;
  - causing annoyance, inconvenience or needless anxiety to others, defamation (genuine scholarly criticism is permitted);
  - copyright infringement;
  - unsolicited advertising;
  - attempts to break into or damage computer systems or data held thereon;
  - unauthorised resale of University or JANET services.

- Acceptable use may include:
  - personal e-mail and recreational use of Internet services as long as these are in keeping with the framework defined in the policy document, and do not interfere with one's duties, studies or the work of others;
  - solicited advertising, such as on electronic notice boards intended for this purpose. However, such use must be regarded as a privilege and not as a right and may be withdrawn if abused or as part of a disciplinary procedure.
  - fair uses applying to the present regulations.
2.3.4 Security issues

Universities recognise the importance of providing a secure and reliable information systems environment, and of establishing and maintaining a reasonable attitude to its full exploitation by the internal and external user population. Most feel that a physical separation should be maintained between the campus LAN and the administrative / departmental computing network. This provides enhanced security for confidential administrative / departmental (or faculty) information (e.g. personal files of staff and students, salaries of staff, examination marks, departmental teaching/learning software, databases, etc.). Any linkage between campus networks should be controlled, with additional password security, and physical connection route validation, to protect against unauthorised access.(64,65,66,67)

Standard procedures are increasingly being applied campus-wide to ensure that information held on any computer is secure from both unauthorised access and accidental loss. The security and monitoring strategy is thus to encourage, and enforce if necessary, a responsible attitude to the use of information systems, and to ensure that the services provided allow only authorised persons access to appropriate data. Further, that data must be made as secure as possible from accidental, or deliberate interference by machine or human (68). The various controls that exist to deter and prevent abuse and to discipline offenders should be vigorously applied according to the regulations and ordinances of the university, and the code of conduct of computing services staff.

2.3.5 New services

The development of UK university networks has therefore been identified as a major element of future strategy to:

- encourage the sharing of ideas, information and materials within local networks of users who have common interests and purposes
encourage and improve the sharing of information and materials between local networks throughout the universities and beyond.

The wide spread use of computer workstations is envisaged and the ownership of computing equipment by increasing numbers of students is recognised as both inevitable and to be welcomed. Therefore a number of activities are becoming the general norm across the UK universities (69).

Within local networks:
- Communication through e-mail and the circulation of papers
- Transfer of files for information, formatting, editing, etc.
- Making files and information available for public consumption
- Improvement of presentations for teaching and other purposes
- Housekeeping - diaries, booking systems, directories, dialling, etc.
- Links via gateways to other local networks and a central computing system

Access across the local network to:
- University databases with management information
- University library database and via JANET to others in Higher Education
- A range of external databases, electronically - published materials, etc.
- CD-ROM files and teaching materials held in libraries and departments
- Teaching materials of varying degrees of interactive sophistication for use in direct teaching and independently by students

It is thought desirable in UK universities that:

- All staff should have access to a networked computing device/workstation in their office.
• A mixture of specialist and pool rooms with workstations for student use should continue to be provided and in greater (though unspecified) numbers than is currently the case.
• Study places in the libraries should have networked computing devices.
• All major teaching rooms should have facilities for computer presentation and projection.
• Student residences provided via the university should be equipped with computer access.
• Staff and students should be able to access institutional facilities from both workplace and home.

Information technology is increasingly changing the way in which teaching, learning, doing research and administration are carried out. Current developments in communications technology are changing the nature of universities. As we have seen in this chapter, campus IT systems deliver information from all over the campus - administrative and management records, teaching and learning materials (softwares), library information, campus news, etc - and increasingly support access to national and international sources of information through the JANET (SuperJANET) and the Internet.

As a result of the new environment of networked IT, organisational structure is needing to be changed on campuses. Convergence and interdependence between service organisations (mainly Computer centres, Libraries and Audio Visual Services) have increased, and are leading to a need to re-engineer the campus academic and business processes in order to take full advantage of new technologies. In order to make effective use of IT tools, the development of information handling skills through training and awareness is needed. Copyright, acceptable use and security of computer networked campuses are all having an impact on higher education as well.
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Chapter 3

Research methodology: soft systems methodology and data collection

3.1 REASONS FOR SELECTING SOFT SYSTEMS METHODOLOGY

3.1.1 Systems approach

The topic of study of this project is the electronic network management problems in South Korean universities. This is a difficult question to tackle. Information technology and its applications via electronic networking are growing and changing very quickly. In addition, South Korea is in the process of rapid structural transformation of all its organisations including universities: transformations occasioned by industrialization and modernization.

In real life, the problems that organisations face are often not well-packaged: they are frequently complex and complicated. The real problem may not be the one that appears on first inspection. For example, what initially appears to be a simple telecommunications (quantitative: technical) problem may later be found to contain many other (qualitative: social and organisational) issues. In order to tackle the topic of this study, it was decided to use a systems approach. The question then was what kind of systems model would best fit the sort of messy and ill-structured problems involved here.
A system is a group of related elements organised for a particular purpose (1, 2). We can therefore look at organisations as systems. Further, particular parts of the organisation may be seen as subsystems of the large system, with their own functionings. The 'system' is an abstract concept that can be embodied in many different ways. For example, we can regard the human body as a system. It has subsystems, such as the skeleton, muscles, the nervous system, the circulation system, the digestive system, etc. As with a human body, the systems within an organisation overlap and interlink the parts, structures and members by their purpose and activities (3).

Modern theories of organisations are increasingly persuaded of the wisdom of using a systems approach when examining their workings. To the extent that information problems often relate to the operations of, and inter-relationships between different people, groups or organisations, then a systems approach appears particularly suited to information science research. One particular advantage of using a systems model is that such an approach can lead naturally to a definition of performance measures for the system concerned.

When the phrase 'the systems approach' is used, it is most likely to be a reference to some variant of the hard systems approach, if only because that is the approach which has been most widely used in practice. The hard systems approach is based on an approach common in engineering (e.g. as applied to telecommunications and computer development). It is aimed at the management of change in an organisation, and is currently the dominant tradition within the systems movement. It evolved first, and developed rapidly, to meet the needs of modern engineering and industrial activities. However, this approach is prone to some serious problems - which have given rise to doubts about its relevance and effectiveness in relation to some kinds of organisational and educational decision-making (4). The soft systems approach, in contrast, considers the surrounding environment and relationships between systems components in a more qualitative way. It can examine factors that may not be apparent when using hard approach (5). Figure 3.1 shows the real-world applications of the two different systems ideas.
Figure 3.1  A map of systems ideas (adapted from Checkland, 1993)

REAL-WORLD APPLICATIONS OF SYSTEMS IDEAS

' HARD' SYSTEMS ANALYSIS:

Machine-based or hardware-dominant systems approach for 'hard', 'well-structured' problems

' SOFT' SYSTEMS ANALYSIS:

Human activity-based systems analysis for 'soft', 'messy', 'complex' and 'ill-structured' problems

APPLICATIONS OF SYSTEMS IDEAS TO ACADEMIC PROBLEMS:

e.g.       Planning    Education  Social work
           Medicine    Geography  Ecology, etc.

3.1.2 Advantages and disadvantages of Checkland's soft systems methodology

The soft systems approach evolved to deal with problem-situations in which human perceptions, behaviour or actions seem to be the dominating factors and where goals, objectives and even the interpretation of events are all problematic. The soft systems approach is concerned with descriptive and qualitative factors, rather than with quantitative measures (6).

Higher educational institutions, which are now increasing their use of IT consist of complex inter-connected systems: they are prone to the influence of
micropolitics between groups of individuals on and off campuses. Kowszun (7) insists that soft systems methodology offers a system-theoretic approach rich enough to help gain insight into the micropolitical issues of an organisational problem in educational establishments. It is proposed that this approach is particularly relevant to IT use in higher education for the following reasons:

- It is a methodology which should appeal directly to those whose working lives are centred on the business of learning, since the basis of the soft systems approach is to engage in processes which enable learning about the problem situation to take place.

- The soft systems approach is helpful in the context of developing quality assurance. The iteration between different stages of the methodology can become part of an on-going quality assurance process.

- Soft systems methodology enables a deep exploration of critical issues which is something all of us in the higher education sector are having to do. It explicitly incorporates all university members into the analysis as an essential part of the system under investigation.

- All too often strategic issues involving human resources, which interact in many complex ways, can seem so large that it is far from clear how to begin an analysis. Soft systems methodology provides a step-by-step procedure which gives structure to an analysis and enables managers to 'plan to plan'.

- Managing information in higher education means managing the learning, research and administrative processes. Soft systems methodology is a way of understanding these activities: it is a way of exploring the process of managing information. It helps to identify the information process by identifying interpretations of situations where objectives are unclear and many perceptions of the problem exist (8, 9).

More advantages can be summarised as follows (10, 11, 12, 13, 14).

- In soft systems methodology, cultural factors are incorporated quite clearly for applying to the real-world of human affairs.
• Flexibility (mouldability) of the methodology makes it adaptable, and so able to accommodate a wide range of study topics.

• Soft systems methodology is a mixture of theory and practice. It has its own terminology and it is structured in clear stages for tackling unstructured problems.

• Soft systems methodology is a learning tool which is related to the nature of human activity systems. The root definition (a description in a couple of sentences) of this methodology is a striking, powerful and effective way of describing the actual human activity system.

Disadvantages of soft systems methodology can be summarised as follows:

• The methodology is time-consuming; for example, apart from the skills needed to apply this methodology, it requires surveys (questionnaires and interview surveys) in order to describe thoroughly the situation in the 'rich picture'.

• The outcome of the process is decided by problem owners, but it is possible that the problem owner will never agree with the proposals that are derived. In any case, it may require repeated iteration to develop the conceptual model further to provide for more detailed discussion. It is an open-ended methodology. Changes suggested could possibly lead to a new problem situation that would need to be tackled.

• The results of the methodology cannot readily be generalised. The degree of subjectivity of the research could be another question. As was stated by Checkland, soft systems modelling is a subjective process because no two people will look at any particular aspect of the world in exactly the same way.

• It is argued that soft systems methodology is very sophisticated and mature: it requires experienced analysts and is dependent on a high level of intellectual input. Its sophistication tends to obscure the rigour.
3.2 APPLYING SOFT SYSTEMS METHODOLOGY

The Soft Systems Methodology was found to be particularly relevant to this research project after conducting an extensive literature survey (15, 16, 17, 18, 19, 20, 21, 22) and following the guidance of systems approach specialists (Professor A. J. Meadows and Dr. A. Booth). According to the Soft Systems Methodology, the problem-solver defines the problem-content system and then uses this methodology to recommend action to solve the problem of the problem-owner. In the context of this study, the investigator holds the role of problem-solver, while information (information resources or databases) and technology (technology infrastructure) providers occupy the role of problem-owners.

The principles of the soft systems approach can be adapted to this research project as follows.

Stage 1: the problem situation unstructured.

This forms the initial stage of finding out as much as possible about the problem to be studied. In this first stage of the study, the problem situation - a mesh of entities, activities and relationships which someone perceives as problematical - has to be defined. Information about electronic networks and information service activities in universities of South Korea can be collected to learn about the relationships and activities between relevant information organizations. At this stage, an attempt will be made to build up the richest possible picture of the information network situation in South Korean universities which is the crux of the problem.

Stage 2: the problem situation analysed (expressed).

The information so gathered is brought together in order to formulate a picture of what is going on. The word 'picture' is to be taken literally here, for a key element involves drawing a 'rich picture' - a kind of cartoon which brings together all the elements, hard or soft, which appear to be relevant to the problem. The elements may either relate to structure (factors that change only slowly with time, such as the institutional hierarchy or the physical layout of the building which houses the organisation), or to process (factors that may change rapidly with time, as many organisational activities do). In this analysis
stage, elements of structure, process and environment (and relationships between them) will be scrutinised for designing the problem-solving and problem-content systems.

The elements of structure, in the present case, can be analysed in terms of computers, telecommunication facilities, organisational and technical layout and electronic resources available in South Korean universities selected for the project. In terms of basic electronic network activities, the processes involved are planning, doing, and monitoring performance on each campus. On the basis of survey data, interaction and relationships between structure and process can be examined at this stage. The components of the university information system, based on information technology and human beings, will also be examined here.

Stage 3: root definitions of relevant systems.

The investigation moves from the concrete to the abstract at this stage. Each problem that has been isolated in the rich picture is examined to see whether it can be conceptualised as some form of system. If so, it is classified as a 'relevant' system. Several such relevant systems can typically be devised for each problem system. It should be stressed that we are not talking here about systems that already exist within the organisation, or even systems that should be installed in the organisation. We are dealing with theoretical systems that appear relevant in some way to some central aspect of the situation. We are looking for what might be termed logic-based systems. The 'root definition' of a system is a statement that tells us what the system does at its most fundamental level. The objective of the root definition is to provide insight into the system. As such, there is no correct root definition, but some attempts provide better insight than others (23). As Cornock (24) noted, root definitions can be generated on the basis of hypothetical system concerning the eventual improvement of the problem situation by means of implemented changes which seem to problem owners to be likely to be desirable and feasible.

Having chosen or identified the relevant systems of the university information network services, the next step is to derive root definitions about the electronic campus information system in order to build conceptual models for the university information services in South Korea.
Stage 4: conceptual models

This stage of building conceptual models involves deciding what is the minimum set of activities that will fulfill the requirements contained in the root definitions. As Davies and Ledington (25) noted, the main elements of a well formulated root definition have been found to be Clients, Actors, Transformation, Worldview, Owners, and Environment. The mnemonic CATWOE is used as a checklist to help ensure that all the necessary components are present in the root definition. The CATWOE concept was originally developed as a means of analysing root definitions and identifying weaknesses in their structure. The components consist of (26):

C Clients of the system, i.e. those who benefit from, or are affected by, the outputs from the system.
A Actors, i.e. those who carry out the activities within the system.
T Transformation, i.e. the changes that take place within, or because of the system.
W Weltanshauung or Worldview, i.e. how the system is perceived from a particular (explicit) viewpoint.
O Owner of the system, i.e., to whom the system is answerable, and/or who could cause it to cease to exist.
E Environment, i.e., the world that surrounds and influences the system, but has no control over it.

As Kowszun (27) noted, one way of tackling the modelling is to start by listing the activities implied by the root definition. The list of activities is then arranged, so that each follows in logical order. This exercise usually leads to the drawing of a diagram (representing the model) which traces the logical consequences of following a particular relevant system (The guidelines for building conceptual models are laid out in Appendix 1).

After defining major sub-systems in the Korean universities' information system, identified from previous stage, the activities of each sub-system will be expressed in terms of verbs such as 'provide', 'access', and 'connect' in logical-order. After development at a more detailed level, each subsystem will then be interlinked to provide a final model of the information network services in South Korean universities.
Stage 5: comparison of 4 with 2

At this point, the abstract (conceptual) model is compared with the original problem situation. There is usually a mismatch between the type and sequence of activities visualised by the model and those that actually occur. Any such occurrences are itemised at this stage. The comparison stage leads into discussion about possible changes which might be made to the problem situation that has been discovered (28).

This stage may cause investigators to change some of their earlier views. It often happens, for example, that the first thing the comparison highlights is a specific area of ignorance about the problem situation - in which case we might need to go back and fill in the blind spots on the rich picture. It can also happen that doing the comparison causes us to re-think our views of the situation, perhaps even to the extent of causing us to change the relevant systems. As Naughton (29) noted, the final output of this stage is the production of an agenda. The agenda established here is a series of topics for discussion.

The current situation on university campuses in advanced countries, as represented mainly by the UK, presented in previous chapters, will be compared with the current campus network activities in South Korea based on the data collected here. The use of information technology in UK universities may be a little behind that of the US in some areas, but it is believed to be ahead of much of Europe in terms of IT use in higher education.

Stage 6: definition of (debate on) feasible and desirable changes.

How important are the mismatches between the model and the problem? To what extent can any changes suggested by the model be implemented? One important question is often whether the difficulties are general, so that it would not be feasible to implement the proposed changes under any circumstances, or whether they are peculiar to the specific situation. Conceptual models based on the themes (sub-systems) developed already lead to the definition of some feasible and desirable changes.

Such changes can be discussed via a comparison of network usage between universities in advanced countries, mainly the UK, and South Korea.
Definitions of feasible and desirable changes will take the form of suggestions and recommendations for the improvement of the campus-wide electronic information handling in the universities of South Korea.

Stage 7: action to solve the problem or improve the situation. Implementation stage.

This stage follows logically from the others. However, it does not follow automatically from the first iteration of the methodology. It may be that, as the proposals are debated, so an increased understanding of the problem situation will call for a second iteration where the analysis is more detailed, or takes a different perspective. Alternatively, iteration may be needed to develop the conceptual model further to provide for more detailed consideration of the logistics of change (30, 31). The consultant advises the clients, as with the hard systems approach, but is rarely responsible for the actual process of implementation at this stage.

Figure 3.2 sums up this soft systems methodology model. Systems analysis proceeds sequentially through the seven stages mentioned as before. The methodology is discussed in more detail in Chapter 6 (data analysis for soft systems methodology) and Chapter 7 (planning and implementation through soft systems methodology).

Finding out

1. Problem situation considered problematic
2. Problem situation expressed
3. Root definitions of relevant purposeful activity systems

Systems thinking

Taking action

4. Conceptual models of the systems named in the root definitions
5. Comparison of models and real world
6. Definition of feasible/desirable changes
7. Action to improve the problem situation

Real World

Systems thinking about Real World

Figure 3.2 The soft systems model for this study
As was stated earlier, the principal aim of the research is to investigate information network systems among South Korean universities, which have situations considered problematic, and then to construct an optimal information network model which will enable all academic members in South Korea to share information resources in an effective and efficient way. For the first stage of the study, we need to make sure that the survey aims are designed to accord with the study objectives.

3.3 SURVEY DESIGN: TECHNIQUES OF DATA COLLECTION

3.3.1 The choice of the data collection method: qualitative and quantitative

Stage two requires a detailed qualitative and quantitative understanding of the situation. Since this does not exist for South Korea, the major effort of the present research must go into establishing it. As Patton (32) notes, qualitative methods typically produce a wealth of detailed information about a small number of people and cases. They increase the depth of understanding of the cases and situations studied. In contrast, the advantage of a quantitative approach is that it is possible to measure the reactions of a great many people to a limited set of questions, thus facilitating comparison and the statistical aggregation of data. It allows a broad generalisable set of findings to be presented succinctly.

Nachmias (33) divides survey research methods into two main types: qualitative interviews and quantitative questionnaires. According to him, the two types of survey can be summarised as follows:

Questionnaire and its advantages

- Low Cost: Economy is one of the most obvious appeals of questionnaires. The lower cost of a mail survey is particularly evident when the population under study is widely spread.
- Reduction in biasing error: The mail questionnaire reduces biasing errors that might result from the personal characteristics of interviewers and variability in their skills.
• Greater anonymity: The absence of an interviewer also provides greater anonymity.
• Considered answers: Mail questionnaires are also preferable when questions demand a considered (rather than an immediate) answer.
• Accessibility: The mail questionnaire permits wide geographic contact.

Interview and its advantages

• Flexibility: The interview allows great flexibility in the questioning process. It allows the interviewer to determine the wording of the questions and to probe for additional information and detail.
• Control of the interview situation: Interviews allow greater control over the interviewing situation. This allows the researcher to interpret the answers more accurately.
• High response rate: Answers can be obtained from respondents who would not reply to a mail questionnaire, often due to unwillingness to take the time.
• Collection of supplementary information: An interviewer can collect supplementary information about respondents. This may include background information about the respondents and their environment that can aid the researcher in the interpretation of the data. Moreover, an interview situation yields spontaneous reactions that the interviewer can record and that might be useful in the data analysis stage.

Patton (34) suggests that because qualitative and quantitative methods involve these differing strengths and weaknesses, they constitute alternative, but not mutually exclusive, strategies for research - both qualitative and quantitative data can be collected in the same study. For this survey, both methods have advantages for particular parts of the research. It was therefore decided to use both approaches:

• Questionnaire survey: In order to reach a large number of network users it was decided to distribute questionnaires.
• Personal interviews: In order to get the perspective of the information provider, interviewing using open-ended questions was selected.

In order to collect the survey data, four steps were carried out as follows.
Institutions were selected carefully to allow for generalisation of the results. These institutions were investigated to get an understanding of their mission, characteristics of their organisation and the network services they offered. Documentary materials (published and unpublished) were used.

A series of questions for the questionnaires and interviews were pre-tested and modified before the main survey was carried out.

Questionnaires were distributed to, and collected from the network users in the selected universities.

Interviews were carried out in the selected institutions.

3.3.2 Population frame and sample selection

Population frame for survey

The first task for the survey was to identify the subjects (members of the population to be surveyed). In order to get the best choice, background information about all Korean universities was needed. Korean universities (including 4-year colleges) are mainly classified into national and private universities depending on the way in which they originated. National universities were founded by the government, and private universities by private individuals or organisations. In 1994, there were 106 private and 35 national (or public) universities. The number of students in each type of university was 809,365 and 270,708, respectively. The private institution is predominant, and it forms about 75% of higher education in terms of number of students and also in expenditure. This is a common tendency in East Asian countries (e.g. Japan and Taiwan), and it makes a contrast to the situation in the UK or other West European countries.

However, the characteristic of Korean universities is the fact that there are very few differences among universities in terms of their administrative organisation, curricula and personnel. The reason for this kind of uniformity is a highly centralised education system under the Ministry of Education. Therefore, there are not so many differences between national universities and private ones. Regardless of their particular specialities and concerns, most universities try to copy the leading institutions. These are mostly located in
Seoul (the capital city is the dominant centre for education, business, culture and government in the Korean peninsula).

It is not possible to examine all these universities when comparing the richest possible picture to the conceptual model for practical reasons (such as constraints of money and time, and the necessity to establish a volume of research that can be handled by one researcher). Some limitation on the numbers is therefore necessary. For the actual fieldwork of the study, it was felt that it was not possible to take more than six universities into consideration. In order to avoid biasing the sample, universities which were felt to be 'special cases' were excluded. For example, women's universities (which usually offer only arts and social science subjects), technical institutes (which usually offer only engineering subjects) and seminary-based colleges (which usually have humanities-based subjects) were excluded. Therefore the population for this study became the 40 universities which have postgraduate courses.

The representativeness of selecting six from 40 institutions might be queried. However, it should be emphasised that this study is a qualitative representation of the research population, rather than an accurate quantification of the general research population. Conceptual models based on the root definition should be the same in essence for every university. This means that the models created in this project can hopefully be used for any South Korean university with a little adaptation. It is believed that problems noted at the end of the project will be typical problems encountered more generally. This is one of the advantages of employing soft systems methodology.

In order to determine the problem situation for networking, it was necessary to classify universities into three groups: network developed for some time, network developed recently, and not yet developed groups. This key factor was combined with other university characteristics to select a stratified sample of six universities (35, 36, 37, 38).

- **Group A universities**

  The largest universities in terms of the number of network (Internet) members and traffic among 40 universities form group A. This included five universities which are all located in Seoul: Yonsei, Sogang, Korea, Hanyang, and Seoul National university. Generally speaking, information
technology at these institutions has developed in advance of the other institutions. These universities started an Internet (initially BITNET) service between 1988 and 1989 (this was an early stage for using international networks among South Korean academics). Two universities (Yonsei and Seoul National) from this group were selected for the survey:

- Seoul National University was chosen as the premier national institution and because it has an important role as a leader institution in networking between national universities.
- Yonsei University was chosen as one of the private institutions from this group to allow for any difference between public and private.

- **Group B universities**

  This group of universities used network facilities less than group A universities. They started their Internet connection services between 1990 and 1993. This included twenty-six universities as below:

  - national universities: Chonbuk, Chonnam, Chugbuk, Chungnam, Kangwon, Kyungbuk (6 institutions)
  - private universities: Chungang, Kyunghee, Hongik, Sungsil, Sejong, etc. (18 institutions)

  Two of the above universities were selected for this group. Chonnam National University was chosen as a public institution outside Seoul, and Chungang University as a private institution within the Seoul area.

- **Group C universities**

  The members of this group of institutions intend to use the Internet service in the near future on their campuses. At present, they do not have campus wide network services. Two universities were chosen out of 17 institutions. Taegu and Chungju were selected because they are suitably geographically distributed: one in Cholla Province on south-west side and one in Kyungsang Province on south-east side of South Korea. Contacts already existed with all these universities, which should ensure good responses to questionnaires and interviews.
Therefore the sample of universities was selected as below:

<table>
<thead>
<tr>
<th>Group A institutions</th>
<th>Seoul National, Yonsei universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B institutions</td>
<td>Chungang, Chonnam National universities</td>
</tr>
<tr>
<td>Group C institutions</td>
<td>Chungju, Taegu universities</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>6 Institutions</strong></td>
</tr>
</tbody>
</table>

According to the type of founding body, these six universities are classified into two national and four private institutions as below:

<table>
<thead>
<tr>
<th>National universities</th>
<th>Seoul, Chonnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private universities</td>
<td>Yonsei, Chungang, Chungju, Taegu</td>
</tr>
</tbody>
</table>

According to their geographical location, these six universities are classified into three regional institutions and three Seoul area institutions.

<table>
<thead>
<tr>
<th>Seoul area universities</th>
<th>Seoul National, Yonsei, Chungang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local area universities</td>
<td>Chonnam, Chungju, Taegu</td>
</tr>
</tbody>
</table>

The selection of samples of respondents

The second task after identifying the universities was to select the respondent samples and their size for interviews and questionnaires.

- **For questionnaires**

In order to get information about network users, the questionnaire method was selected to examine user types, their use of the network, their expectations, etc. User categories for samples are described as follows.
- Network users (types of user)

Academic staff and postgraduate research students who may use the network services at the six universities (four networked and two non-networked universities) were selected. Undergraduate students on taught courses, who were not allowed to have network accounts personally, were not selected.

- Scientific disciplines

In order to allow for inter-disciplinary comparisons, two disciplines were chosen. Science-based activities (pure science and engineering) were selected because generally the use of information technology is most advanced among scientific disciplines (39, 40). A further breakdown by subject was made as follows: Physics, Chemistry, Biology, Electronic Engineering, Chemical Engineering, Mechanical Engineering. These six departments are regarded as the basic departments in pure science and engineering disciplines in South Korea.

- Number of participants

All staff of 18 science and 18 engineering departments were approached. In addition, 15 copies of the questionnaire were sent for distribution to the postgraduate students of these science departments and engineering departments. These samples gave reasonable coverage for the purpose of the study (41). For Group C universities, questionnaires were sent to all postgraduate students because the number of such students at these was very small. Table 3.1 shows the total number of recipients of the questionnaire survey.
Table 3.1 Number of recipients of questionnaires

<table>
<thead>
<tr>
<th>Disciplines</th>
<th>Group A</th>
<th></th>
<th>Group B</th>
<th></th>
<th>Group C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A - 1</td>
<td>A - 2</td>
<td>B - 1</td>
<td>B - 2</td>
<td>C - 1</td>
<td>C - 2</td>
</tr>
<tr>
<td>SCIENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>28 (15)</td>
<td>14 (15)</td>
<td>13 (15)</td>
<td>6 (15)</td>
<td>7 (11)</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>25 (15)</td>
<td>14 (15)</td>
<td>10 (15)</td>
<td>7 (15)</td>
<td>6 (7)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Biology</td>
<td>12 (15)</td>
<td>10 (15)</td>
<td>9 (15)</td>
<td>7 (15)</td>
<td>6 (9)</td>
<td>5 (9)</td>
</tr>
<tr>
<td>ENGINEERING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical eng.</td>
<td>20 (15)</td>
<td>10 (15)</td>
<td>10 (15)</td>
<td>9 (15)</td>
<td>5 (5)</td>
<td>3 (5)</td>
</tr>
<tr>
<td>Electronic eng.</td>
<td>14 (15)</td>
<td>12 (15)</td>
<td>12 (15)</td>
<td>14 (15)</td>
<td>11 (19)</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Chemical eng.</td>
<td>11 (15)</td>
<td>10 (15)</td>
<td>9 (15)</td>
<td>8 (15)</td>
<td>4 (6)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Sub - total</td>
<td>110 (90)</td>
<td>70 (90)</td>
<td>63 (90)</td>
<td>51 (90)</td>
<td>39 (57)</td>
<td>29 (40)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>819</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Note: Numbers outside brackets are for staff, those within brackets are for postgraduate students]

- For interviews

In order to get the richest possible picture of the current situation on campuses, each element of the networking services as an information provider was considered for the survey as follows:

- Information professionals

Staff working in the computer centre, university library and in the computing laboratories of academic departments were chosen. They administer the computer and library, and manage daily routines in each unit. Usually directors of computer centres and central libraries in South Korean universities are senior teaching staff who are appointed by the president to the post of dean for a fixed term of service. The directors are usually assisted by professionals (as executive assistants), who have an academic background in information technology and information services (information and library studies, computer studies, etc.).

In the case of staff of computer centres, two from each institution were interviewed: one who was in charge of technical aspects and one from
administrative services. In the case of librarians, two from each institution, one from library automation and one from user services were interviewed (some of these were the same person). In the case of departmental staff, one from each department who was in charge of computing services was interviewed. Altogether eighteen professionals were interviewed.

- Directors

Usually senior teaching members are appointed as directors by the president on the basis of length of service. So, some of them are non-professional in terms of background, but they are in charge of management of the information units (computer centre, university library) officially. One from each information unit was interviewed (six in all). In the case of the departments, the head of the department, who was in ultimate charge of departmental (or faculty) computing facilities, was interviewed. (The organisational structure of Korean universities is on a faculty and college basis, rather than a departmental one. So most science-based departments using computing facilities in their departments are now sharing computing resources with other departments in the same discipline. Normally, departments in the same discipline use the same building in the university.)

- Vice-Presidents or senior administrative members

These are people who are in charge of the university strategic planning and/or who are in charge of the management of finance, staffing and general planning on the campus. One from each of the six institutions was interviewed.

- Staff of the National Computer Centre for Education (KREN: KoRea Education Network, supported by the Ministry of Education) and the National Computer Centre for Research (KREONet: Korea Research Environment Open Network, supported by the Ministry of Science and Technology)

These are the people who are in charge of the national plan for computers in higher education and research institutions. One manager, who is in
charge of the networking for higher education and research, and one senior staff member, who is in charge of national network policy, were chosen. The two organisations were selected because there is no single organisation for national academic networking in South Korea.

- Managers of the computer and communications hardware/software manufacturers who sell electronic networking equipments

People who are in charge of selling IT and networking equipment to higher education institutions at two top selling companies (Samsung and Sambo) were chosen. In these cases, the managers for academic services were interviewed. Table 3.2 shows the total number of interviewees selected. Details of the people interviewed during the course of this research project are given in the Appendix 5.

Table 3.2: Total number of interviewees

<table>
<thead>
<tr>
<th>TYPES OF INTERVIEWEE</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFORMATION PROFESSIONAL</td>
<td></td>
</tr>
<tr>
<td>Computer Centre Staff</td>
<td>6</td>
</tr>
<tr>
<td>Library Staff</td>
<td>6</td>
</tr>
<tr>
<td>Departmental IT Staff</td>
<td>6</td>
</tr>
<tr>
<td>DIRECTOR / HEAD</td>
<td></td>
</tr>
<tr>
<td>Computer Centre</td>
<td>6 (six institutions)</td>
</tr>
<tr>
<td>Library</td>
<td>6 (&quot;&quot;          )</td>
</tr>
<tr>
<td>Department</td>
<td>6 (&quot;&quot;          )</td>
</tr>
<tr>
<td>VICE PRESIDENT (or senior administrator)</td>
<td>6 (six institutions)</td>
</tr>
<tr>
<td>STAFF OF NATIONAL COMPUTER CENTRES</td>
<td>4</td>
</tr>
<tr>
<td>MANAGERS OF C &amp; C MANUFACTURERS</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>48</td>
</tr>
</tbody>
</table>

3.3.3 Procedures for data collection

Questionnaires design

Discussion of the content of questionnaires normally begins at an early stage of the planning survey and does not finish until the pilot study has been completed. Table 3.3 shows an outline of the stages followed in questionnaire design for interviews and questionnaire distribution (42).
Table 3.3 An outline of stages in questionnaire construction

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>WHAT IS THE AIM OF THE RESEARCH?</td>
</tr>
<tr>
<td>2.</td>
<td>WHAT INFORMATION IS REQUIRED TO FULFIL THESE AIMS?</td>
</tr>
<tr>
<td>3.</td>
<td>UNDERTAKE PRELIMINARY READING AROUND THE TOPIC AND INITIAL FIELDWORK</td>
</tr>
<tr>
<td>4.</td>
<td>WHAT TYPE OF QUESTIONNAIRE WILL BE USED AND HOW WILL SAMPLE BE DERIVED?</td>
</tr>
<tr>
<td>6.</td>
<td>CONSTRUCT A FIRST DRAFT TAKING INTO ACCOUNT THAT PRE-CODED QUESTIONS ARE EASIER TO ANALYSE AND THE ORDER OF QUESTIONS IS THE BEST SOCIAL-PSYCHOLOGICAL SEQUENCE</td>
</tr>
<tr>
<td>7.</td>
<td>PILOT THE QUESTIONNAIRE AND ELICIT THE OPINIONS OF THE SUBSAMPLE. GAIN CRITICAL BUT SUPPORTIVE COMMENTS FROM THOSE FAMILIAR WITH THE DESIGN AND ANALYSIS OF QUESTIONNAIRES</td>
</tr>
<tr>
<td>8.</td>
<td>EDIT THE QUESTIONNAIRE TO CHECK ON FORM, CONTENT AND SEQUENCE OF QUESTIONS. MAKE SURE THE QUESTIONNAIRE IS NEATLY TYPED AND ALL INSTRUCTIONS AND CODING ARE CLEAR AND FILTER QUESTIONS, IF ANY, ARE UNDERSTANDABLE</td>
</tr>
<tr>
<td>9.</td>
<td>ADMINISTER THE QUESTIONNAIRE</td>
</tr>
<tr>
<td>10.</td>
<td>ANALYSE THE QUESTIONNAIRE</td>
</tr>
</tbody>
</table>

a) Questions for the questionnaire

In deriving a final version of the questionnaire, a great effort was made to keep the questionnaire short, unambiguous, easy for the respondent to complete, and easy to analyse (question wording, length of questions, order of questions and questionnaire format were considered seriously). The resultant questions are listed in Appendix 2.

The three main content requirements for the questionnaire to satisfy the aims of the project are as follows:

- Demographic characteristics: age, computer experience, highest qualification
• Job-background characteristics: department and current position of users

• Network related characteristics:
  - Computer type used.
  - Network use (terminal usage by function - network application).
  - Source of training/advice (user training and services).
  - Opinion, suggestions and expectations for more use of network.

b) Questions for the interview

The main questions for the interviews covered the following areas:

• The existence of IT resources in the university and its policy regarding their funding and purchasing.
• Networking and communication systems between the computer centre and other information units, such as the library, faculty, etc.
• The university's planning (national networking plans as well) with regard to the use of IT in teaching, research, and administrative systems.

It was planned that further background information about university organisational structures would be collected from each institution visited. This would help look at their hierarchical framework regarding information policy. Decision making and the operation of the computer committee and library committee in each institute was also examined. The questions for each interview group are given in Appendix 3.

The pre-testing (pilot test)

Once the initial questionnaire construction has been completed, it is wise to try out the results. Pre-testing fulfils the role of a dress rehearsal and is useful for obtaining experience of how the questions will be understood (43).

Moser et al. (44) argue that a pre-test before the main survey provides an indication of the suitability of the questions and of any hidden problems in carrying out the main survey. Furthermore, it is the researcher's last safeguard against the possibility that the main survey may be inefficient. Pilot-testing
items for the evaluation of individual questionnaires, as suggested by de Vaus (45), were followed. They can be briefly summarised as follows.

- Variation: If most people give similar answers to a question, it will be of little use in later analysis. Questions with low variation create serious problems at the data analysis stage and make it very difficult to correlate the analysis.

- Meaning: Check to ensure that respondents understand the intended meaning of the question and that the investigator understands the respondent's answer.

- Redundancy: If two questions measure virtually the same thing, only one is needed in the final questionnaire.

- Non-response: The refusal of a large number of people to answer a particular question produces difficulties at the data analysis stage and can lead to serious reductions in sample size. This can arise for such reasons as: lack of clarity, too intrusive questions, and insufficient choices of response.

The pre-testing interviews tried to examine what would happen when the interviews took place in respondents' offices. The following points were kept in mind when carrying out the pre-testing interviews (46).

- The interview schedule should be followed, but it can be used informally.

- The interview should be conducted in an informal and relaxed atmosphere, and the interviewer should avoid creating the impression that what is occurring is a cross-examination or a quiz.

- The questions should be asked exactly as worded in the questionnaire.

- Questions should be presented in the same order as in the questionnaire.

- Questions that are misinterpreted or misunderstood should be repeated and clarified. In most cases, respondents should not have any problem in interpreting or understanding a question.
Using a contact at the Yonsei University, comments from members of staff in
the computer centre, library and departments were obtained. After the pre­
testing was finished, the final wording was established to avoid ambiguities and
lack of clarity. The questions for the questionnaires and the interview schedule
were first worded in English to have the guidance of, and discussion with the
supervisor. After getting comments, several revised versions were tried.
Finally, they were translated into Korean language. Copies of the
questionnaires and interview schedules to be used, along with the covering
letters, are attached (in English and Korean) in Appendices 2- 4.

Questionnaire forms for research and teaching staff were distributed by the
contact in Yonsei university. Interview question forms for directors of the
computer centre, library and faculty computing laboratory were distributed
through him as well. In order to communicate with the correspondent in South
Korea more quickly, electronic mail between Loughborough University and
Yonsei University was used. The HanMe-Hangul program (Korean
wordprocessing version for Korean scripts on Windows 3.1) was tested for four
weeks, and it was found that there was no special problem when sending e­
mail messages with HanMe-Hangul Korean script files to Korea. One
newsgroup called soc.korean.culture from the Usenet Group on the Internet
was helpful here in obtaining current information on how to use the HanMe
Korean script program in the Windows 3.1 environment.

All questionnaires were sent out with an accompanying letter. In constructing
this, the suggestions by Stone (47) were followed:

- The identity of the organisation conducting the study. You may also
  include details of the funding body and the identity of the researchers
  involved if you wish.
- The purpose of the study and its usefulness. This may include details of
  expected uses of the data and form of publication.
- Explain why the respondent is important by simply describing the way he or
  she was chosen.
- Describe the degree of confidentiality which the respondent can expect and
  explain the purpose of the identification number.
- The respondent should be told whom to contact if he or she has any
  enquiries. A phone number should be included.
• Thank respondents for their co-operation.

Conduct of survey

Forty-eight people were selected for interview and 819 questionnaires were distributed to network users on the campuses as described previously. The design of the interview and questionnaire methods was controlled primarily by the objectives of the study, the investigator's experience and the resources available (money, time, etc.). The procedures for data collection were as follows:

a) Questionnaire distribution

After requesting cooperation by letter, followed by a telephone call, or by visiting places where the questionnaires were to be distributed, questionnaires were distributed and collected through the postal service and via research assistants who were working in each school of science and engineering in the universities surveyed.

When conducting this postal questionnaire survey, the recommendations of Stone (48) were followed:

• Number each questionnaire and keep a record of numbers and corresponding names or addresses so that reminders can be sent out.
• Post all questionnaires at the same time, if possible.
• Enclose stamped addressed envelopes, if necessary.
• Specify a date by which a reply would be appreciated.
• Send a reminder letter to respondents who have not replied after a given time. Enclose a second questionnaire. (For present purposes, a reminder after three weeks seemed appropriate.)

b) In-depth interview

The open-ended questions were selected to obtain the network providers' opinions, expectations and feelings. After sending a formal letter to the interviewees about the survey and requesting cooperation, followed by a telephone call or visiting their work place, interviewing was carried out in the
respondents' offices. Each interview took between around thirty minutes and an hour.

There is no recipe for effective interviewing as there is no one right way to interview, no single correct format that is appropriate for all situations, and no single way of wording questions that will always work. However Patton (49) offers some guidelines for interviewing, as follows, and these suggestions were followed when conducting the interview.

- Throughout all phases of interviewing, from planning through data collection to analysis, it is important that the purpose of the investigation is kept central. The purpose has to guide the interviewing process.
- The fundamental principle of qualitative interviewing is to provide a framework within which respondents can express their own understandings in their own terms.
- Clear questions must be logically ordered, using understandable and appropriate language. One question must be asked at a time.
- Probes and follow-up questions should be used to solicit more detail.
- A personal rapport and a sense of mutual interest should be established.
- Neutrality toward the specific content of responses must be maintained. The interviewer is there to collect information, not to make judgements about the person.
- The interviewer should observe while interviewing and be aware of, and sensitive to, how the person is affected by and responds to different questions.
- Whenever possible interviews should be tape-recorded to capture full and exact quotations for analysis and reporting.
- Notes should be taken to capture and highlight major points as the interview progresses.
- As soon as possible after the interview the recording should be checked for malfunctions; notes reviewed for clarity; elaborated where necessary; and observations recorded.
- Whatever steps that are appropriate and necessary should be taken to gather valid and reliable information.
- The person being interviewed should be treated with respect. It should be kept in mind that it is a privilege and responsibility to peer into another person's experience.
- Interviewing needs to be practised in order to develop the necessary skills.
Time-table for implementation of the survey

The survey was carried out between April and August 1995, with the sequence of institutions selected according to their geographical proximity. Time-tabling was initially as follows (but more time was needed eventually due to an unexpected family problem of the investigator).

1. March 1995: leave for Seoul, Korea. Arrange for the survey after arriving (time schedules, equipment, etc.)
2. April 1995. Yonsei University: three weeks
3. Chungju university; KREONet (interview only) and KRONet (interview only): three weeks
4. Taegu University: three weeks
5. Chunnam University: three weeks
6. Seoul University; KREN (interview only): three weeks
7. August 1995. Chungang University; computer companies (interview only): Samsung, Sambo

Geographical proximity of the institutions is as follows (see the map of Korea in Chapter one).

- Taejon-based institutes: Chungju University, KREONet in SERI/KIST (Chongju included)
- Taegu-based institutes: Taegu University
- Kwangju-based institute: Chonnam National University
References

(Details of publishers are included in the bibliography at the end)


16 Kowszun, J. ref. 7.


23 Naughton, ref. 11. p.32.


25 Davies & Ledington. ref. 8, p.68.


27 Kowszun, J. ref. 7. p.6.

28 Ibid., p.8.

29 Naughton, J., ref. 11, p.45

30 Booth, A. ref., 13, p.125

31 Davies & Ledington. ref. 8, p.130.


41 Patton, ref. 32, p. 184-186.


43 Stone & Harris. *Designing a user study: general research design*, *CRUS Guide: 1*, 1984. p.15


48 Ibid. , p.39.
Chapter 4

Results from questionnaire responses

This chapter presents a picture of computer use among South Korean universities as derived from the questionnaires collected. In total, 819 questionnaires were sent, and 580 questionnaires were returned. This gives a satisfactory overall response rate of 70.8%. The response rate from each university is as in Table 4.1.

Table 4.1: Response rate from each university

<table>
<thead>
<tr>
<th>Institution</th>
<th>No. issued</th>
<th>No. of returns</th>
<th>% return</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - 1</td>
<td>200</td>
<td>125</td>
<td>62.5</td>
</tr>
<tr>
<td>A - 2</td>
<td>160</td>
<td>119</td>
<td>74.3</td>
</tr>
<tr>
<td>B - 1</td>
<td>153</td>
<td>94</td>
<td>61.4</td>
</tr>
<tr>
<td>B - 2</td>
<td>142</td>
<td>101</td>
<td>71.1</td>
</tr>
<tr>
<td>C - 1</td>
<td>95</td>
<td>78</td>
<td>82.1</td>
</tr>
<tr>
<td>C - 2</td>
<td>69</td>
<td>63</td>
<td>91.3</td>
</tr>
</tbody>
</table>

Total 819 580 70.8
The data were coded for analysis on a mainframe computer using SPSS at the Computer Centre, Loughborough University. After the use of the Frequencies command which enables the determination of the extent of cleaning necessary before the generation of statistical information, the Pearson product-moment coefficient of correlation and a Chi-square test were processed in order to get the appropriate statistical results. The analysis was carried out primarily in terms of the three groups of universities described before, in Chapter 3. (Group A universities form the largest universities in terms of the size of network user and traffic; group B universities are the second largest group in terms of size of network user and traffic; group C universities are the institutions which do not have network services for their users yet.)

4.1 BACKGROUND VARIABLES

4.1.1. Age distribution

Most respondents (81%, N = 580) were aged between 20 - 39 years old: group C universities have a greater proportion of these ages (77%: 85%: 90%). The number of over-50s among the groups was small (6%): of this, group A had a relatively greater proportion than groups B and C (9%: 4%: 2%). This suggests that the older and better-established universities have more senior staff. The data also reflect the relative youth of staff as compared with a country such as the UK.
4.1.2 Academic qualifications

Group C universities had a greater proportion of PhD degree holders than groups A and B (34%: 31%: 40%). This was because there were relatively fewer research students at group C universities. There were more Master's degree holders in groups A and B than group C (35% : 26% : 13%); on the other hand, there were more Bachelor's degree holders in group C than in the others (30% : 43% : 48%); group C had fewer postgraduate students than the other universities.
4.1.3 Department distribution

Science departments (Physics, Biology, Chemistry) provided 48% of the responses, with 52% drawn from engineering departments (Electronic, Chemical and Mechanical Engineering). The Electronic Engineering department made up 20% of group C university respondents. One group C university had 28% of respondents from their Electronic Engineering department, which was much more than any other subject imbalance across the universities. It seems that the Electronic Engineering departments in group C universities are encouraged to use computers more than other departments. There is an overall similarity in the distribution of subjects across the universities, except for Electronic Engineering.

![Department distribution](image)

Figure 4.3: Department distribution of respondents

4.1.4 Position of respondents

About 35% were academic staff, while 65% were postgraduate students and 5% were research assistants. Group C shows a slightly higher proportion of staff than groups A and B (34% : 29% : 42% in groups A, B and C), mainly because group C universities had fewer postgraduate students than groups A and B (64%: 64%: 52%). Group C universities have a slightly greater proportion of junior professors (12%: 13%: 20%).
CHAPTER 4
RESULT FROM QUESTIONNAIRE RESPONSES

Figure 4.4: Academic positions of respondents

4.1.5 Computer experience

Around 70% of respondents had computing experience of less than 10 years, with 30% having more than 10 years experience. In group A universities, 18% of respondents had over 15 years experience, while group C showed only 7% in this category. Group C had fewer postgraduate students and senior academic staff than the other groups. The survey results found that only six respondents (0.1%, N = 570, two people in each group) were non-computer users who had zero years experience. As previous surveys (1, 2) have noted, it must be remembered that, even if random sampling is used, computer users are more likely to fill in and return the questionnaire than non-computer users.

Figure 4.5: Computer experience of respondents
4.1.6 Correlation between background variables

In terms of cross-correlations between background variables, analysis of the foregoing results implies the following.

- Age versus academic qualification: The result shows that the older the respondent, the higher the qualification they hold (Pearson's correlation: -0.77, Chi-square test: 0.001, N = 578). It was found that all respondents of over 40 years (19%) had a PhD.

- Age versus position: All respondents who were over 40 years (19%) were academic staff. The survey revealed that the older they were, the higher the position they held (Pearson's correlation: -0.87, Chi-square test: 0.001, N = 578).

- Age versus computer experience: The survey showed that, on the whole, the older the respondents were the more years computer experience they had (Pearson's correlation: 0.55, Chi-square test: 0.001, N = 570).

- Position versus computer experience: The result showed that the respondents who were academic staff had more experience using computers than students did (Pearson's correlation: 0.64, Chi-square test: 0.001, N = 570).

- Position versus academic qualification: The survey indicated that the majority of academic staff had a PhD (98%); 40% of postgraduate students held a master's degree; 60% of postgraduate students held a bachelor's degree. The more educated the respondents were, the higher the position they held (Pearson's correlation: 0.84, Chi-square test: 0.001, N = 580).

- Academic qualification versus computer experience: The survey showed that the more educated the respondents were, the more years computer experience they had (Pearson's correlation: -0.61, Chi-square test: 0.001, N = 559).
CHAPTER 4 RESULT FROM QUESTIONNAIRE RESPONSES

= 570). Some 37% of PhD holders had over 15 years experience of computer use, whilst 95% of bachelor's degree holder had computer experience of less than 9 years.

4.2 INFORMATION HANDLING BY COMPUTERS

4.2.1 Computer usage by group

As can be seen in Table 4.2, respondents in group A universities used network facilities more often than others for such activities as E-mail, BBS, File transfer, telnet, OPACs, CD-ROM searching, campus-wide database searching, nation-wide database searching and international database searching. Group B and C universities showed generally lower levels of networking activities. However, it is worth noting that around 30% of group C respondents used electronic mail and BBS on a personal basis via public telephone lines.

There is an overall similarity in the use of computers for data collection, statistical analysis, graphical display and word processing. However, group C had a slightly higher proportion who managed databases and controlled systems than groups A and B. This seems to be because group C had more Electronic Engineering respondents who were encouraged to use computers more. Library-based services, such as OPACs and CD-ROM searching showed greater variation between the groups: group C showed a relatively low level of activities here. Generally use of databases (from campus, nation and international-based) is relatively low. Group A showed rather more use of these databases than other groups: there was no difference between groups B and C. Table 4.3 shows what tasks were included under the "other" category. As the table indicates, the range of such additional activities varied considerably between the different institutions. Respondents at group A universities showed a greater variety of activities than groups B and C.
Table 4.1 Computer usage by university groups

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Group A institutions</th>
<th>Group B institutions</th>
<th>Group C institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Data collection</td>
<td>37</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td>Statistical analysis</td>
<td>43</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>Graphical display</td>
<td>37</td>
<td>24</td>
<td>39</td>
</tr>
<tr>
<td>Word processing</td>
<td>10</td>
<td>17</td>
<td>73</td>
</tr>
<tr>
<td>Personal database</td>
<td>55</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>Control system</td>
<td>58</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>E-mail</td>
<td>43</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>Bulletin board system</td>
<td>61</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>File transfer</td>
<td>52</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>Telnet</td>
<td>48</td>
<td>16</td>
<td>36</td>
</tr>
<tr>
<td>OPAC</td>
<td>53</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>CD-ROM search</td>
<td>64</td>
<td>26</td>
<td>10</td>
</tr>
<tr>
<td>Searching campus DB</td>
<td>67</td>
<td>23</td>
<td>10</td>
</tr>
<tr>
<td>Searching nation-wide DB</td>
<td>72</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Searching international DB</td>
<td>66</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>51</strong></td>
<td><strong>21</strong></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

[Notes: Column 1 in each group indicates the percentage that used computers rarely or never; Column 2, once a week or once a month; Column 3, more than once per week.]
### Table 4.3 Other computer usage

<table>
<thead>
<tr>
<th>Other tasks</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designing multi-media software</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Language programming</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Simulation</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Web page searching</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Games</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

(Home banking, scientific calculations, CAL for foreign language practice etc.)

[Note: Numbers represent numbers of respondents who mentioned these tasks.]
4.2.2 Computer usage by subject

The results showed that computer usage differed with academic subject area. In general, more engineers used computers than scientists; the one exception being use of CD-ROMs in the following table. Activities marked by an asterisk show statistically significant differences.

Table 4.4 Breakdown of computer usage by subject areas: Science vs Engineering

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage using computers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Science</td>
</tr>
<tr>
<td>1 Data Collection from experiment*</td>
<td>59.4</td>
</tr>
<tr>
<td>2 Statistical analysis*</td>
<td>48.9</td>
</tr>
<tr>
<td>3 Graphical display*</td>
<td>54.3</td>
</tr>
<tr>
<td>4 Word processing*</td>
<td>89.7</td>
</tr>
<tr>
<td>5 Managing database</td>
<td>41.2</td>
</tr>
<tr>
<td>6 Control systems*</td>
<td>31.7</td>
</tr>
<tr>
<td>7 Electronic mail*</td>
<td>35.4</td>
</tr>
<tr>
<td>8 Bulletin Board System**</td>
<td>29.1</td>
</tr>
<tr>
<td>9 File transfer: ftp*</td>
<td>28.4</td>
</tr>
<tr>
<td>10 Telnet: remote login*</td>
<td>28.1</td>
</tr>
<tr>
<td>11 Online Public Access Catalog</td>
<td>31.3</td>
</tr>
<tr>
<td>12 CD-ROM database searching</td>
<td>25.5</td>
</tr>
<tr>
<td>13 campus-wide database searching</td>
<td>19.3</td>
</tr>
<tr>
<td>14 nation-wide database searching*</td>
<td>19.3</td>
</tr>
<tr>
<td>15 international database searching</td>
<td>21.5</td>
</tr>
</tbody>
</table>

[Notes: * shows statistically significant differences at 0.01 level. ** shows statistically significant differences at 0.05 level.]
Electronic engineers used computers more heavily than other subject groups. However, they used computers less for bibliographic database searching (OPACs and CD-ROM searching), than other department members. Activities marked below with asterisks (*) indicate significant differences.

**Table 4.4 Breakdown of computer usage by subject: Electronic Engineering vs the other departments (Physics, Chemistry, Biology, Chemical Engineering and Mechanical Engineering)***

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage using computers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electrical Engineering</td>
</tr>
<tr>
<td>1 Data collection from experiment**</td>
<td>75.0</td>
</tr>
<tr>
<td>2 Statistical analysis*</td>
<td>70.7</td>
</tr>
<tr>
<td>3 Graphical display*</td>
<td>74.2</td>
</tr>
<tr>
<td>4 Word processing</td>
<td>90.5</td>
</tr>
<tr>
<td>5 Managing database*</td>
<td>58.6</td>
</tr>
<tr>
<td>6 Control systems**</td>
<td>50.0</td>
</tr>
<tr>
<td>7 Electronic mail **</td>
<td>53.5</td>
</tr>
<tr>
<td>8 Bulletin Board System*</td>
<td>39.7</td>
</tr>
<tr>
<td>9 File transfer: ftp*</td>
<td>60.4</td>
</tr>
<tr>
<td>10 Telnet: remote login**</td>
<td>49.2</td>
</tr>
<tr>
<td>11 Online Public Access Catalog</td>
<td>29.3</td>
</tr>
<tr>
<td>12 CD-ROM database searching</td>
<td>20.7</td>
</tr>
<tr>
<td>13 campus-wide database searching</td>
<td>25.9</td>
</tr>
<tr>
<td>14 nation-wide database searching</td>
<td>30.0</td>
</tr>
<tr>
<td>15 international database searching</td>
<td>31.0</td>
</tr>
</tbody>
</table>

[Notes: * shows statistically significant differences at 0.01 level.
** shows statistically significant differences at 0.05 level.]

A further investigation (Table 4.6) showed that electrical engineers differed from other engineers, as well as from scientists in these respects.
Table 4.5  Breakdown of computer usage by subject area: Electronic Engineering vs other engineering departments (Mechanical and Chemical Engineering)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage using computers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electronic Engineering</td>
</tr>
<tr>
<td>1 Data collection from experiment**</td>
<td>75.0</td>
</tr>
<tr>
<td>2 Statistical analysis</td>
<td>70.7</td>
</tr>
<tr>
<td>3 Graphical display</td>
<td>74.2</td>
</tr>
<tr>
<td>4 Word processing</td>
<td>90.5</td>
</tr>
<tr>
<td>5 Managing database</td>
<td>58.6</td>
</tr>
<tr>
<td>6 Control systems</td>
<td>50.0</td>
</tr>
<tr>
<td>7 Electronic mail *</td>
<td>53.5</td>
</tr>
<tr>
<td>8 Bulletin Board System *</td>
<td>39.7</td>
</tr>
<tr>
<td>9 File transfer: ftp *</td>
<td>60.4</td>
</tr>
<tr>
<td>10 Telnet: remote login</td>
<td>49.2</td>
</tr>
<tr>
<td>11 Online Public Access Catalog</td>
<td>29.3</td>
</tr>
<tr>
<td>12 CD-ROM database searching</td>
<td>20.7</td>
</tr>
<tr>
<td>13 campus-wide database searching</td>
<td>25.9</td>
</tr>
<tr>
<td>14 nation-wide database searching</td>
<td>30.0</td>
</tr>
<tr>
<td>15 international database searching**</td>
<td>31.0</td>
</tr>
</tbody>
</table>

[Notes: * shows statistically significant differences at 0.01 level. ** shows statistically significant differences at 0.05 level.]
4.3 USE OF INFORMATION TECHNOLOGY

4.3.1 Nearest computers

Most respondents (over 99%) had access to computing facilities within their offices. The proportion of networked computers in their offices among the three groups were 86%: 56%: 27% in groups A, B and C. This indicates that even group C used networks, though on a personal basis via commercial network services through public telephone lines. Group B universities were not completely networked at the time the data were gathered, so the proportion of networked computers in their offices was relatively lower than for group A. Roughly 60% of the respondents had networked computers in their offices, while 40% used stand-alone PCs only. Computer use from outside offices (e.g. from their departments, faculties, university libraries and computer centres, etc.) was very rare.

Figure 4.6 Nearest computers
4.3.2 Home computer

Many respondents (79%) had PCs at home. Of these, around one third of home PCs were networked. This high figure of PC ownership and network use at home was not expected prior to this survey. According to recent surveys (3, 4), there is the new trend towards use of on-line networks from home, not only from the office or at school. Group C respondents showed slightly more PC ownership (78% : 76% : 84% for A, B and C groups). They were more likely to use PCs personally at home because, they did not have access (or good computing facilities) to computers in their working place (university). There was an overall similarity in the proportion of networked computers at home among the three groups.(30%: 27%: 26%)

![Ownership of Home PCs](image)

**Figure 4.7** Ownership of Home PCs

![Home PCs: networked vs stand-alone](image)

**Figure 4.8** Home PCs: networked vs stand-alone
4.3.3 Other usage: telephone and fax

Group A universities had better access to fax than group B and C institutions (75%: 65%: 61%). Group A use fax more actively (i.e. internationally, as well as locally) than groups B and C (76%: 61%: 53%). It appears that there were some restrictions on communication by fax and telephone, especially for international calls. These restrictions were due basically to financial reasons (not only no resources to purchase more fax machines and telephone receivers, but also limited support for paying telephone/fax bills), and also the level of respondents' research activities.

The survey shows that academic staff use fax more than their postgraduate students (Pearson's correlation: 0.40, p = 0.001, N = 580). The majority of academic staff (93%) use fax, whereas, only around a half (54%) of postgraduate students use fax for their work. The respondents who held a higher position were more likely to use fax internationally (Pearson's correlation: 0.49, p = 0.001, N = 575). Most academic staff used fax internationally, as well as nationally; only a quarter (26%) of students used fax internationally. More educated respondents were more likely to use fax than less educated respondents (Pearson's correlation: 0.45, p = 0.001, N = 580). Some 93% of PhD holders used fax as compared with 70% of master's degree holder and 45% of bachelor's degree holders.
The survey shows that two-thirds of respondents in each group used the telephone for their work. Group A respondents used the telephone internationally for their research more than the other respondents.
4.4 ADVICE ON COMPUTERS

Generally, 'departmental research students' appeared to be the most popular source of advice for staff as well as students (staff: 31%, students: 57%). However, group C showed a much smaller proportion having advice from this source than other groups (60%: 44%: 30%). The second most popular source was 'computer manuals' (22%: 26%: 31% in groups A, B and C; staff: 29%, student: 22%) followed by 'books' (8%: 8%: 19% in each group; staff: 10%, students: 11%) and 'departmental colleagues' (5%: 12%: 13% in each group; staff 22%, students: 2%). Group C respondents were more likely to rely on 'manuals', 'books' and 'departmental colleagues' than groups A and B.
Figure 4.13 Sources of advice

Other sources of advice were not favoured greatly by respondents: academic journal articles (overall 0.9%), computer magazine articles (overall 4.5%), local computer shops (overall 1.7%), students and colleagues in other departments (overall 2.6 and 1.6% each) were very little used. Respondents rarely turned first to university computer centres (overall 2.6%) to get advice about their computing.

The survey results show that academic staff used 'departmental research students' (31%), 'computer manual' (29%) and 'departmental colleagues' (22%) for their major advisory sources for computing. Student respondents mainly used 'departmental research students' (57%), 'computer manual' (22%) and 'computer books' (11%) for getting help about computing. It is apparent that most users tried to get their advice from the nearest places - people around their office. At the time of the survey, there were no advisory services to provide personal advice about computing in their universities.
4.4.1 Satisfaction with advice

Respondents of group A showed relatively more satisfaction with advice received than the users in groups B and C (64%: 54%: 49%). The overall satisfaction rate for advice is 56%.

![Satisfaction with advice](Figure 4.14 Satisfaction with advice)

4.4.2. Satisfaction with training

For training, the overall satisfaction rate was only about 40%. Group C users showed more dissatisfaction than groups A and B (dissatisfaction rate: 52%: 61%: 66%): this appeared to be because their computing facilities and training services on the campus were poorer than others.
4.4.3. Satisfaction with their organisation:

Only a small proportion (about 15%) of respondents agreed that their universities were well organised for their information needs. Group C respondents showed the strongest dissatisfaction with their organisation as regards their information needs (such as information handling). The dissatisfaction rate between the groups was 76%: 88%: 96%. This reflects that, for group C, their computing facilities were poorer than others.
CHAPTER 4 RESULT FROM QUESTIONNAIRE RESPONSES

4.4.4. Expectations for personal computing

Groups A and B showed a greater range of personal computing activities than group C. It was found that there was little difference as regards future expectations of computing among the groups. One exception was that group C, which had more Electronic Engineering respondents, was more interested in 'Graphic use' for their future computing (3%: 8%: 16%). Expectations mentioned in the questionnaires can be divided into five categories, as follows:

1) Training:  
- Computer Aided Instruction  
- Modelling (molecular structure modelling, etc.)  
- Remote teaching/learning  
- Designing CAI software  
- Designing simulation Package  
- Using graphics (Drawing)  
- Programming languages  
- Statistical analysis (mathematics and statistics)  
- Video-conferencing  
- Simulation practice and designing

2) Networking:  
- Internet resource searching  
- Using Supercomputers  
- On-line library catalogue searching  
- Creating Internet WWW homepage  
- On-line database searching (nation-wide, international)  
- Tele-working

Figure 4.16 Satisfaction with their organisation
CHAPTER 4

RESULT FROM QUESTIONNAIRE RESPONSES

3) Software:

- Designing and developing telecommunication programs
- Designing game software
- Designing multimedia software
- Using databases (personal, or for a research project)
- Designing multimedia databases
- National database construction (medical DB, etc.)
- Use of basic packages (e.g. Windows WP, Spreadsheet, etc.)
- Multi-media computing

4) Hardware:

- Controlling systems
- CIM (Computer integrated management)
- Managing network (Internet server) system
- Collection of data from experiments

5) Miscellaneous:


4.5 PROBLEMS IN USING COMPUTERS ON THE CAMPUS

Most respondents (around 85%) rated 'lack of access' and 'lack of training/education' as the major problems in using computers on the campus. The majority of groups A and B indicated 'lack of education/training' as the biggest (ranked it as first) problem (A, B, C: 50%, 53%, 38%), while non-networked group C indicated 'lack of access' as the major (ranked first) problem (A, B, C: 25%, 28%, 43%).
Lack of training: ranked first

**Figure 4.17** Lack of training: ranked first

Lack of access: ranked first

**Figure 4.18** Lack of access: ranked first
Most respondents (over 80%) indicated that 'poor documentation' was a problem: Group C respondents showed a greater proportion agreeing than group A respondents (77%, 86%, 82%). In terms of rating first, responses were more even (13%, 12%, 10%). Language (foreign language, especially, English) was not considered as a serious problem among the groups (rated at around 2%). However, most respondents (65% : 73% : 78% in A, B and C groups) indicated it was a minor problem: group C showed a slightly greater proportion than groups A and B here.

'Network speed (bottleneck)' was mentioned more frequently as a problem by group A, which had relatively better network facilities, than by groups B and C (9%: 5%: 2% respondents in A, B and C groups). This was, probably, due to the lack of networked computers in groups B and C. 'No problem at all at the moment' was equally mentioned more frequently by group A (7%: 4%: 1% respondents in A, B and C). This better reflects the fact that respondents in group A were encouraged to access computers more, and became more competent at using computers. Insufficient professional assistance for maintenance, insufficient software, absence of networking facilities and insufficient time for practice (non-usefulness for their current research) were also mentioned as problems.
References

(Details of publishers are included in the bibliography at the end)


Chapter 5

Results of the interviews

In addition to the data collected from the questionnaires, interviews were conducted with the information providers in order to establish the rich picture. As previously explained, group A universities formed the dominant group of universities in terms of the number of Internet users and amount of traffic. Information technology at these universities had advanced more than at the other institutions. They started an Internet service (initially known as BITNET) at the end of the 1980s. Group B universities started an Internet service between 1990 and 1993, and so became the second largest group of universities in terms of the number of Internet users and the size of the traffic. Group C comprises the institutions which do not have campus-wide network and Internet services yet.

Forty-eight interview respondents were invited to participate, and all of them agreed to be interviewed. Interviews were conducted with three main groups within the universities: the computer centres, the libraries, and the departments themselves. In order to structure the interview response, four topics were initiated to examine the current situation and problems thereby generated as follows:
• The location and nature of IT resources in the university and its policy regarding their funding and purchasing.

• The management and decision making structure which affected the degree of information system development.

• Networking and communication systems between the computer centre and other information units, such as, libraries and departments.

• Future plans, including national networking plans, with regard to the use of IT in teaching, research, and administrative systems.

Two national bodies for computer networks and two PC manufacturers were visited to find out about the universities external relationships and activities. The results of the interviews with senior personnel in each body revealed the many complex issues in South Korea for developing academic computer networking. The results have been put in sequence as follows: computer centres, university libraries, departmental computing, top university management, government bodies for networking and PC manufacturers.

5.1 UNIVERSITY ASPECTS

Each element of the information networking services on university campuses, such as computer centres, libraries, science and engineering departments and top management offices were visited in order to get a picture of the current situation. The basic function of these units was found to be the same as in UK universities.
5.1.1 Computer centres

Understanding of current services and IT policy

Respondents were asked whether they thought information services provided on the campus matched all of the information needs of the students, academic staff and administrative staff. The general response was that the information services currently provided did not match all the information needs because computing facilities (hardware and software) were constantly changing and being upgraded very quickly. This led to the rapid obsolescence of IT equipment functionally and, consequently, its inability to satisfy the new needs of users. Every respondent, not only from computer centres, but also libraries, departments and top management thought that current IT services on their campus were unsatisfactory.

University groups A and B planned to increase university network capacity and stability, and non-networked group C institutions planned to initiate campus-wide networks. Members of each group were interested in expanding and exploiting software applications in administrative computing because it currently took place at too slow a pace. Long-term planning is difficult because of the uncertainty of the IT market in even the near future. No official link between information-providing units, such as computer centres, libraries and departments, was found. They appeared to be planning independently without co-ordination between information units on the campus. The interview responses also revealed that there was no clear division of ownership of responsibility between the different information providers. The networking services were seen, generally, to be the responsibility of the computer centre. Academic information services were usually held to be the responsibility of the library.

With regard to IT equipment purchasing procedure for their campuses, the decisions were always made by the computer centres. The interviews revealed that each group had a committee for computerisation on their campus.
However, they only dealt with general policy, such as how to charge for the electronic mail services employed by campus users, opening hours for computing, or networking on and off the campus. It was found that the procedure to purchase computer equipment in the computer centres was mostly dependent on the computer centres' own judgement. When departments and libraries purchase their IT equipment, they sought advice from their computer centres, but this was usually done informally.

It was noted that the university computer committee included senior academic members from each faculty and the directors of both the computer centre and the library. Administrative and Audio-Visual Units did not appear to provide any representatives. The members of this committee usually met twice a year (every semester) to plan and discuss the IT policy. When the meeting was held, the computer centre usually reported their activities to the committee. When there was a need to buy expensive equipment (such as mainframes, etc.), groups A and B set up 'ad-hoc' teams to carry out an analytical study in order to identify future trends and what is available on the market. This study team consisted of people mainly from the computer centre and from science or engineering departments within the university which have computer and network experts. One of the group C universities did not form this kind of evaluation and selection team even in their computer centre. They were more likely to depend on the commercial companies to get information about computer and communication equipment. During the interviews in all three university groups, it was noted that there was no 'computer user committee'. Such a user committee would involve university members who use the computer and network facilities, as is commonplace in the UK. It is concerned with the practical operation of the computer centre, and with feedback on problems that are found on and off the campus.

Group C universities all suffer from poor funding. They do not have a special government grant and they have less endowment from the academic foundation and industry areas. They only have university working expenses available for the funding of IT development on their own campus. On the other hand, group
A and B universities have government support, special grants for campus networking and library automation, and relatively better endowment from the industries (linked to cooperative projects with the universities), in addition to the normal university working expenses. The financial situation of group A universities is relatively better than that of group B universities.

Networking and computing

The interviews revealed the state of play with regard to computing to differ between the universities as shown in Table 5.1. As mentioned before, group A universities have the most advanced facilities, followed by groups B and C, respectively.
Table 5.1 Computing and personnel by institution

<table>
<thead>
<tr>
<th>Group / Universities</th>
<th>Main computer</th>
<th>Workstation</th>
<th>PCs / terminals and its ratio with students*</th>
<th>Personnel in computer centres</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group A</strong></td>
<td><strong>SNU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM 3090</td>
<td>RS6000/560 = 4</td>
<td></td>
<td></td>
<td>Total: 52</td>
</tr>
<tr>
<td>Cyber 962</td>
<td>Sun (SPARC)10</td>
<td></td>
<td></td>
<td>faculty member: 7</td>
</tr>
<tr>
<td>Alliant</td>
<td>Sun 4/470</td>
<td></td>
<td></td>
<td>system analyst: 4</td>
</tr>
<tr>
<td>VAX-4200</td>
<td>Sun 4/330</td>
<td></td>
<td></td>
<td>programmer: 6</td>
</tr>
<tr>
<td>SSM 7000 (TiCOM)</td>
<td></td>
<td></td>
<td></td>
<td>operator: 10</td>
</tr>
<tr>
<td>CD 4680</td>
<td></td>
<td></td>
<td></td>
<td>key puncher: 8</td>
</tr>
<tr>
<td>IBM 4381</td>
<td></td>
<td></td>
<td></td>
<td>assistant: 10</td>
</tr>
<tr>
<td>MVAX 4000</td>
<td></td>
<td></td>
<td></td>
<td>admin. staff: 6</td>
</tr>
<tr>
<td>MVAX-3800</td>
<td></td>
<td></td>
<td></td>
<td>admin assistant: 1</td>
</tr>
<tr>
<td><strong>YSU</strong></td>
<td><strong>IBM 4381</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAX-6420</td>
<td>Sun 10 = 2</td>
<td></td>
<td></td>
<td>Total: 26</td>
</tr>
<tr>
<td>HI Server (TiCOM)</td>
<td>STD/Sambo-250</td>
<td></td>
<td></td>
<td>faculty member: 2</td>
</tr>
<tr>
<td>DEC 7000/M630</td>
<td>STD/Sambo-300E</td>
<td></td>
<td></td>
<td>system analyst: 4</td>
</tr>
<tr>
<td>SUN Center 2000</td>
<td>RS6000-S20</td>
<td></td>
<td></td>
<td>programmer: 6</td>
</tr>
<tr>
<td>VAX-3100</td>
<td>DEC 3000</td>
<td></td>
<td></td>
<td>operator: 3</td>
</tr>
<tr>
<td></td>
<td>DEC 5025</td>
<td></td>
<td></td>
<td>technician: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>admin. staff: 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>assistant: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>etc.: 3</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td><strong>CNU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM 4361</td>
<td>IBM RS/6000</td>
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<td></td>
<td>Total: 37</td>
</tr>
<tr>
<td>TiCOM (DTC-9000)</td>
<td>SUN 2</td>
<td></td>
<td></td>
<td>faculty member: 5</td>
</tr>
<tr>
<td></td>
<td>SUN 10</td>
<td></td>
<td></td>
<td>system analyst: 2</td>
</tr>
<tr>
<td></td>
<td>GWS-25</td>
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<td>programmer: 9</td>
</tr>
<tr>
<td></td>
<td>HP 9000/800-G70</td>
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<td></td>
<td>operator: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>key puncher: 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>assistant: 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>admin. staff: 4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>etc.: 3</td>
</tr>
<tr>
<td>Group</td>
<td>Institution</td>
<td>Computer Models</td>
<td>System Administration Details</td>
<td>Total</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>----------------</td>
<td>------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>CAU</td>
<td>IBM 3090 (150J-Vector)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VAX 4300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DPS-8152</td>
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</tr>
<tr>
<td></td>
<td>TiCOM</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>MVAX-2</td>
<td></td>
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<tr>
<td></td>
<td>RS6000/520</td>
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<tr>
<td></td>
<td>RS6000/32H</td>
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<tr>
<td></td>
<td>RS6000/320</td>
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<td></td>
<td>1,028</td>
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<td></td>
<td>Total: 46</td>
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<tr>
<td></td>
<td>faculty member: 1</td>
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<tr>
<td></td>
<td>system analyst: 3</td>
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<tr>
<td></td>
<td>programmer: 11</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>admin. staff: 2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>assistant: 29</td>
<td></td>
<td></td>
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<tr>
<td>Group C</td>
<td>CJU</td>
<td>PRIME 9750</td>
<td></td>
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<tr>
<td></td>
<td>ALPHA MICRO</td>
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<td></td>
<td>Alliant</td>
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<tr>
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<td>938</td>
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<td></td>
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<td></td>
<td>faculty member: 1</td>
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<tr>
<td></td>
<td>programmer: 6</td>
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<tr>
<td></td>
<td>assistant: 6</td>
<td></td>
<td></td>
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<tr>
<td>TGU</td>
<td>VAX 6410</td>
<td></td>
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<tr>
<td></td>
<td>VAX 4400</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>VAX 8350</td>
<td></td>
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<tr>
<td></td>
<td>DEC 150</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>SUN 1000</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>STG STATION</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>842</td>
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<td></td>
<td>(1:29)</td>
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<tr>
<td></td>
<td>Total: 8</td>
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<td></td>
<td>faculty member: 1</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>programmer: 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>operator: 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>admin. staff: 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Note: * There is no official statistics on how many PCs are available for staff and students. However, it was planned that every academic staff would have a PC each.]
Table 5.2 shows the network speed for each institution visited. Figures 5.1 - 5.6 show the configuration of each campus network. In terms of network configuration, the two group A universities in Figure 5.1 and 5.2 used FDDI (Fibre Distributed Data Interface) double ring (fibre optic) for the campus backbone. The two group C institutions are using a coaxial-cabled Ethernet bus configuration as shown in Figures 5.5 and 5.6. Figures 5.3 and 5.4 show that group B universities are in a transition phase between Ethernet links and FDDI fibre optic links.

Table 5.2 Network speed for universities

<table>
<thead>
<tr>
<th>Types / Inst.</th>
<th>SNU</th>
<th>YSU</th>
<th>CNU</th>
<th>CAU</th>
<th>CJU</th>
<th>TGU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NETWORK SPEED</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>backbone</td>
<td>100 Mbps</td>
<td>100 Mbps</td>
<td>100 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
</tr>
<tr>
<td>subnet</td>
<td>100 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
</tr>
<tr>
<td>h/w for end user:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>workstation</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
<td>10 Mbps</td>
</tr>
<tr>
<td>PC / terminals</td>
<td>9.6 Kbps</td>
<td>9.6 Kbps</td>
<td>9.6 Kbps</td>
<td>9.6 Kbps</td>
<td>9.6 Kbps</td>
<td>9.6 Kbps</td>
</tr>
<tr>
<td>dial-up (modem)</td>
<td>2,400 bps</td>
<td>2,400 bps</td>
<td>2,400 bps</td>
<td>2,400 bps</td>
<td>2,400 bps</td>
<td>2,400 bps</td>
</tr>
<tr>
<td></td>
<td>9,600 bps</td>
<td>9,600 bps</td>
<td>9,600 bps</td>
<td>9,600 bps</td>
<td>9,600 bps</td>
<td>9,600 bps</td>
</tr>
</tbody>
</table>
Figure 5.1 Network of the Seoul National University (Group A)
Figure 5.2 Network of the Yonsei University (Group A)
Figure 5.4 Network of the Chungang University (Group B)
Figure 5.5 Network of the Chungju University (Group C)
Figure 5.6 Network of the Taegu University (Group C)
CHAPTER 5

RESULTS OF THE INTERVIEWS

For the extension of their network services, all the universities visited were planning to change their backbone topology from the old-fashioned Ethernet to FDDI in group C, and from FDDI to ATM (Asynchronous Transfer Mode) in groups A and B institutions. They all mentioned that their campus networking was in a transitional phase of development to provide better networking facilities and services. Group C universities planned to initiate fully integrated campus-wide networks as soon as possible. On the other hand, groups A and B universities planned to upgrade network speed and bandwidth; to update the contents of on-campus information services (such as the Bulletin Board Systems and file transfer services); to connect links with commercial computer network service providers such as HiTEL (a Korean version of the French Minitel) and NowCom for external access (mainly home); and to increase university capacity for a dial-up service for home computing in the near future. One of the group B institutions was considering the use of wireless LAN on the campus and intended to distribute mail servers to each faculty (college).

The universities visited showed much less difference between the groups in using computers for administrative work, such as financial systems for payroll and budget and word-processing. Universities in group A recently started to use computers and networks for registration, for applications to attend lectures and for browsing syllabuses. There was no registration service yet via computer networks in groups B and C universities. It was also found that there was no resource sharing for financial information among the groups.

Training and education

It was apparent that group A and B universities have better user training programmes, such as regular training courses, handbooks for network computing, and provision of Bulletin Board Systems to guide the use of the network by computer centres. They put on regular training courses twice a year (every semester) - see table 5.3. Staff at the computer centres teach their users on the campus. They devise the courses and organise the programmes
according to the number and types (staff and student) of users. The computer centres did not have separate advisory offices to help users who need personal advice (face to face service with consultation staff). However, one of the group B institutions has temporarily started to use ARS (auto-response system) for inquiry-answer services by telephone. At present, the interviewees of group C institutions indicated that there are irregular training sessions, little documentation and no plans for guidance services, such as Electronic Bulletin Boards. In general, the user training courses in the computer centres of the three groups of universities covered the following topics.

<table>
<thead>
<tr>
<th>Table 5.3 Topics of user training in the computer centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic IT skills</td>
</tr>
<tr>
<td>Graphic packages</td>
</tr>
<tr>
<td>Programming languages</td>
</tr>
<tr>
<td>*Use of campus network facilities (e-mail, Internet searching etc.)</td>
</tr>
<tr>
<td>*Statistical packages</td>
</tr>
</tbody>
</table>

[Note: The topics marked with * are only available in one of the group A and one of the group B universities.]

One of the group A universities indicated that they had more specialised tutorial sessions for staff who were working in the faculty of engineering. They provided tutorials for engineering computing every semester. Group C institutions, which did not have network facilities for their users, provided courses on basic computing topics, such as basic IT skills, programming languages, etc.

With regard to staff training, group B universities have more opportunities for attending seminars than A and C group institutions. Senior members of group B computer centres emphasised that staff training was currently very important, because there is an urgent need to help with the development of the networking
facilities presently used around the campus. They noted that staff training was imperative to keep the staff up-to-date with rapid changes of IT.

Group A universities take technical advice from one of the national working groups (which is organised by KREOnet, under the control of KIST, Korea Institute of Science and Engineering) for managing their networks. This has increased and updated their knowledge of networking and computing. They mentioned that they have already reached the highest level of computer expertise in South Korea, so, at the moment, there is almost nothing to be learned from local and national-level seminars. They are more dependent on foreign suppliers, such as IBM who have a branch in Seoul (IBM Korea), to obtain new IT skills in order to cope with new IT facilities than on sending staff abroad (mainly the United States) for training or for attending seminars and courses. This approach was preferred because of current limitations (especially financial constraints) and the few staff who were fluent in foreign languages, in this case English. In order to increase and update their computing knowledge, they have also been using current publications, such as computer manuals and books, the experience of colleagues, and the experience of teaching and research staff and equipment suppliers.

Group C institutions had poorer staff training sources than groups A and B. These universities often used domestic publications only. They had no skilled specialists. They also had less support from their academic staff and less support from equipment suppliers. One of the group C universities mentioned that they were developing and upgrading their IT knowledge from a PC user group of a commercial network service, HiTEL. However, it is worth noting that the other group C university had acquired IT specialists from advanced institutions (academic and business areas) especially to accelerate IT projects, such as campus networking and library automation, on their campus.
5.1.2 University libraries

IT policy and planning

The interviews in the university libraries indicated that, when they plan information policy, all three groups experience the same pressures, such as reluctance internally to change their working environment, insufficient motivation, and insufficient manpower and income in their libraries. There were however some differences between the groups. Group A and C universities claimed to have insufficient support for library information services from the university authorities. Group B universities claimed to have reasonable support for library information services. These universities were trying to catch up with group A universities in terms of library automation.

University libraries in group A experienced some conflict and tension with the computer centres concerning IT provision on the campus, because computer centres always take the initiative in purchasing computer hardware (and sometimes even software) for the library. Interviews revealed that there was no effective body for coordinating the purchase of IT equipment between the various information provision units on the campus. As mentioned before, decisions are always made according to the wishes of the computer centres. Group B and C universities had relatively little tension with computer centres, both because they are trying to avoid this kind of problem and because they are less advanced. All three groups were experiencing the pressure of insufficient budgets.

Interviewees from groups A, B and C all mentioned that it was difficult to have long-term plans for IT resources in the library because of the uncertainty of the IT market. Long-term plans were also affected by the non-existence of bodies to coordinate information provision for overall IT services on the campus. At the time of the interview, groups A and B university libraries were planning to purchase more equipment for multi-media services (CD-ROM based) in order to improve IT services. The university libraries of group C have no plans, as
yet, for multi-media services. The interviews revealed that one of the group B institutions already provided access to foreign commercial database services, such as Dialog/BRS. The other university of this group planned to introduce compact disks for newspapers, journals and thesis collections within their library to form a regional information resource centre.

**IT resources in the libraries**

Group B and C libraries were found to have completed their retrospective online catalogue conversion already. However, group A libraries who have more collections and have their own catalogue packages (each of them developed their own Korean versions of DOBIS/LIBIS, IBM and UTLAS, University of Toronto Library Automation System, T Series 50) have not totally finished the job of retrospective catalogue conversion. The CD-ROM database of one Group A university library is now available on the campus. Table 5.4 shows basic computer facilities and systems which were being used in these libraries.
Table 5.4: Library resources and personnel

<table>
<thead>
<tr>
<th>Universities</th>
<th>Total collections</th>
<th>titles of annual increase</th>
<th>personnel</th>
<th>computing facilities</th>
<th>library packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNU</td>
<td>1,663,000</td>
<td>45,000</td>
<td>Total: 148 lib. professional: 97 admin, etc.: 41 systems lib: 10</td>
<td>TANDEM HK 1000 SUN 630 MP</td>
<td>Solaris, total system (Korean version of UTLAS)</td>
</tr>
<tr>
<td>YSU</td>
<td>1,007,000</td>
<td>60,000</td>
<td>Total: 120 lib. prof: 39 admin, etc.: 74 systems lib: 7</td>
<td>IBM 4381 from CC</td>
<td>DOBIS/E, total system (Korean version of DOBIS/LIBIS)</td>
</tr>
<tr>
<td>Group B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CNU</td>
<td>534,000</td>
<td>35,000</td>
<td>Total: 65 lib professional: 21 admin, etc.: 23 systems lib: 2</td>
<td>PCs based</td>
<td>OROM</td>
</tr>
<tr>
<td>CAU</td>
<td>538,000</td>
<td>40,000</td>
<td>Total: 19 lib prof: 15 admin: 2 systems lib: 2</td>
<td>PCs based</td>
<td>KORE</td>
</tr>
<tr>
<td>Group C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CJU</td>
<td>418,000</td>
<td>30,000</td>
<td>Total: 30 lib prof: 14 admin: 14 systems lib: 2</td>
<td>PCs based</td>
<td>KORE</td>
</tr>
<tr>
<td>TGU</td>
<td>373,000</td>
<td>25,000</td>
<td>Total: 45 lib prof: 23 admin, etc.: 21 systems lib: 1</td>
<td>VAX 8350</td>
<td>LINNET, total system</td>
</tr>
</tbody>
</table>

In terms of the LAN and WAN connections for provision of information services in the library, group A noted that their library OPACs are available on the campus as well as off the campus through network links; group B said that OPACs are accessible on their campus only; group C had OPACs available in the library only. Libraries of group A and B universities had a network service for CD-ROM databases within the library. One of the group A universities noted that a CD-ROM network service is available on the campus through campus LANs. No CD-ROM database service for library users was found in the libraries of group C universities. With regard to information provision using IT, in order to fit in with their printed resources, groups A and B libraries had plans to increase the number of CD-ROM versions of printed resources gradually. Group C had no special plans yet for electronic versions.
Training and education

For the handling of electronic information by the user, topics, such as use of OPACs and CD-ROM database searching, were covered in user training courses by groups A and B university libraries. The libraries of group C universities had user training sessions for using OPACs. One of the group B libraries was unique in having an Internet search training course. All these courses were run by the library staff who were in charge of library instruction or and library automation. The libraries of group A, B and C universities were all aware that networking is becoming the basic indispensable facility for library work. Library staff training, such as self-study from publications and learning or training through seminars, was used among all three groups in order to develop information skills for their effective use of IT.

Library staff of group B universities had relatively less advice from computer centres for the computerisation of library information activities than group A and C institutions. Instead of contacting their computer centres they were more likely to use providers of library automation packages for learning how to maintain and manage computer facilities. Group A sought advice from the original foreign library package suppliers (Yonsei University Library: IBM Korea for DOBIS/E system; Seoul National University Library: Hankuk Computer Co. for UTLAS, University of Toronto Library Automation System). The library staff of both groups B and C universities increase their computing knowledge via domestic library package providers and user group meetings devoted to relevant packages. One of the group B institutions used in-house training given by the IT team of their own library.

5.1.3 Departmental computing

Network use and computer equipment

It was found that, in general, the departments of group A universities had better computing power. There was a clear intention to increase the computing
facilities still further in the departments visited. Departments of group C universities had problems in expanding the power of computing for their teaching and research because of financial problems. One interviewee in this group remarked that they were reluctant to use computers in their department because most of the teaching members were quite ignorant of how to use computers for teaching and research. The situation of the departments in group B institutions lies between groups A and C universities. Computer equipment in the departments visited for interviews was found to be as follows.

Table 5.5 Computer equipment in the departments of universities

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SNU: Chemical Engineering</strong></td>
<td><strong>CNU: Mechanical Engineering</strong></td>
<td><strong>CJU: Electronic Engineering</strong></td>
</tr>
<tr>
<td>- Workstations: 17</td>
<td>- Workstations: 7</td>
<td>- Workstation: 20</td>
</tr>
<tr>
<td>- PCs: 84</td>
<td>- PCs: 32 (Mac: 1 included)</td>
<td>- PCs: 20</td>
</tr>
<tr>
<td><strong>YSU: Electronic Engineering</strong></td>
<td><strong>CAU: Physics</strong></td>
<td><strong>TGU: Chemistry</strong></td>
</tr>
<tr>
<td>- Workstation: 40</td>
<td>- Workstation: 1</td>
<td>- Workstation: no w/s</td>
</tr>
<tr>
<td>- PCs: 64</td>
<td>- PCs: 15</td>
<td>- PCs: 19 (Mac: 2 included)</td>
</tr>
</tbody>
</table>

With regard to network use in the departments, group A institutions made particular use of these for their engineering subjects through an engineering LAN in the engineering faculty building. Departments in groups B and C universities did not have a customised network, like this engineering LAN, and departmental LANs were used less expertly than by the departments of group A institutions. Through national network connections, science and engineering departments of groups A and B universities used supercomputing facilities from one of the national computer centres, SERI in KIST. Departments of group A universities used supercomputing facilities more heavily than departments of group B institutions; there were no links to national supercomputing resources.
in group C institutions. Some members of group C institutions used national computer networks on a personal basis via commercial network (Internet) providers, such as KORnet of Korea Telecom.

All groups agreed that their working style had been changed by the introduction of computers. The speed of change depended on their computing facilities for teaching, learning and administration. The following computing activities were especially mentioned as affecting work style.

- teaching and learning: computer projector use, presentation packages, new computational courses (such as CAD/CAM), simulations, etc.
- research: electronic mail and electronic bulletin board use, OPACs and database searching from remote locations.
- administration: word-processing, database management, etc.

They all agreed that the introduction of computers had made their departments more efficient. However, they also remarked that the potential of IT equipment in their departments was not yet fully exploited. They all agreed that the integration of computer activities (e.g. use of multi-purpose computing) was increasing. All interviewees of the departments visited similarly noted that the importance of networking for teaching and research was gradually increasing. For teaching, they mentioned computational courses, video conferences etc.; for research, communications with foreign researchers and facilities. In conclusion, they all agreed that computers and networks have become indispensable items of equipment in their academic life.

Interviewees also noted that all three groups have problems due to rapid changes in the IT environment. For hardware, they need finance to replace old machines, and, for software, continuous training is needed for applying new software. Users' demands are increasing for replacing hardware as new software is developed.
Training and advice

With regard to training and education, departmental members of all three groups who were in charge of computing services noted that systematic advice is required. They mentioned that their knowledge of managing computer equipment was not sufficient. They also noted that, currently, they are nevertheless able to meet departmental needs. At present, they are receiving advice on computing from other staff - especially departmental colleagues who have recent PhD degrees from advanced countries, such as the United States, colleagues from other science and engineering departments, and staff of their computer centres. They also make use of newsletters from their computer centres.

Departmental computing staff at groups A and B institutions indicated general satisfaction when communicating with their computer centres. They obtained assistance and advice when they purchased new computers and when installing network systems in their departments. Staff in the departments of group C universities did not have special contact with the computer centre for getting advice. One of the group C respondents complained that the computer centre staff were not competent enough to advise on computing needs in the department.

IT policy in the departments

In order to extend and introduce more computer-based resources, all three groups intended to purchase new products when they have shown themselves to be effective. They wanted to use computer projection systems for teaching, and process simulation software for student learning in their departments. During the interviews, it was noted that departmental staff of group B and C universities intended to run departmental Bulletin Board Systems for information dissemination and exchange between their staff and students in the future. Departments of group A universities had already started to use Bulletin
Board Systems in their departments for these purposes. However, they emphasized the need for upgrading with new information as necessary.

Insufficient finance, manpower limitations (computing and network managers) and lack of space in their departments were pointed out as problems among departments at all the universities. In addition, departmental staff at groups B and C universities noted that their current budgetary system for purchasing expensive IT hardware and software was an additional problem. Their university authorities controlled the purchase of expensive IT equipment that cost around 10,000,000 Korean Won (8,330 UK Pounds) or more. They did not make allowance for IT equipment to be included in the normal university budget. Generally, departments of group C universities were more resistant to computerisation than other group universities mainly because of the shortage of finance.

5.1.4 Top management

IT policy and planning for organisational change

In terms of links between national policy and the higher education sector, it was found that group A universities had been selected to be test-bed institutions for the application of the new national superhighway project (mentioned in Chapter 1). One of the group B institutions had also been appointed as a regional centre for national network applications in the superhighway project. Group A and B institutions received special government grants for campus LAN construction and library automation. Group C institutions had no government grants, and no direct links with the central network bodies as yet.

In order to overhaul the computer and networking systems (information infrastructure) on their campus, one of the group A institutions intended to introduce a Chief Information Officer (a Vice President post) with the role of enhancing information services. One of the group B institutions visited was considering introducing a package which was originally developed from EDS
(Electronic Data Systems Corporation), but adapted to the Korean language by one of the South Korean commercial company (LG-EDS Systems Co.), for campus systems integration.

Tables 5.6 and 5.7 show the organisation and user distributions for the six universities visited for interviews. As can be seen from the general procedure for university decision making shown in Figure 5.7, there were committees for university computerisation. However, it was apparent that most of the computer and network related planning and working was determined by the computer centre as the dominant decision making body. The computer centre was accepted as the major influential body for the computing and networking areas, and was also perceived to have the IT specific (technical) knowledge necessary. Current organisational structures for each university are depicted in the following Figures 5.8 - 5.13.
### Table 5.6 University organisation

<table>
<thead>
<tr>
<th>Types/Inst.</th>
<th>SNU</th>
<th>YSU</th>
<th>CNU</th>
<th>CAU</th>
<th>CJU</th>
<th>TGU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculties</td>
<td>16</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Departments</td>
<td>106</td>
<td>53</td>
<td>88</td>
<td>83</td>
<td>60</td>
<td>72</td>
</tr>
<tr>
<td>*Postgraduate Schools</td>
<td>1 main &amp; 3 special courses</td>
<td>1 main &amp; 8 special courses</td>
<td>1 main &amp; 4 special courses</td>
<td>1 main &amp; 5 special courses</td>
<td>1 main &amp; 2 special course</td>
<td>1 main &amp; 4 special courses</td>
</tr>
<tr>
<td>**Supportive Institution</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

*Note: * Special courses in postgraduate schools are specialist Master's courses.

**Supportive institutions consisting of libraries, computer centres, museums, audiovisual centres, campus dormitories, student unions, campus newspapers and campus broadcasting stations, etc.*

### Table 5.7 User distribution by universities

<table>
<thead>
<tr>
<th>Type/Inst.</th>
<th>SNU</th>
<th>*YSU</th>
<th>CNU</th>
<th>CAU</th>
<th>CJU</th>
<th>TGU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate</td>
<td>19,460</td>
<td>17,642</td>
<td>17,141</td>
<td>17,560</td>
<td>10,470</td>
<td>14,570</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>8,266</td>
<td>6,771</td>
<td>2,477</td>
<td>3,187</td>
<td>718</td>
<td>982</td>
</tr>
<tr>
<td>Professors</td>
<td>1,374</td>
<td>929</td>
<td>761</td>
<td>568</td>
<td>265</td>
<td>339</td>
</tr>
<tr>
<td>Staff (admin.)</td>
<td>541</td>
<td>354</td>
<td>230</td>
<td>248</td>
<td>158</td>
<td>145</td>
</tr>
</tbody>
</table>

*Note: * YSU covers the Seoul campus only in these figures.*
ADVISORY/DISCUSSION BODIES
- Faculty Council
- Deans & Directors Council
- Planning Committee
- Research Committee
- Graduate School Committee

SPECIALISED DISCUSSION BODIES
- Fund raising committee for the development
- Space committee
- Election committee for the president
- Operation committee for library
- Univ. computerisation committee: Co-ordination committee for computation
  - *library computation committee
  - *campus networking committee
  - *administrative computing committee

Figure 5.7 General organisation of university decision-making in South Korean universities
CHAPTER 5 RESULTS OF THE INTERVIEWS

Figure 5.8 Administrative organisation of Seoul National University
Figure 5.9 Administrative organisation of Yonsei University
Figure 5.10 Administrative organisation of Chunnam National University
CHAPTER 5 RESULTS OF THE INTERVIEWS

Figure 5.11 Administrative organisation of Chungang University
Figure 5.12 Administrative organisation of Chungju University
Figure 5.13 Administrative organisation of Taegu University
CHAPTER 5 RESULTS OF THE INTERVIEWS

With regard to organising the network infrastructure, the group A institutions planned to develop a sub-network infrastructure for each faculty (college). Group B universities had plans to complete first the campus network as a totally integrated system. Group C universities intended to develop a campus wide networks in the near future. It was noted that they all wanted to facilitate computer applications for research, instruction and management and to be able to provide a stable source of finance. It was found, however, that there was no evaluation process to monitor IT performance on any of the campuses. All three groups wanted to have external links with other education bodies, research institutions and government offices in the future.

All groups pointed out that financial support for upgrading IT equipment was one of the major problems. Interviewees at group A and B universities mentioned that additional manpower was needed to expand computer and networking services as well. The respondents in group C noted that they were suffering from a shortage of skilled staff for computing. All three groups mentioned that there was no long-range planning because of the uncertainty of how new information technology would be used in the future. Group C universities especially noted that conflict between university governing bodies and university faculty members (due to non-democratic decision making processes) was currently the main issue on both their campuses.
5.2 NATIONAL ASPECTS

National planning

The government has recently planned the superhighway project as a three-stage development process. Two national computer and networking bodies, KREONet (Korea Research Environment Open Network) manage one of the Internet gateways via US Internet and European Europanet links; and KREN (KoRea Education Network) acts as the national gateway for BITNET II, and as a gateway to Korea Telecom Research Centre for Internet connections. The following figures show the configurations of networks (Internet) in South Korea (Fig. 5.14), KREONet (Fig. 5.15), and KREN (Fig. 5.16).
Figure 5.14 Internet backbone in South Korea, 4. 1995
CHAPTER 5 RESULTS OF THE INTERVIEWS

INTERNET (HEPNET, BIONET, InterNIC...)

256Kbps

64Kbps

overseas networks

EURÓPA NET

Intelsat

Japan

South America

Middle East

Asia-Pacific

ICMNET/NSFNET
Stockton, CA

overseas PSDN

KREN HANA...

Dacomnet

KORDIC

O;~

T1 x 2

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

512Kbps

256Kbps

256Kbps

256Kbps

Seoul

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

56Kbps

Seoul KREONet

LAN Dialup: 968-0451-9 964-5451-9

(NIC) MP870 ("gaya")

Daeduk KREONet

Cray

LAN

CYBER

LAN

Dialup: 861-4021-9

(NIC) MP690 ("garam")

Figure 5.15 Configuration of KREONet, 4. 1995

176
Figure 5.16 KREN (Korean Education Network) backbone

KREN (Korean Education Network) backbone, 4. 95

KREN (Korean Education Network) backbone, 12. 95 (planned)

(Source: Choi, Yanghi, 1995)
The two national bodies for networking (KREONet for research centres, supported by the Ministry of Science and Technology; and KREN for school networking, supported by the Ministry of Education) noted that the computer services and networks for the academic setting (their teaching and research) have the following requirements:

- basic service: e-mail, file transfer, remote terminal access, and electronic bulletin board systems
- super-computing services: access and application
- on-line database access service: national and international database searching

As noticed in Chapter 4, networked universities in groups A and B use basic, on-line database access services and super-computing services on their own campus. Respondents remarked that remote education with the basic services mentioned above, and cooperative projects with the industrial sector, are possible through computer networks. In terms of a policy to bring all universities up to the same enhanced level for networking, KREONet provides services as follows:

- technical support to the member universities through the KREONet technical group (from instalment to maintenance) with manuals, guide books, newsletters, symposium and mailing list services.
- training services for the application of programs.

KREN was reported to be less active than KREONet for training services due to the frequent changes of personnel who were in charge of the technology development and transfer between institutions. However, they train university network managers by visiting and instructing on site, or by giving seminars at the request of the member universities.

Through cooperative projects with research and industrial sectors, these bodies try to link their work to external bodies, such as universities, to help develop
their technology. For example, KREONet has been developing a search engine, "Spider", with one university; KREN has a close relationship with academic staff of the Science and Engineering College in Seoul National University, which already has cooperative projects with the industrial sector. They felt that the lead for IT development in South Korea comes from KIST (Korea Institute of Science and Technology, one of the national think tanks for science and technology), leading domestic universities and via links to advanced countries, such as the US.

The interviews revealed that, over the next few years, KREONet network services would be more active than the KREN service. They planned several projects as follows:

- high-speed backbone network architecture design and construction
- Daeduk science town backbone (metropolitan area network) construction with over 622 Mbps/ATM
- national science and technology policy supporting system design (e.g., EDI system of MOST, Ministry of Science and Technology)
- supercomputer application software development
- developing automatic translation system for foreign DB retrieval (Japanese-Korean, English-Korean)
- developing user interface technology
- developing information retrieval tools
- constructing high speed special lines for multimedia services (video-conference, etc.) between the US (T3, 45 Mbps), Europe and Japan (T1, 1.54 Mbps each)

KREN has been planning to upgrade the current backbone from 64 Kbps to 256 Kbps for international services and to change the network topology from the current tree type to star type as indicated in Figure 5.16.
CHAPTER 5

RESULTS OF THE INTERVIEWS

Training services

For training and for encouraging the use of IT, KREONet provides their members with the following services:

- For network information: user guides, reports and papers
  -visits, telephone and postal services
  -introductions to foreign resources

- For networking technology: support installment (for naming, addressing and routing, etc.)
  -support maintenance and management
  -maintaining the NIC (Network Information Center)
  -training and seminars for network managers (3-4 times a year)
  -maintaining mailing lists (BBS)

On the other hand, KREN does not provide an official training programme. At present, they only give services relating to their user education and training in response to enquiries.

Problems and obstacles

The two national networking bodies pointed out some key problems associated with networking the universities as follows:

- top management's understanding of IT on the campus varied from university to university.
- there was a conflict between the information units involved (i.e. computer centres, libraries, departments, etc.).
• supporting services from the public bodies, such as Korea Telecom, was described as insufficient (for example, the number of technicians working on public network connections was insufficient).

It also appeared from these interviews that the national project for networking is subject to a number of limitations, as follows:

• insufficient manpower for participating in the national and global networking systems.
• totally insufficient government budget for Research and Development.
• non-execution of the basic plans which have already been decided by the government (these are still being delayed).
• no unified body for the national academic and research network. It is difficult to exchange opinions and experiences as KT (Korea Telecom) is under the control of the Ministry of Information and Telecommunications, whereas KRENNet is under the Ministry of Education and KREONet is under the Ministry of Science and Technology.
• the mother institution of KREONet, SERI (Systems Engineering Research Institute) is too small for nation-wide projects (i.e. independence from SERI is needed for rapid progress to be possible).

Moreover, KREN pointed out that there are organisational problems, such as:

• an absence of higher ranking IT professionals who can support computer network projects in the Ministry of Education. Decision makers for the national policy for science and technology are general administrative officers who are neither science-based, nor experienced specialists.
• as a government institution, they appeared to suffer from bureaucratic inertia. A more dynamic and flexible management in their approach to IT development is required for proper planning and budgetary control.
5.3 BUSINESS MARKET ASPECTS

Background and marketing strategies

During the interviews with sales managers of the two leading computer manufacturing companies in South Korea (Samsung Electronics Co. and Sambo TriGem Computer, Inc.) it was noted that both of the companies have the same sort of understanding of the needs for national planning for networking. The main factors included:

- construct a nation-wide infrastructure for the information superhighway project by the year 2015.
- protect national computer business markets by constructing a national neural network.
- ensure that the network and the computer market meet the new trade regulations before opening them to the world market.
- promote the policies of government and industry through mass campaigns. This kind of campaign should mobilise large groups of people in South Korea to work towards the common objective of encouraging the use of computers and networks.

With regard to the annual growth rate, they expected 100 % growth in 1995 (the year they were visited for interviews) as compared with the previous year (see the number of PCs sales in 1994 in Table 5.9). They noted that the trends for IT purchase are:

- downsizing
- preference for foreign equipment
  (which is more powerful and reliable)
- Internet use
- systems integration
They agreed that the market for PCs is growing very quickly due to the nationwide commercial PC telecommunication services and Internet use.

Table 5.8 PC sales for 1994 in South Korea

<table>
<thead>
<tr>
<th>User division</th>
<th>Numbers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Users</td>
<td>600,000</td>
<td>50</td>
</tr>
<tr>
<td>Business bodies</td>
<td>420,000</td>
<td>35</td>
</tr>
<tr>
<td>Public/Educational bodies</td>
<td>180,000</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>1,200,000</td>
<td>100</td>
</tr>
</tbody>
</table>

[Note: Official figures for PC sales by individual computer companies were not available, but overall PC sales for 1994 are shown above (4).]

It was noted that the current limitations that affect the marketing of computer and communications products are as follows:

- learning about new technology which is growing and changing very quickly.
- uncertainty about standardisation of new technology (such as ATM) etc.
- price competition between companies is very high.
- insufficient Korean-made networking equipment (5). In general, computer manufacturing technology in South Korea lags behind that of advanced countries, except for semi-conductor memory and mother-board parts (as in Table 5.10).
- dependency on foreign network vendors (the three major foreign vendors who have branches in South Korea are Novell, Cisco and 3 COM) for advice when using foreign networking products.
### Table 5.9 Information technology and South Korean competitiveness

<table>
<thead>
<tr>
<th>IT equipment</th>
<th>Advanced countries</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>United States</td>
<td>Japan</td>
<td>Europe</td>
<td>NICs*</td>
</tr>
<tr>
<td>Small size computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>laptop computer</td>
<td>100</td>
<td>100</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>High Performance Computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligent multimedia</td>
<td>100</td>
<td>100</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>parallel processing</td>
<td>100</td>
<td>80</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>optical computer</td>
<td>100</td>
<td>80</td>
<td>70</td>
<td>20</td>
</tr>
<tr>
<td>neural computer</td>
<td>70</td>
<td>100</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Operating Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallel processing OS</td>
<td>100</td>
<td>80</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>object orient OS</td>
<td>100</td>
<td>50</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallel processing</td>
<td>100</td>
<td>80</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>Database Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>parallel processing DBMS</td>
<td>100</td>
<td>50</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>object orient DBMS</td>
<td>100</td>
<td>40</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>multi-media DBMS</td>
<td>100</td>
<td>70</td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>Middleware</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>distributed system</td>
<td>100</td>
<td>80</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>computer communications</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input/Output Devices</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>60</td>
</tr>
</tbody>
</table>

(Source: Ministry of Science and Technology, 1995)

[Note: 100 = most highly developed technology of this type. Other figures represent semi-quantitative estimates of relative standing (as of 1994). * means Newly Industrialised Countries, such as Taiwan and Malaysia including South Korea]
Strategies for the education market place

Both computer companies stated that they have special strategies for interacting with schools and universities. One company had already suggested a 50% - 60% reduction from the original market price for academic purchases. The other was considering zero margin sales - as an advertisement for the company to attract future customers and obtain a dominant position in the fast growing market. As regards marketing strategies, both companies agreed that good relationships with academic institutions could yield multiple benefits for their companies and their products. They both have a policy of small profits and quick returns. One interviewee remarked that the computer industry's relationships with universities could be seen as an example of symbiosis, a relationship between two dissimilar organisations that yields benefits for both.

With regard to cooperative research with universities, there was no such work with research universities on networking. However there were some PC-based research projects with some universities by two companies, Samsung Electronics Co., especially, has been developing multimedia application research for the national test-bed project with universities. Both companies have a very active recruitment policy for degree holders from foreign countries in order to supply new technology to their company. In order to support university customers, they provide a one-year guaranteed service, including a callout facility and after-sales for maintenance and enhancement of computer and network technology. Sambo TriGem provides engineers on the site for three months after installation in order to support technology transfer to their university customers.
References

(Details of publishers are included in the bibliography at the end)


5. Ibid., p.421.
Chapter 6

Data analysis through
Soft systems methodology

As we have seen, the previous chapters, 4 and 5, correspond to stage two in the soft systems methodology. The surveys have highlighted the current situation and difficulties relating to information handling (provision and practice) in the six different universities visited for this project. In this chapter, the current issues and situation will be discussed in terms of internal and external factors affecting the campuses. In order to analyse the data collected via an application of the soft systems methodology, as outlined in Chapter 3, the data will then be presented in a logical sequence, from stage 1 to stage 7, after this summary.

INTERNAL ASPECTS

On the university management side

- Group A universities had the most advanced computing facilities, followed by groups B and C. However, they were all planning to replace their old-fashioned computing facilities with newer and better facilities to allow for the extension of network services. A lack of access to the networks and
the use of lower-speed networks were pointed out as problems among the universities.

- Poorer universities (group C) had insufficient financial support from both internal and external sources to build up their networking activities to the level of groups A and B universities.

- The committees for computerisation of the universities were not working properly. They were dependent on the decisions of the computer centres.

- There was a lack of co-ordination between information units in their planning of IT policy and purchasing of IT resources.

- All staff (members of computer centres, libraries, departments and top management) were dissatisfied with the information services provided on the campuses across all universities.

- Top management's understanding of improving IT on the campus varied from university to university.

- In group C universities, there was antagonism between university board members (who are appointed by private individuals or organisations) and academic staff due to the non-democratic decision-making processes. These universities have authoritarian styles of management, which can hinder the efficient introduction of IT services.

- Only one university was considering introducing a Chief Information Officer (as a vice-president post for enhancing information services). The idea of an information 'supremo' is not yet being discussed as it is in the UK.

- There was no evaluation process to monitor IT performance on campus.
On the service departments side

- There was an ill-defined division of responsibility for IT services between information units on the campus. There were no written job descriptions for members of the units.

- There were conflicts between information units (computer centres, libraries and academic departments) about both planning and practice.

- Staff training of members of the computer centres was needed immediately, especially for group C institutions.

- Topics of user training provided by the computer centres were limited in scope. There were no established channels via which members of the university could approach the centres for advice.

- The computer centres circulated insufficient technical advice throughout the university to satisfy the needs of staff.

- There was insufficient financial and personnel support for library information services. Most universities underestimated the role of the library in terms of providing electronic information (as compared with what is happening in the UK).

On the academic departments side

- Academic staff in the departments surveyed overwhelmingly believed that computer facilities were indispensable. They agreed that the introduction of IT had produced a more effective working style.

- There was no IT user committee to evaluate and monitor the performance of IT services on the campus.
• Staff had insufficient IT knowledge to manage efficiently computer equipment in their departments. Academic departments were dissatisfied with the process of getting advice from computer centres.

• Most staff thought there were insufficient funds, manpower and space for computing and networking in the departments.

EXTERNAL ASPECTS

On the government side

• Supporting services from public bodies, such as Korea Telecom, were insufficient; for example, there was an insufficient provision of technicians to provide and maintain public network connections between national lines and universities.

• There was insufficient government budget for research and development of networks and network services.

• Some of basic plans for research and education networks, which had already been decided, were still being delayed by the government.

• There was no one body for controlling and planning the national academic and research network. The exchange of opinions and experience between KT (Korea Telecom) at the Ministry of Information and Telecommunication, KREN at the Ministry of Education, and KREONet at the Ministry of Science and Technology was clearly difficult and limited in extent.

• The parent body of KREONet (Systems Engineering Research Institute, SERI), was too small to undertake nation-wide projects efficiently.
There were no high-ranking IT professionals in the Ministry of Education support network project. (The decision makers for national policy in science and technology are general administrative officers who are not science-based or experienced specialists.)

As a government organisation, the management system of KREN was too rigid to handle information technology efficiently. (The rapidly changing IT environment requires more dynamic and flexible management.)

On the business side

There was uncertainty about the standardisation of new technology required in the universities (e.g. ATM).

There was a dependence on foreign vendors (more especially, the three major foreign vendors: Novell, Cisco and 3 COM) for high performance networking equipment, and an understanding of how it should be developed.

6.1 APPLICATION OF THE DATA IN A SOFT SYSTEMS MODEL

6.1.1 Stage one

This is the initial stage, in which the problem situation needs to be examined. As mentioned in Chapter 3, this stage corresponds to generating the aims of the investigation and of the study objectives that they entail.

6.1.2 Stage two

This is the stage where the problem situation is expressed. In order to get the richest possible picture, interviews with information providers were carried out,
and questionnaires for information users were distributed, as described in the previous chapters. Additionally, written data concerning organisational structures and operations, policies, procedures, roles, etc., was collected to get an overall view of each organisation as a system. This stage does not imply completely defining the problem. An attempt to do this so early in the process would be inappropriately restrictive in terms of generating innovative solutions. Rather it implies designing the problem-solving and problem-content systems and linking them together.
CHAPTER 6

Problem Solver:

- Research student

Resources:

- Survey evidence
  interviews for qualitative data
  questionnaires for quantitative data
- Available literature
- Guidance of specialists
- Working experience as an information professional
- Research experience

Constraints on Problem Solver:

- Satisfy requirements for a higher degree (Ph. D)
- Submit thesis within time limit
- Finance and manpower

Power of View:

- Contribution to knowledge of academic information-handling problems and the idea of systems thinking

Figure 6.1  Problem solving system
Problem Owner:

- Managers of information-providing units as network components
- In general, South Korean universities

Structure:

- University management bodies
- Information service organisations
- Network and information resources
- Network and information providers and users
- Information infrastructure

Process:

- Provide network facilities for both teaching and research
-Receive, organise, and provide information for both teaching and research
- Serve and educate for campus users and professionals
- Facilitate the use of networking as an information channel
- Internetworking with other organisations

Climate:

- Information system
- Internetworking system
- Information professionals as suppliers for users
- Demand-pull and technology-push

Figure 6.2 Problem content system
Figure 6.3: The relationship between the problem-solving system and the problem-content system
The relationship between the problem-solving and the problem-content systems is depicted in Figure 6.3. The problem solver here explains the problem-content system, and then applies soft systems methodology to take action to solve the problem (or to explain it again) on behalf of the problem owner. When the analysis is being done, the starting point is thinking about 'problem-content' and 'problem-solving' systems and identifying the elements in these systems which are likely to be of relevance to the 'problem situations' on the campuses.

One of the ways to work towards an appropriate level of analysis is via the generation of 'a rich picture'. The information resources and the pressures on them now need to be represented on a single complex diagram as a rich picture. As mentioned in Chapter 3, there are key elements which such a diagram should contain, such as organisational structure, formal role relationships, and communication channels, as well as informal elements, such as conflict, or the mutual perceptions of people who are involved in the rich picture. The purpose of the rich picture is to gain insight into the situation, in order to understand it more fully and to see where major problems and issues lie. A rich picture (literally a pictorial representation), relevant to the present case situation and based on the information collected in Chapters 4 and 5, is presented in Figure 6.4.

The diagram highlights the various parties affected in the present studies, such as top management members, directors, staff, students, etc. Human figures represent the (key) actors in the system. The chart and IT usage trends graphs are used to represent information crucial to the actors involved. Problems and expectations of some of the actors are represented in 'think' bubbles. Conflicts are depicted by crossed swords. Those parts of the environment which affect the problem situation, such as the influence of external bodies, are represented by eyes with glasses. The organisational boundary of the universities has been taken to be the systems boundary here.
The relationship between the problem-solving and the problem-content systems is depicted in Figure 6.3. The problem solver here explains the problem-content system, and then applies soft systems methodology to take action to solve the problem (or to explain it again) on behalf of the problem owner. When the analysis is being done, the starting point is thinking about 'problem-content' and 'problem-solving' systems and identifying the elements in these systems which are likely to be of relevance to the 'problem situations' on the campuses.

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Figure 6.4 Rich picture: holistic view

- **Actors**
  - Head of department
  - Director of computer centre
  - Director of library
  - Faculty: Departments
  - Computer Centre
  - University Library
  - University Board of Trustees
    - President
    - Vice president
  - Deans committee
  - Faculty Council
  - Office of Planning
  - Administrative Officers (finance, personnel, etc.)
  - Student Union
  - Higher management body
  - Ministry of Education
  - Ministry of Science & Technology
  - Ministry of Information Communication (Korea Telecom)
  - Alumni Association
  - Soft/Hardware manufacturers (vendors)
  - Subscribers and online network service providers

- **Questions**
  - How to give administrative support and what are they spending their money on?
  - How to give technical support and standardisation?
  - Special charges for higher education?
  - Have they computerized?

- **Problems and Expectations**
  - We are behind other academic institutions in information services
  - We need a network system nationally, internationally
  - What happens if the system crashes?
  - Are we expected to train all users?
  - Do we really need to provide electronic information services?
  - Do we need more networked terminals?
  - What kind of information can we get from the network?
  - How good is the information provision on the campus?
  - What do users want?
  - What can we afford?
  - What is PG/Foundation/University?
  - Social/hardware mechanisms (vCDHDCn)
  - Commercial database makers and online network service providers
  - How to sell?
  - We need more training
  - What is going on at this university?

- **Trends**
  - IT Usage trend
  - Resource
  - No. of users
6.1.3 Stage three

This is the stage at which relevant systems for root definitions are defined. As noted in Chapter 3, a relevant system is one which is relevant to the problem situation in that it will yield insight into the situation when the system is described more fully. Exploring different ways of looking at what is going on and what the problems are in the specific situation may prove very useful in tackling the problem of bringing about change and improvement. The initial step in stage three is to name relevant systems for each of the problem themes in the situation to be analysed.

For the situation as it applies to campus information networks, relevant systems can be defined for four different themes as follows:

- Networking IT and organising the information it carries.
- Maintaining IT and the information on it.
- Monitoring IT and the information on it.
- Training users.

As described in Chapter 3, the aim in developing a root definition is to capture the basic elements involved in the system. For human activity systems, the major elements involved have been represented by the mnemonic CATWOE. A general format for a root definition of the 'campus information network system', which takes account of these CATWOE elements, can be developed as follows:

- C = the Clients of the system
  (as victims and beneficiaries)
  Information and network users

- A = the Actors in the system
  Information professionals
• **T= the Transformation process** supported by the system
  
  Fragmented information units with disparate information services, locally available, changing to coordinated information units with interconnected services, globally available

• **W= the Weltanschauung (Worldview)** underlying the actions of those concerned as actors in the system
  
  A desirable system which provides all requisite information via the network in order to meet fast growing and continuing needs locally, nationally and internationally

• **O= the Owner** of the system
  
  University management bodies and funders

• **E= Environmental constraints** on the system
  
  Universities and government information policy, marketing strategies from business sectors, contribution of human/electronic components, their existing infrastructures, existing information plans, campus and national resources, technical constraints (existing
network infrastructure
and hardware &
software facilities, etc.)
Requirements of
human computer
interaction to fit in with
new information system

This leads to the following overall root definition of a campus information
network system:

A university (or government) owned operation, which seeks to fulfil its
agreed function to manage an information network system supplying
access locally and globally to co-ordinated electronic information, to
provide an electronic communication channel for students and staff,
facilitating their information use, and with the goal of meeting the fast
growing and continuing needs on the campus for an efficient networking
service.

6.1.4 Stage four

This is the stage for building conceptual models, based on the root definitions,
which are considered to be most relevant or worthy of further exploration. This
can be the most difficult part of the process. The model building stage starts
from the root definition and asks: "What activities would have to take place in a
system that meets the requirements of the root definition?" As Booth (1)
noted, the aim is to include all the activities implied by the definition (not taken
from the real world problem situation) and build them into a model developed
from the root definition using logic alone. The model displays the activities
expressed as verbs and connected in a logic-based order. When the conceptual
models are completed, the models can be checked using appropriate guidelines
and the formal systems model (as noted in Appendix 6).
If we apply the model building method mentioned in Chapter 3 to this project, the first root definition of the 'networking theme' could be 'a system to provide internal (on campus) and external (between campuses or between nations) services that give the user (staff and postgraduate students) effective access to information resources and communication channels via the campus network'. The activities that can be defined by verbs are 'provide', 'access' and 'communicate'. To carry out these activities, it is necessary to know about 'information needs for staff and postgraduate students'. The first level of modelling is shown in Figure 6.5. This shows the minimum necessary activities.

![Diagram showing the initial stage of model development]

**Figure 6.5**  Initial stage of model development
CHAPTER 6

DATA ANALYSIS

The next level of modelling is to consider what other activities are implied logically by these starting activities and put them into the model. Thus, 'information needs of staff and postgraduate students' implies procedures for obtaining information on such needs from the various sources available. Second-level modelling at a more detailed level is presented in the following chapter.

As Davies and Ledington (2) noted, the modelling process is finished when no further iterations are needed. When this has been achieved, the position should have been reached whereby all the elements of the root definition are reflected in the conceptual model. The root definition of the relevant systems, as mentioned previously in section 6.1.3, suggests three additional conceptual models, i.e. the maintenance sub-system, the monitoring sub-system, and the training sub-system. Incorporation of these sub-systems leads to a complete model, as in Figure 7.5 in Chapter 7. The conceptual model of this project was developed as in the above procedures (in three steps). In order to explain the conceptual model of the real world, four themes (or sub-systems) were modelled and described as follows. The rich picture (Figure 6.4) shows the system as a representation of the real world information services on the campus. The system modelled here includes human issues and the management and the control of the system.

Examining the problems suggested by the rich picture leads to the following four conceptual models which define how activities should proceed for the systems to function properly.

- Networking theme

The mission of a university relates to research (the exploration of learning) and teaching (the dissemination of learning). This mission can be assisted if there is an immediate availability of electronic resources and electronic channels to help staff and students communicate more efficiently and effectively. The
better organised the information system adopted on the campus, the more effective it is likely to be. The root definition of the networking theme is as follows.

This is a system to provide internal (on campus) and external (between campuses or between nations) services that gives the user (staff and students) effective access to information resources and communication channels via the campus network.

The main requirements of the conceptual model can be laid out as follows:

- Provide access to network services.
- Make electronic information sources available.
- Provide input / output (client/server) systems for easy access (sub-networks of the main network).
- Organise Campus Wide Information Services.
- Facilitate electronic communication between components.
- Offer computer networks on campuses, regionally, nationally and globally.
- Offer computer network services and data from commercial network service companies.

- Maintenance theme

The system should be maintained without interruption on the campus. If it is not, then users will lose confidence in the reliability of the system as a source of information and as a communication channel for their research and teaching needs, and turn to other more reliable sources. Maintenance must be organised with the computer centre and computer suppliers (hardware and software) so that immediate support is available on request, any time, anywhere on the campus and for off-campus links. The root definition of the maintenance theme is as follows.
This is a system which must maintain the network so that interruptions are minimised and confidence in the reliability of the system is maximised. It is necessary to create, maintain and promulgate information policies, guidelines and understanding for managing electronic information services.

The main requirements of the model can be defined as below.

- Understand the components involved in the system.
- Understand the existing situation and facilities.
- Maintain existing services and resources
- Maintain mission statements, aims and objectives.
- Maintain standards.
- Prepare detailed specifications for networking activities.
- Provide security services.

**Monitoring theme**

All systems, if they are to operate efficiently, need to monitor their effectiveness. Universities must have their own quality control and assurance systems to carry out continuing quality improvement. The root definition of the monitoring theme is as follows.

A system to carry out continuing quality improvement to enhance effectiveness and to allow an optimal allocation of resources between the various activities.

The main requirements of the model can be specified as below.

- Monitor performance.
- Determine constraints (funds, technology, people, etc.).
- Define measures of performance.
- Use them to analyse effectiveness.
- Modify services as indicated by feedback.
– Incorporate new policy as appropriate.

• Training / education theme

Unless the system is operated correctly, maximum benefit cannot be gained from the implementation of a network system. An adequate training /education system must therefore be supplied. The root definition of the training / education theme is as follows.

A system to provide training /education that gives students and staff (information professionals included) knowledge and skills concerning how to handle networked information and services easily, in line with university information policies, and with technological developments.

The main requirements of the model can be laid out as below:

– Provide adequate training facilities for information professionals (computer staff, library staff, departmental staff, etc.) to update their IT knowledge for their work.
– Provide appropriate induction and on-going tutorial programmes for students and staff.
– Provide instruction guides and manuals that can be easily understood (so that users can deal with some of their problems by themselves).

After developing each of the four themes as above, models for each theme were constructed: they are included in the next chapter. These sub-systems have also been incorporated in a completed (final) systems model in Chapter 7.

6.1.5 Stage five

This is the stage at which the real world, based on data collected at stage two, is compared with the conceptual world, as developed at stage four. The comparison can be carried out in various ways, but, as mentioned in Chapter 3,
there is a structured way of doing the comparison, as follows. Take the model and its structure and activities and use it to define a set of questions which you can try to answer from the real world situation. For example here is an activity in the model. Does it happen in the real situation? If so, who is involved in it, and why? What is the previous experience of it? Is there any particular reason for doing it in a certain way? In other words, an analyst uses the conceptual model as a way of constructing a set of questions to be answered on the basis of knowledge of the real world derived from data collected at stage two.

The purpose of the comparison stage is to set up a debate concerning the problem situation. For that we need an agenda, so the final output of this stage is the production of an agenda. Before proceeding to the next stage, it is important to be clear about what is, and is not, admissible as part of this agenda. The following tables show how drawing up an agenda at the end of this stage is based on the structured way of doing comparison described previously. Each conceptual model in the system is compared to the real world situation theme by theme. The accepted agenda (marked by 'yes' in the tables) provides a series of topics for discussion in the next chapter. What is not necessary, or admissible as part of the agenda is marked by 'no', and will be discarded from further discussion.
### Networking theme

<table>
<thead>
<tr>
<th>Activity in conceptual model (stage 4)</th>
<th>Present in real world situation (stage 2)</th>
<th>Comments on real world situation (stage 2)</th>
<th>Include on agenda?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide access to network services</td>
<td>Partially</td>
<td>Universities visited for this study were not fully networked on their campuses. Groups A and B universities were networked, but not networked fully, and Group C universities were not yet networked. Absence of network connections affected the introduction of information technology on the campuses for more effective and efficient teaching, research and administration.</td>
<td>Yes</td>
</tr>
<tr>
<td>Requirement</td>
<td>Status</td>
<td>Description</td>
<td>Result</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Make electronic information sources available</td>
<td>Partially</td>
<td>Some resources, such as OPACs, were partially available among the universities, but an increase in the number of sources was needed, for example, CD-ROMs, remote (commercial) databases, supercomputing resources, teaching, learning and administration materials.</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide input/output system for easy access</td>
<td>Partially</td>
<td>Local systems (Client / Server systems) were needed to reduce work load on the central systems, and to support local demands from the departments.</td>
<td>Yes</td>
</tr>
<tr>
<td>Organise campus-wide information system</td>
<td>Partially</td>
<td>Most information services were carried out independently rather than integrated.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Facilitate electronic communication between components

| Facilitate electronic communication between components | No | There was no encouragement to use electronic channels. New mechanisms to improve the communication between information units was needed | Yes |

Offer computer networks between institutions nationally and internationally

| Offer computer networks between institutions nationally and internationally | Yes, partially, in group A and B universities. No, in group C universities. | Provide connections not only on-campus, but off-campus as well. | Yes |

Offer computer network services and data from commercial bodies

| Offer computer network services and data from commercial bodies | No (except one university) | These services are costly, but, as shown by one university, could be made available. | Yes |

- Maintenance theme

<table>
<thead>
<tr>
<th>Activity in conceptual model (stage 4)</th>
<th>Present in real world situation (stage 2)</th>
<th>Comments on real world situation (stage 2)</th>
<th>Include on agenda ?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand the components involved in the system</td>
<td>Partially</td>
<td>Parts of the activity already done, but not comprehensive.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### CHAPTER 6
**DATA ANALYSIS**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Status</th>
<th>Comments</th>
<th>Include on agenda?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand and maintain existing situation and facilities (services &amp; resources)</td>
<td>Partially</td>
<td>Parts of the activity already done, but not comprehensive.</td>
<td>No</td>
</tr>
<tr>
<td>Maintain mission statements, aims &amp; objectives</td>
<td>Partially</td>
<td>Brief statements existed, but these were out-of-date.</td>
<td>Yes</td>
</tr>
<tr>
<td>Maintain standards</td>
<td>Partially</td>
<td>Insistence on standards was not prominent, leading to uncertainty.</td>
<td>Yes</td>
</tr>
<tr>
<td>Prepare detailed specifications for networking activities.</td>
<td>No</td>
<td>No formal detailed plans available.</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide security services</td>
<td>Partially</td>
<td>Low security meant less confidence in the system.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Monitoring theme**

<table>
<thead>
<tr>
<th>Activity in conceptual model (stage 4)</th>
<th>Present in real world situation (stage 2)</th>
<th>Comments on real world situation (stage 2)</th>
<th>Include on agenda?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine constraints</td>
<td>Partially</td>
<td>Partially known with regard to future funds, technology and manpower.</td>
<td>No</td>
</tr>
</tbody>
</table>
### Analyse effectiveness

<table>
<thead>
<tr>
<th>Activity</th>
<th>Action</th>
<th>Comments</th>
<th>Include on agenda?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse effectiveness</td>
<td>No</td>
<td>Only parts of this activity done, no overall analysis.</td>
<td>Yes</td>
</tr>
<tr>
<td>Define measures of performance</td>
<td>No</td>
<td>This activity has not been implemented.</td>
<td>Yes</td>
</tr>
<tr>
<td>Monitor performance</td>
<td>No</td>
<td>Without this activity, there is no commitment to continuing quality improvement.</td>
<td>Yes</td>
</tr>
<tr>
<td>Incorporate new policy as appropriate</td>
<td>No</td>
<td>This activity is not done at all</td>
<td>Yes</td>
</tr>
<tr>
<td>Modify services as indicated by feedback</td>
<td>No</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Training / education theme

<table>
<thead>
<tr>
<th>Activity in conceptual model (stage 4)</th>
<th>Present in real world situation (stage 2)</th>
<th>Comments on real world situation (stage 2)</th>
<th>Include on agenda?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide training facilities for information professionals</td>
<td>Partially</td>
<td>Partially done, but the activity was not adequate to update staff in new IT knowledge</td>
<td>Yes</td>
</tr>
<tr>
<td>Provided induction and ongoing tutorial programmes for staff and students</td>
<td>Partially</td>
<td>Partially done, but the activity did not provide adequate training for staff and students</td>
<td>Yes</td>
</tr>
<tr>
<td>Provide documentation of IT guidance for user</td>
<td>Partially</td>
<td>Partially done, but the level of activity was not adequate.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
References

(Details of publishers are included in the bibliography at the end)


Chapter 7

Planning and implementation using soft systems methodology

Stages six and seven are the points at which planning for change and implementation occurs in soft systems methodology. The previous stage, five - the comparison stage, leads naturally into a discussion of 'things as they are now currently' and 'things as they might be for changes'. There are various ways of performing stage six. For example, one is to conduct a structured discussion with the actors involved about the ideas which are starting to emerge from the analysis. On this scenario, actors, such as problem-owners and problem-solvers, are approached to try to identify ideas about possible changes which are agreed by the actors to be both systematically desirable and culturally feasible. This generates a list of possible changes that could be made in order to improve the current situation on each university campus. However, an alternative way of performing stage six, instead of such discussion, is to carry out an analysis based on the sort of agenda constructed in Chapter 6. This seemed the appropriate route for the present project because there are complex issues in the problem situation which have no clear ownership. This is true, for example, of some of the inter-organisational and supra-institutional
problems. In this respect, university organisations differ from most business organisations, to which soft systems methodology has primarily been applied.

A list of feasible and desirable changes is presented below according to the activities of each sub-system. These sub-systems together make up the model of an information service system after integrating together.

7.1 STAGE SIX: MAJOR SUB-SYSTEMS FOR PLANNING

According to the conceptual models and the agenda previously developed, the information services system on the campus is composed of four interconnected sub-systems.

- Networking sub-system,
- Maintenance sub-system,
- Monitoring sub-system,
- Training and education sub-system

The major issues facing each sub-system are identified in the following sections. Then, as an outcome of the discussion, recommendations for action by South Korean institutions are put forward. These suggest feasible and desirable changes that could be made by those concerned with the problem situation as laid out in previous chapters.
7.1.1 Networking sub-system

- **Provide access to network services**

Access to the networks is the most crucial part of the infrastructure for electronic services on the campuses. Universities need to develop campus network systems to provide access to network services available anywhere on the campus, whether controlled centrally and locally. The following are the basic items, as determined by the present survey.

- **High-speed backbone connecting sites:** Universities need to upgrade their network systems to support image data as well as textual data, and to increase network capacity and stability. They need to transfer their backbone system from Ethernet to FDDI, and from FDDI to ATM, respectively, according to their current situation.

- **Provide more access on the campus:** The universities should be fully networked with access available as widely as possible in offices, teaching rooms, residential halls and the library to facilitate the use of centrally stored materials and external network facilities. They also need to make it easy for users to utilise modem facilities to connect from the users' homes (remote locations) into the university networks and computing facilities as on the campuses. Students and staff in some subjects (e.g. engineering) need to have special computing and networking facilities made available.

- **Make electronic information resources available**

The basic idea of networking is to make information resources available to all users. Universities need to increase the number and variety of electronic sources available (for example, in the areas of teaching and learning
materials, administrative databases, bibliographic materials, supercomputing materials and CD-ROM titles). They also need to develop or purchase software for teaching and learning and administrative systems.

- **Provide input/output systems for easy access**

The provision by central services of e-mail, directory, database, back-up and archive systems, etc., is critical. Local input and output systems (client / server) need to be constructed for supporting and complementing the main system and for supporting the increasing local demands of the departments or groups.

- **Organise campus-wide information systems**

Integrated and organised information services are indispensable for easy use via the network. Universities need to provide effective and efficient information gateway services for campus-wide information services. For example, the initial entry point to the most of the institution's information resources should be provided by the central computing systems. The library servers should also provide search engines for finding information in a wide variety of locations on campus and off campus alongside OPACs. Current library services need to be restructured to rely more heavily on remote access and to move toward a fully linked digitised network of library collections.

- **Facilitate electronic communication channels**

New mechanisms to facilitate and improve the communications between information units and users are necessary on the campuses. Video conferencing systems would help interactive (two-way and multi-way) instruction, real-time research collaboration and administrative tasks on campus, nationally and globally.
• Provide network links between institutions nationally and internationally

Network links between institutions on campus, regionally, nationally and globally should be provided and supported by the universities.

• Provide computer network services from commercial bodies

At present, these services can only be used to a very limited extent in South Korean universities. As explained in Chapter 4, there is a great demand for searching academic information via the network, including commercial network services such as Dialog. Universities need to provide an array of networked academic information (including full-text, abstracting and indexing services, and image databases, etc.) and this should include commercial input.

In the light of this discussion, the networking sub-system can be modelled as follows.
Figure 7.1: Conceptual model of the networking system
7.1.2 Maintenance sub-system

- **Understand the needs of participants and their situation**

Universities need to understand the computing needs of users and the situations they face on their campuses (for example, the use of computers and networks within departments, administrative offices, libraries, audio-visual services and computer centres).

- **Maintain mission statements and standards**

Mission statements, aims and objectives among campus information providers should be described in written forms to clarify the responsibility between service providers. A minimum standard of IT provision should be sustained by information providers on the basis of an agreed written prescription.

In order to achieve optimal institutional strategies, there are good grounds for considering the creation of Chief Information Officer posts. Higher ranking members are needed to tightly co-ordinate the activities of the various campus information providers, such as the computer centre, libraries and departments. Such officers can guide and advise on the priorities for information resources and services. Arrangements for collaboration between campus information providers need to be clarified in order to address the highest strategic priorities of their institutions.

At the least, an information systems committee should occupy an influential position in the university decision-making structures on each campus. Such information systems committees should be chaired by a Vice-president, and include the directors of computer centres and librarians together with elected senior academics. The mission statement and standards should be regularly reviewed and maintained.
• Prepare IT specification for networking activities

Universities need to have a clear specification for managing, controlling and developing the network systems. The institutional standards need to be prepared and applied in the evaluation, selection and adoption of new systems, and in the upgrading, enhancing, and transformation of existing systems.

• Provide security services

Universities should provide secure and reliable information systems. If universities do not recognise the importance of the various types of security problem, both internal and external users will lose confidence in the system as a channel for information processing.

In the light of this discussion, the maintenance sub-system can be modelled as follows.
Create and maintain "supporting activities"
Create and maintain policy, strategy, regulations and standards
Create and maintain explicit statement of networking in details
Understand the existing situation
Understand the needs of participants
Understand who is being served and who serves the system
Create and maintain professional knowledge of networking

Figure 7.2: Conceptual model of the maintenance system
7.1.3 Monitoring sub-system

- **Analysis effectiveness**

Universities need to identify gaps between user needs and what is provided. In order to work towards reducing such gaps, they should establish a mechanism for continuing analysis of the effectiveness and efficiency of information provision.

- **Define measures of performance**

Each university should prepare a system to measure the performance of their IT services. The performance indicators chosen must relate to service delivery for users rather than rely solely on financial and technical inputs and outputs. They need to be reviewed regularly by the appropriate committee. Although quality is hard to measure in objective terms, some statistics can be used successfully. Measurements should include academic programme support, administrative support, accessibility and partnership between institutions.

- **Monitor performance**

After establishing the information needs of each group of users, monitoring needs to be carried out on a regular basis. The evaluation is needed not only to assist the information professionals, but for the information users themselves. Each university should have some mechanisms, such as a users' committee, to monitor the providers' performance and the use of services by different user groups. User surveys and bench-marking activities are needed on a continuing basis to help assess the effectiveness of the information services on the campuses.
• Know constraints (funds, technology, people, etc.)

Universities need to appreciate fully their resource constraints (such as funding sources, manpower for IT provision and current information technology capabilities on their own campuses) in order to make effective plans.

• Modify services and take action

The identification and monitoring of IT services on the campuses is a necessary step before developing new IT service mechanisms. Such mechanisms should encourage widespread participation and continuing innovation so that electronic information transfer can be improved on the campuses. These mechanisms should be firmly integrated into the organisational frameworks of the universities. Universities should also plan to establish working parties to address particular developmental areas as they arise, before taking action.

In the light of this discussion, the monitoring sub-system can be modelled as follows.
Figure 7.3: Conceptual model of the monitoring system
7.1.4 Training / education sub-system

- **Provide adequate training facilities for information professionals**

  As noted in Chapter 2, training and awareness facilities need to be developed and offered on a regular basis to update staff of the central information resources organisations with new IT skills as a continuing activity. Existing staff should be provided with opportunities to attend seminars, courses, etc., in order to update their IT knowledge. New staff should be provided with appropriate induction courses for their jobs. In addition, universities should encourage their staff to actively participate in professional associations and recognise the benefits of learning from colleagues at other institution.

- **Provide induction and tutorial programmes for users**

  Universities should encourage and assist students and staff (academic, academic-related, technical and clerical) to acquire information-handling skills through courses closely related to their academic work. These courses should aim to train every member of the university to an acceptable base level, from which they can progress to the more sophisticated applications that are made possible by advanced technologies, e.g., computer-mediated communication, courseware design and development, multi-media, etc. They should adopt the best available human-computer interaction (HCI) practice as they develop training and awareness programmes. University libraries, also, should provide instruction on the location and use of information resources via the campus network and national/international networks.
• **Provide documentation of IT guidance for users**

In addition to the tutorial programmes, the survey, noted in Chapter 4, strongly suggested that a variety of approaches should be employed for assisting users. Documentation which can be easily understood allows staff and students to deal with some of their problems by themselves. A help desk, duty advisor, and other consultation should also be provided to help users solve their problems relating to the use and manipulation of information.

In the light of this discussion, the training sub-system can be modelled as follows.

![Conceptual model of the training system](image)

**Figure 7.4: Conceptual model of the training system**
7.1.5 Conceptual model of the total system

Interlinking between the four sub-systems of networking, maintainance, monitoring and training gives the final model shown in Figure 7.5. As has been noted before in this study, the model is not a representation of activities actually carried out in the real world, but rather an ideal version of an organised set of activities which should be constructed for networking and information services on the campus. The completed model can be used to contribute to the university's academic success based on electronic networks and information services as the figure presents.
Figure 7.5 Conceptual model of the total system

**Boundary**

**Networking system**
- Provide access to high-speed communication network with network services
- Understand the networking activities required
- Organise network resources and services for easy access
- Define more desirable state of networking activities
- Provide input/output system for easy access
- Facilitate network services

**Training system**
- Provide advisory services personally / impersonally
- Update new IT knowledge
- Provide instruction guides and manuals on-line / off-line
- Provide tutorial programmes personally / impersonally

**Monitoring system**
- Monitor all activities
- Compare "actual" with "desired" systems
- Measure "actual"
- Specify "desired"
- Define desired states of activities
- Take control / action / (Modify services)

**Maintenance system**
- Understand the existing situation
- Understand the needs of participants
- Understand who is being served and who serves the system
- Create and maintain explicit statement of networking in details
- Create and maintain policy, strategy, regulations and standards
- Create and maintain "supporting activities"
- Create and maintain professional knowledge of networking

Contribution to university's academic success based on electronic networks and Information services

University's need for academic development using Information technology
PAGE NUMBERING AS ORIGINAL
Inter-institutionally, new structures such as the inter-university committee on computing and its sub-committees (software, hardware, networks, courseware etc.) are needed to advise and review policy issues and problems. The absence of this kind of inter-university infrastructure in South Korea has discouraged the utilisation of IT facilities in higher education. As we have seen in Chapter 2, British organisations, such as the Computer Teaching Initiatives Support Service (CTISS), the Teaching and Learning Technology Programme (TLTP), and Management and Administrative Computing (MAC), though not a hundred percent successful, have helped unify university views in the UK on how IT should be used by universities. Similar initiatives should be developed in South Korea to establish teaching and learning IT systems on the campuses based on the pros and cons derived from these British experiences. South Korean universities need to realise that collaboration between institutions is more important than competition for improving IT applications and services on their campuses.

As a corollary, coordination of national academic and research network projects between government bodies (mainly, the Ministry of Education, the Ministry of Science and Technology, the Ministry of Information and Telecommunications and Korea Telecom) is also necessary. The government should consider setting up a unified body to construct a national information network for enhancing academic and research performance in efficient and effective ways. Again, some lessons can be learnt from experience in the UK, especially in terms of the way JANET is run and the way upgrading of the network is currently being planned and implemented.

As remarked in Chapter 4, computer companies in South Korea are not purely commercial entities, serving higher education only for profit-seeking purposes. The relationships between IT companies and higher education settings are complex and manifold, involving marketing and sales, research and development, training and professional development, endowments and leadership. Universities in South Korea have not yet realised that IT companies in the future will play more significant roles in the development of the
knowledge infrastructure than in the past. Arrangements of partnerships, consortia, and collaboration with IT business companies need to be developed by universities in order to achieve the mission of handling information on the campus more efficiently and effectively.

7.2 STAGE SEVEN: TAKING ACTION

In the light of the survey and the resultant conceptual model, a list of possible changes has been drawn up for improving the current situation and to help make judgements about which changes are likely to be the most effective. As was particularly evident in the interview data, there are several difficulties which are slowing down the growth of computing in South Korean universities. These include organisational problems (e.g., funding, management, structure, policy), physical problems (e.g., network capacity, connectivity, hardware) and user problems (e.g., services and training). The fundamental factor which is common to all of these difficulties, is the financial problem. If there is not enough investment for IT services, they cannot expect better services for academic members in South Korea. The question is whether enough funds can be made available from the government, donations or universities themselves, so that they can take action to change and improve their situation along the lines of the model developed here.

As mentioned previously, iteration may be needed to develop the conceptual model further. This is particularly true for its application to individual institutions. It is worth noting that soft systems methodology is not an algorithm which can be followed step-by-step with the guarantee of a required result at the end of the line, but rather it is a heuristic device. Its use in an innovative culture, can contribute to ongoing development of the institution as it faces a changing environment.

Since, as has been shown, the factors affecting South Korean universities vary from institution to institution, any list of recommendations has to be modified
in detail for each institution. The systems model that has been developed can be taken as a general model for South Korean universities. It corresponds to the average picture derived from the surveys. The solutions that emerge for leading, large universities (groups A and B), which have more funds, may not meet to the needs, goals and resources of non-networked and relatively small universities (such as group C). These latter institutions have many more constraints on campus networking.

However, the model that has been constructed can be adapted to the needs of each group of universities, so forming a common model for enhancing their network services. Indeed, the conceptual models covering the major issues of each sub-system (networking, maintenance, monitoring, and training) can be used as the basis for developing information services on university campuses in South Korea.

On the national side, the results suggest that the government should focus its activity and resources on the key issue of developing national research and education networks. Although national networks (KREN and KREONet) exist currently, they are not providing all the necessary information services for academic members. In addition, not all university campuses have yet been connected to the national networks. Another issue is that the existing speeds of national networks are insufficient for effective communication between academic members. The existing national networks must be co-ordinated and upgraded to support the needs of universities. Local Area Networks of educational institutions, libraries, research institutions and other organisations must be interlinked together via the national networks to provide a national academic information resource. Development of effective training and education programmes for the users of the national networking system also requires some central input, and should be provided along with the implementation of the national information infrastructure plan for 1995-2015.
7.3 VALUE OF THE STUDY

So far as can be determined from the literature, this is the first application of soft systems methodology to the planning of academic network information services in South Korea. The results of the study suggest that managers and professionals could apply this methodology themselves to tackle ill-structured and unclear problems in their organisations. Though the methodology may be new to them, the actual methods can be well established. Using social science survey methods, such as interviews and questionnaires, for this study was both sufficient and relevant to the identification of problems and the provision of an optimal model to improve problem situation.

The application of the methodology allows the investigator to examine the importance of the 'monitoring', 'maintaining' and 'training' themes which are often neglected, or carried out only to a limited extent. The results of this study may be useful not only for academic settings, but also for other organisations, such as business and public bodies which have information units, to 'monitor', 'maintain', and 'train' their components. Models developed for this project, e.g., networking, maintaining, monitoring, and training subsystems, are basic and adaptable to other organisations with modifications based on their particular situation. This became apparent during the interviews in South Korea. Equally, the model could be used to study electronic information services and management in other countries as well.

7.4 SUMMARY AND SUGGESTIONS FOR FURTHER STUDY

As mentioned before, one of the problems arising from the complexity of the situation is that no single person or body has ownership of the problem situation. It would be interesting to identify a more restricted scenario where one particular group or body could be considered as full owners of the problem situation.
The recommendations in section 7.1 provide guidelines (rather than a prescription) for establishing an optimal information network in South Korean universities. The complete accuracy of the model which has been developed for this study cannot be guaranteed, because information technology is changing so quickly. However, it provides a general model which is applicable to other academic institutions with a small amount of adaptation and modification based on their different situation and characteristics.

In conclusion, an overall summary of how the work in this study developed is presented to highlight the more important points that arose in applying the soft systems methodology.

- At the beginning of the study, there existed only a vague picture of electronic information services in South Korean universities. Subsequent study and data collection clarified the problem situation and the ideas relating to it were gradually and continuously extended.

- In the initial phase of the study, dissatisfaction with electronic information services among academics in South Korean universities was already apparent, and this became increasingly emphasized as the project progressed.

- Evaluation of electronic information services and computer networks as systems brought the systems approach and soft systems methodology into play.

- Two problems were identified in terms of PhD work: the 'problem situation' itself and the 'problem of doing the work and writing the thesis'. These were later recognised as 'problem content' and 'problem solving' systems.

- The problem situation was represented based on knowledge gained via questionnaires and interviews during the survey. This was made highly
detailed in order to obtain the richest picture possible to help investigate more deeply.

- Root definitions were produced from the relevant system.

- Conceptual models were issued from these root definitions.

- The problem situation was outlined from both the information user's and information provider's point of view.

- Data on computer centres, libraries and science and engineering departments and consequent assumptions about them were derived in the analysis phase from sources located in the literature review (described in chapters 1 and 2), and on the researcher's own knowledge. In order to reduce the possibility of personal bias, preliminary exchanges of opinion were carried out with academics who were working in South Korean universities.

- There was no clear division of ownership of responsibility between the different information providers. This was particularly true of problems that have been labelled here 'inter-organisational' and 'supra-institutional'.

- Once the problem owners had been identified from a rich picture description of the survey, their corresponding root definitions and conceptual models could be built.

- The comparison between the conceptual models and real world showed significant differences.

- Because of the complexity of the academic situation, stage six (debate about change) could not be carried out via face-to-face discussions with a limited number of people. Recommendations for changes for improving the
problem were therefore prepared from the experience of academic institutions in advanced countries, especially the UK.

- As a result of the comparison of the four derived themes (networking, maintaining, training and monitoring) to the real world, an agenda for change was established.

- Detailed 'networking, maintaining, training and monitoring' sub-systems were designed based on this agenda. They provided a model on the basis of which recommendations could be made.

- Recommendations concerning the networking, maintaining, monitoring and training sub-systems were then suggested for South Korean universities with the aim of improving their information services.

- Based on the findings found of this project, suggestions could be made for further researches.

- Changes have been considered in the light of two main criteria - system desirability and cultural feasibility. In addition, it would also be worth taking account of other factors, such as economic feasibility and technical feasibility, in further studies.

- As has been noted, discussing the proposed problem solutions and obtaining feedback would be different because of the range of people involved. Nevertheless, it would be interesting to debate the differences between the conceptual models and the real world with the senior members of the bodies concerned. This would establish the range of reactions and some of the causes of the differences.

- As mentioned in Chapter 3, specialist institutions - women's universities, technical and seminary-based colleges - were excluded from this project.
These institutions could be included in further studies to see whether the same model can be applied to them.

- Because research was of particular interest in information terms for this project, the questionnaires were distributed to academic staff and postgraduate research students only. Undergraduate students and administrative staff (including clerical staff) need to be investigated further to see whether their information requirements affect the model.

- Only two faculties - science and engineering - were selected for study because generally the use of IT seemed to be most advanced in scientific disciplines. Hence, they tend to set the pace as regards campus information systems. However, other disciplines such as social sciences and humanities, should be investigated as a further study to see whether they have information requirements that are not fully covered by the model.
BIBLIOGRAPHY


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APPENDICES
Appendix I The guidelines for building conceptual models

The model represents a human activity system. Therefore its elements are activities, and can be represented on paper as verbs. The first thing to do is to scrutinise the Root Definition carefully and write down the list of verbs which you think are implied by it.

- Having derived your list of verbs, arrange them into a logically coherent order.

- The analysis aims to have a complete account of the system in as small a number of major activities as possible.

- Having arranged your main activities into a logical sequence, next examine each in turn, asking whether it logically implies its own set of subsidiary back-up activities. If the answer is yes, write these down as verbs, and arrange them in logical order around their front-line activities.

- Your model now has clusters of primary and secondary activities. Scrutinise the clusters carefully to see whether some have functional points in common. For example, if you have activities involving, say monitoring and target-setting, then it may be reasonable to group them together as a control sub-system. Other sub-systems may also suggest themselves.

- In building your model, you are not allowed to introduce any real world considerations (for example, the names of real world departments or entities) into the model. You are required only to
deduce what is logically implied by the Root Definition - and nothing else.

• The logical nature of the relationship between Root Definition and Conceptual Model means that it makes sense to think about Definitions and Models as linked pairs. Since all the stages of the methodology (including this one) are iterative in any case, what you will probably find yourself doing is going back to revise the Definition as you struggle with the construction of the model.
APPENDIX II  Questions selected for questionnaires

Information Handling via Computer Questionnaire

Please tick the bracket with the correct answer or fill in brief answers alongside the questions. Your experiences are important, even if you do not use computer and networks. So please answer each question as completely as possible.

Background:
1. What is your age group?
   - 20-29 years [ ]
   - 30-39 years [ ]
   - 40-49 years [ ]
   - 50-59 years [ ]
   - 60 years or over [ ]
2. What is your highest academic qualification?
   - PhD [ ]
   - Master [ ]
   - BSc/BA [ ]
   - Other [ ]
3. What is the name of your Department?
4. What position do you currently hold?
   - Professor [ ]
   - Associate Professor [ ]
   - Assistant Professor [ ]
   - Lecturer [ ]
   - Research Fellow [ ]
   - Research Assistant [ ]
   - Postgraduate PhD student [ ]
   - Postgraduate MSc student [ ]
5. How long have you used computers in your work? ________ Years
   IF YOU DO NOT USE COMPUTER, please go to Question 9.

Usage of computers and networks:
6. Where is the nearest computer which you use on a regular basis, and what type of computer do you use?
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
   - [ ]
7. Do you use a computer at home?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

If yes, is it networked? [ ] stand-alone? [ ]

8. How often do you use the computer for performing the following tasks? (Please circle the appropriate number)

1 = not at all  
2 = less frequently  
3 = once a week to once a month  
4 = several times a week  
5 = more than once a day

<table>
<thead>
<tr>
<th>TASKS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Collection of data from experiments</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2 Statistical analysis of data</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3 Graphical display of data (CAD/CAM, Modelling, etc.)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4 Wordprocessing</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5 Managing personal Database/Index</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>(bibliographic or non-bibliographic)</td>
<td></td>
</tr>
<tr>
<td>6 Controlling systems/equipments</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7 Sending/receiving messages to individuals (E-Mail)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>8 Electronic bulletin boards, Mailing lists, Discussion groups for group messages (BBS, Computer forum etc.)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9 Transferring data files (FTP) between computers</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10 Remote logging-in (Telnet) between computers</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>11 Online library catalogue searching</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>12 On-line CD-ROM bibliographic database searching</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>13 Searching campus-wide online database</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>14 Searching nation-wide online database</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>15 Searching international online database</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>16 Other (please specify)</td>
<td></td>
</tr>
</tbody>
</table>

9. What are the problems in using computers in administration, teaching and research? Please rank the followings according to your opinion by entering numbers as 1,2,3,4 in the brackets provided on the right-hand column.

1 Lack of education and training [ ]
2 Lack of easy access to computers [ ]
3 Poor documentation (leaflets, handouts etc.) [ ]
4 Language problems (non-Korean: English etc.) [ ]
5 Other (please specify): __________________ [ ]
10. Do you use fax when you contact people to obtain information for your work?

Yes [ ] No [ ]

If yes, nationally only [ ] internationally also [ ]

11. Do you use telephone when you contact people to obtain information for your work?

Yes [ ] No [ ]

If yes, nationally only [ ] internationally also [ ]

Advice/Education:

12. If you do (or wish to) use a computer in your work, from where/whom do you get (or will get) advice and information about computerisation. Please rank the most important four of the followings according to your opinion by entering numbers as 1, 2, 3, 4 in the brackets provided on the right-hand column.

1 University Computer Centre [ ]
2 Departmental Colleagues [ ]
3 Colleagues in other departments [ ]
4 Departmental Students [ ]
5 Students in other department [ ]
6 Local computer Shops [ ]
7 Computer manuals/documentation [ ]
8 Books [ ]
9 Computer magazine articles [ ]
10 Academic journal articles [ ]
11 Other (please specify) [ ]

13. On balance, do the above sources satisfy all needs for advice?

Yes [ ] No [ ]

14. On balance, do the above sources satisfy all needs for training?

Yes [ ] No [ ]
15. Do you believe that present organisation of computing on the campus is satisfactorily organised for your information needs?

Yes [ ]  No [ ]

Expectations:

16. How do you expect to use personal computing for your work in the future?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

THANK YOU VERY MUCH FOR YOUR CO-OPERATION

I would be very grateful if you could return to the address as below in the envelope provided and addressed at your earliest convenience.

Kyung-Mook OH
Samik Mansion Apt.1609 - 1501,
Chung-dong Sindosi Sarang-Maul,
Kyung-gi Puchon,
Seoul, 421-020
경보이용설계 설문조사 히포트로그

안녕하십니까?
저는 다년간 연세대와 그 자체대학원 영국 세필드대학에서 얻은 문헌정보서비스의 실험경험을 바탕으로 현재는 영국 (국립) 러포비리대학에서 정보학을 전공하고 있는 오정욱입니다. 선생님께 서신을 읽에게 된 이유는 제 연구 Project의 Survey Data 수집을 위하여 선생님의 협조를 부탁드리는데 있습니다. 선생님의 토크실 일정을 알면서도 협조를 요청하니 한국대학의 Information Super-Highway를 통한 정보서비스의 향상과 후학의 개인적 학문경진을 위하여 도와주시면 감사하겠습니다.

이 질문서의 목표는 컴퓨터 사용에 대한 선생님의 경험, 교내 정보서비스 기관 (전산소, 도서관, 학과 등)에 대한 기대등에 관한 설문 data를 수집하는데 있습니다. 따라서 선생님의 의견이나 경험은 향후 컴퓨터를 이용하지 않으시더라도 중요합니다. 보다 나은 대학정보시스템 구축을 위해 정보공급자인 최고 정보진들과도 공 인터뷰를 시도하여 그보 banned 판에서도 참고할 예정으로 있습니다.

모든 응답과 고견은 본연구 목적이외에는 사용치 않을 것을 약속드립니다. 거듭 선생님의 도움과 협조를 부탁드리오며, 설문지를 완성해 주실 것이라 믿습니다. 참고로 본연구는 영국대사관내 영국문화원에서 연구기금을 지원받고 있습니다. 선생님의 편의를 위하여 최신용 봉투가 등록되어 있어오니 설문지를 냅으셔서 일일 까지 도착하도록 해주시면 감사하겠습니다.

오 경록 룸림

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추신: 문의사항이 있으시면 아래주소로 연락주시기 바랍니다.

(W) 421-020
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사랑마을 상익A 1609-1501호
E-mail: kyungmoh@bubble.yonsei.ac.kr
tel: 032-321-2248
컴퓨터를 이용한 정보처리 실험조사 : 설문서

다음 각 질문에 따라 해당된 꼭호에 체크 [V] 또는 해당사항을 기입하여 주십시오. 혹시 컴퓨터를 이용하지 않으시더라도 질문사항에 답해 주시기 바랍니다.

1. 선생님의 연령은 어디에 해당되니까?
   만20-29세 [ ] 만50-59세 [ ]
   만30-39세 [ ] 만60세 이상 [ ]
   만40-49세 [ ]

2. 선생님의 최종학력은?
   박사 [ ] 석사 [ ] 학사 [ ] 기타 [ ]

3. 선생님이 소속된 학과의 명칭은 무엇입니까?

4. 선생님의 현재 직위는 무엇입니까?
   정교수 [ ] 전임연구원 [ ]
   부교수 [ ] 조교 [ ]
   초교수 [ ] 박사과정학생 [ ]
   전임강사 [ ] 석사과정학생 [ ]

5. 선생님의 컴퓨터 사용 경력은 몇년 입니까? ____________ 년

만일 선생님께서 컴퓨터를 전력 사용치 않으신다면 9번 항으로 넘어가서 16번 까지 계속해 주시기 바랍니다.

컴퓨터 및 네트워크 사용:
6. 주로 사용하시는 컴퓨터는 어디에 있으며, 이 컴퓨터는 교내의 다른곳과 네트워크 연결이 되어 있습니까?

<table>
<thead>
<tr>
<th>위치</th>
<th>Network 연결됨</th>
<th>Network 연결안됨</th>
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<td>2 학과 내</td>
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<td>3 소속 단과대학</td>
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<td>4 도서관</td>
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<td>5 컴퓨터 센터</td>
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<tr>
<td>6 기타 ( 구체적으로 적어 주십시오 )</td>
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</tr>
</tbody>
</table>

257
7. 신생물은 데에서 (DO) 컴퓨터를 사용하십니까?

예 [  ] 아니오 [  ]

"예"에 해당할 경우, Network 연결 됐다 [  ] Network 연결 안됐다 [  ]
(Modem 설치)

8. 신생물께서는 아래의 업무를 수행하는데 얼마나 자주 컴퓨터를 이용하십니까?
해당번호에 O 표 해주십시오. (예: 1 2 3 4 5)

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<td>2 = 자주 사용 한다</td>
<td>4 = 1주 몇과 이상</td>
</tr>
<tr>
<td>3 = 1주 ~ 1달에 1회 정도</td>
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<tr>
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<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4</td>
<td>문서편집 (Wordprocessing)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5</td>
<td>개인 Database / Index관리(서지/서지 자료등)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6</td>
<td>장비나 시스템 조작</td>
<td>1 2 3 4 5</td>
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<td>7</td>
<td>E-Mail (전자우편)의 송수신</td>
<td>1 2 3 4 5</td>
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<td>8</td>
<td>전자게시판 (BBS = Electronic Bulletin Board, Usenet newsgroup, Discussion 그룹등)</td>
<td>1 2 3 4 5</td>
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<td>9</td>
<td>컴퓨터 간 파일전송 (FTP)</td>
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<td>11</td>
<td>온라인 도서관 목록 검색</td>
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<td>12</td>
<td>온라인 CD-ROM 데이터 검색</td>
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<td>국제 On-line 정보검색</td>
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<td>16</td>
<td>기타 (구체적으로 적어 주십시오.)</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

9. 컴퓨터를 이용하시는데 신생물께 문제가 되는가 여부면, 어떤 것인지 우선순위에 따라 (가장 중요한것부터 1,2,3,4 순으로) 평가해 주심시요.

<table>
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<th>번호</th>
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<td>5</td>
<td>기타 (구체적으로)</td>
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</table>
10. 선생님께서는 업무에 관한 정보를 얻기 위해 국내/국제간 다른 곳 (사람)과 연락하실 때 팩스 (Fax)를 사용하시나요?
   예 [ ] 아니오 [ ]

   "예"에 해당할 경우, 국내만 이용 [ ] 국내/국제 모두 이용 [ ]

11. 선생님께서는 업무에 관한 정보를 얻기 위해 국내/국제간 다른 사람과 연락하실 때 전화 (Telephone)을 사용하시나요?
   예 [ ] 아니오 [ ]

   "예"에 해당할 경우, 국내만 이용 [ ] 국내/국제 모두 이용 [ ]

교육/상담/이용안내:

12. 선생님께서는 업무상 컴퓨터 사용에 관한 조언을 어디 (누구)에서 얻으시나요?
   가장 중요한 것 비가지만 순서대로 (1, 2, 3, 4) 번호를 적어 주십시오.

   1. 대학 컴퓨터 센터 [ ]
   2. 학과의 교수 [ ]
   3. 다른 학과의 교수 [ ]
   4. 학과의 학생 [ ]
   5. 다른 학과의 학생 [ ]
   6. 컴퓨터 상담 [ ]
   7. 컴퓨터 매뉴얼/사용설명서 [ ]
   8. 서적 [ ]
   9. 컴퓨터 잡지의 기사 [ ]
   10. 학습참가기사 [ ]
   11. 기타 (두세적으로 적어 주십시오)

13. 위 (12번 문항)에서 언급된 것들이 선생님께서 컴퓨터를 이용하시는 데 있어서 충분한 안내/상담 역할을 한다고 생각하였나요?
   예 [ ] 아니오 [ ]

14. 위 (12번 문항)에서 언급된 것들이 선생님께서 컴퓨터를 이용하시는 데 있어서 충분한 교육/훈련 역할을 한다고 생각하였나요?
   예 [ ] 아니오 [ ]
15 컴퓨터이용과 관련된 현재의 교내기관들이 선생님의 정보이용 욕구를 만족시킬 수 있게 조직되었다고 생각하십니까?

예 [ ] 아니오 [ ]

장비 기대/바람:

16 컴퓨터를 사용하여 업무를 수행하는데 있어서 앞으로 선생님께서 혼란시고자 하는 것을 적어 주십시오.


당연히 거듭 감사드립니다.

선생님의 편의를 위해 협신등 봉투가 통보되었습니다. Project진행을 위해 조속한 시일내에 영국으로 동아가야 하므로 가능하신대로 선편지로 바친 시일내에 보내주시기 바랍니다.
오 경욱 손선
APPENDIX III  Questions selected for interviews

<table>
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<tr>
<th>Computer Centre Director</th>
<th>Interview</th>
</tr>
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</table>

**Understanding of current IT services:**
1. Do you think information sources on the campus match all information needs of the students, academic staff and administrative staff?

**IT policy; plan; funding:**
2. How is the IT policy/plan (long term, short term) decided? (what is the committee structure; are there internal/external pressures?)
3. What kind of plan do you have? How will it be funded?
4. How is the computer centre funding decided? What is the planning connection between central computing and the other units?

**Responsibility between information units:**
5. What division of responsibility for electronic information do you have with the library?

**Questions about network situation:**
6. What are the LAN and WAN connections on the campus now?
7. How do the university use computers for campus administration?
8. What is your policy with regard to extensions of network and network services (LANs / WANs) in the future?

**Training and education:**
9. What are your plans (in training, availability, documentation etc.) to encourage users' individual access for teaching/learning/research materials?
10. What topics are covered in training services now / in future?

In addition to the above question the following is for Computer staff only:

**Question about training in new technology**
11. How do you keep up-to-date yourself in new areas of computing?
University Library Director Interview

Understanding of current IT services
1. Do you think computerised information sources on the campus match all information needs of the students and academic staff?

IT policy; plan; funding:
2. How is the information policy/plan decided? (What is the committee structure; internal/external pressures)
3. What kind of plan (short term, long term) for IT resources do you have in the library? How will it be funded?
4. How is the library IT funding decided? What is the planning connection between the library and central computing?

Responsibility about information provision:
5. What division of responsibility for electronic information do you have with the computer centre?

Questions about network situation:
6. What are the LAN and WAN connections for provision of information services now?
7. What are your plans for on-campus provision of information using IT? How will it fit in with printed resources?
8. What are your plans for provision of information services via WANs?

Training and education:
9. What topics are covered in training services for electronic information handling now / in future?

In addition to the above question the following is for Library Staff only:

Awareness of networking:
10. What do you think about the impacts of networking for (1) library housekeeping (2) administration of information provision?

Training of IT skills:
11. How do you (or how are you going to) develop information skills for library staff in the IT environment?
General and Usage:

1. What computers and terminals (numbers and main types) are available for staff, postgraduate and undergraduate students respectively within the department?

2. What arrangements are there for the use of LANs / WANs? What other computers / networks / services are available from your department?

3. How do you use computers for administrative activities?

4. Has the introduction of computers altered the style of working (e.g. of teaching / learning / administration) within the department? Has it altered efficiency at all?

5. Do you feel that the potential of your equipment is being fully exploited?

6. Do you think that integration of computer activities (e.g. use of a multi-purpose workstation) is increasing?

7. How do you think about the importance of networking now and in the future for teaching and research? What sort of demands will it create?

8. What problems do you have due to the rapid changes in IT?

Training and Education:

9. Do you have a competent knowledge of IT for their needs?

10. How do postgraduate students and staff receive advice (or training) on computers? Do they mainly teach themselves?

11. To what extent are you in touch with the computer centre? Do you think you can obtain enough advice/assistance or not?

Policy:

12. What future plans are there to extend and introduce more computer-based resources (e.g. courseware, multi-media systems, simulation systems etc.) for Teaching/Learning and Research in your department/faculty?

13. What are the problems of funding associated with the use of information technology in the teaching and research activities in your department? e.g. acquisition of hard/software, space, personnel, maintenance etc.
Understanding of current service:

1. Do you think information sources on the campus match all information needs of the students, academic staff and administrative staff?

IT policy and planning for organisational changes:

2. How is your IT policy decided? Does it have links to the national policy?

3. Do you have any plan for adjusting the computers and networking system (campus information infrastructure) to link a multiplicity of campus activities: (1) administrative (2) teaching (3) research.

4. How do you think this infrastructure should be organised (1) on campus (2) externally?

5. What problems (funding, space, personal etc.) do you have for extending IT services on the campus?
National planning:

1. What general policy (planning) is there in Korea which may affect the provision of information technology in higher education / research nationally?

2. What general policy (planning) is there in Korea which may affect the provision of information technology in higher education / research internationally?

3. What is the role of computers / networks in (1) teaching (2) research?

4. What is the policy to bring all universities up to the same high level?

5. What links to other bodies (eg. industry) do you have?

6. Where does the lead for IT development come from?

7. What further provision (expansion) of networked services is likely to take place over the next few years nationally and internationally (eg. centrally negotiated access; creation of Korean services etc.)?

Training/Education:

8. What plans are there for training users and for encouraging the use of information technology?

Problems/obstacles:

9. What problems can you identify associated with networking of the universities with your institute (problems of universities; consequent limitations on access by groups; different levels of institutions etc.)?

10. What are the limitations on your body (KREN; KRONet) in the national project for computer networking?
Managers of Computers and Networks Manufacturers

Background and marketing strategies:

1. What is your view of national planning for networking?
2. Who are the customers? What is the annual growth rate?
3. What are the trends for IT purchasing by universities?
4. What marketing strategies do you have at present for Computer and Communications sales to your customers?
5. What are the current limitations in marketing computer and network products?
6. What is your future plan for IT marketing?
7. What do you think about the importance of networking for the growth of sales?

Special strategies for the education marketplace:

8. What special sales strategies for academic establishments do you have now/or for the near future?
9. What links with universities for cooperative research and recruitment of staff do you have?

Training: support services after instalment:

10. How do you support (provide training) your university customers after sales for maintenance and enhancement of computer and network technology on their campus?
언어적 요청 서신

준경하는 ________님께:

안녕하십니까?

세르오 정보화 사회로의 전환기에 정보학(업)계 발전을 위해 수고하시는 ________님께 노고와 경의를 드립니다. 저는 다년간 연세대와 영국 세필드대학에서 얻은 문헌 정보서비스의 실무경험을 바탕으로, 현재 영국 (국립) 리프버리대학에서 정보학을 전공하고 있는 오경복입니다. 지난 3년간 영국에서 컴퓨터네트워크 정보서비스를 배우게 되었고, 현재는 "대학에서의 정보네트워크 사용"에 대한 박사학위 논문의 Survey data를 수집하고 있는 중입니다.

교내 정보이용자인 교수 및 대학생들의 대상으로 컴퓨터네트워크 이용실태를 설문지로 조사한데 이어 이번에 하고자하는 인터뷰의 목적이 학내의 주요 정보공급자인 ________님으로부터 첨부된 면접의 내용과 같이 다음 사항에 관한 고견과 기대를 얻는데 있습니다: 1. 교내 정보자원의 특성 2. 교내 정보기관간의 컴퓨터 네트워크 시스템 사용 3. 교육, 연구, 행정에서의 전산자원 활용에 관한 대학의 계획/경쟁.

6개 대학기관에서 연구대상이 되기때문에 이분야에서 ________님의 전문지식과 고견은 제 연구에 매우 중요하고 가치가 있으며, 향후 한국대학에서의 정보학 연구를 위한 모델을 개발하는데 반영될것입니다. ________님의 바쁜 일정을 알면서도 인터뷰 협조를 요청드리으니, 후학의 학문 성과 및 이 분야의 학문적 발전을 위해서 2-30 분정도 시간을 허락하여 주시면 감사하겠습니다. 참고로 본 연구는 주한 영국 대사관내 영국문화원에서 연구전용을 지원받고 있습니다.

모든 응답과 의견은 본 연구목적 이외에는 사용하지 않을 것을 약속드리며, 연구결과에 대한 자료를 원하시면 본 연구가 끝나는데도 그 사본을 기꺼이 보내드리겠습니다. 전화로 대면 다음 주에 전화를 드려서 인터뷰 시간을 정하고 싶습니다. 기쁨 ________님의 도움과 협조를 부탁드리오며, 끝으로, ________님과 밀내에 두루 만복이 깃들시길 기원합니다.

오경목 올림
DILS, Information Studies
Loughborough University
England. UK

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---인 팀버 1 (전산소장님)---

정보서비스 현황에 대한 이해:
1. 소장님께서는 현재 교내에 있는 정보자원 이용자 (학생, 교수, 행정직원)들의 정보이용욕구를 모두 만족시킨다고 생각하십니까?

정보정책, 계획, 기금:
2. 어떠한 절차를 거쳐 전산정책 및 장단기 계획이 결정되었습니까?
(위원장 조직은 어떤것이며, 내/외적인 알력요인은 무엇입니까?)
3. 현재의 교내 전산 시설에 대한 단기 계획은 무엇이며, 그 자금은 어떻게 조달할 계획이십니까?
4. 전산소의 예산은 어떻게 결정되며, 교내 다른 기관과의 발전계획은 상호 어떻게 연관되어 있습니까?

교내 정보 기관간 책임소재:
5. 전자정보처리에 대해 도서관과 업무상 어떤 책임의 구분이 있습니까?

Network 현황:
6. 현재 교내의 LAN과 WAN의 연결상황은 어떻습니까?
7. 학교 정정업무를 위한 컴퓨터의 이용 상황은 어떻습니까?
8. Network (LAN/WAN) 확장을 위한 장래의 정책은 무엇입니까, 또한 Network 이용 서비스 정책에 대한 향후 계획은?

교육/Training:
9. 이용자 개개인이 컴퓨터를 이용하여 강의/연구/학습 자료를 보다 쉽게 이용토록 유도하기 위한 계획은 무엇입니까?
(예를 들면, training course; 보다많은 PC 확보; 이용안내 책자 개발 등등)
10. 현재 그리고 앞으로 이용교육에서 다루어질 주제내용은 무엇입니까?

직원용 (실무과장/실무직원)
11. 선생님께서는 업무를 위해 어떤 방식으로 새로운 컴퓨터 기술을 얻으십니까?
정보서비스 현장에 대한 이해:
1. 관점쟁임로서 현재 교내에 있는 정보자원이 이용자(학생, 교수, 행정직원)들의 정보이용욕구를 모두 만족시킨다고 생각하신니까?

정보정책, 계획, 기금:
2. 어떠한 절차로 거쳐 전산정책 및 장단기 계획이 결정될니까?
(위원회 조직은 어떤것이며, 내/외적인 압력요인은 무엇입니까?)
3. 전산장비 확충 계획(단기: 2~3년, 장기: 5년이상)은 어떤 것이며, 그 재정은 어디서 지원될니까?
4. 도서관용 전산장비에 대한 기금(예산)은 어떻게 결정될니까?
전산장비 확보에 대한 계획 수립시, 전산소와 어떤 인관성을 갖습니까?

교내 정보 기관간 정보공급에 관한 책임소재:
5. 전자정보 처리에 대해 전산소와 업무 책임의 구분을 어떻게 하고 계심니까?

Network 현황:
6. 현재 도서관정보 공급을 위한 LAN과 WAN의 연결환경은 어떻게습니까?
7. 전산장비를 이용한 도서관 정보공급(서비스)은 어떻게 하실 계획입니까?
전자형태 자료와 프린트(인쇄)된 자료는 어떻게 조화를 갖게 됩니까?
8. WAN을 이용하여 도서관 정보서비스를 하실계획은 어떤것이 있습니까?

교육/Training:
9. 현재 그리고 앞으로 전자정보 처리에 대한 이용지도교육에서는 어떤 주제들이 다루어 집니까?
실무과정/직무원용
네트워크에 대한 인식:
10. 네트워크 이용이 1) 도서관 장비관리에 2) 정보공급 서비스를 운영하는데 미치는 영향은 무엇이이라고 생각하십니까?
IT기법에 대한 훈련/Training:
11. 빠르게 변화하는 전산정보 환경에 있어서 정보이용 기술/기법은 어떻게 개발하 (배워나가) 싶습니까?
1. 학과내에 (혹은 소속 단과대학 내에) 교수님, 대학원생, 학부생 각각을 위해 어떤 컴퓨터와 터미널(종류와 덕수)이 사용되고 있습니까?

2. LAN/WAN 사용을 위해 어떤 준비가 되어 있습니까? 학과에서 이네트워크를 통해 어떤 컴퓨터를 (어떤 네트워크: 어떤 서비스들) 이용할 수 있습니까?

3. 행정업무를 위해 학과에서는 어떻게 컴퓨터를 이용하십니까?

4. 컴퓨터 도입으로 인해 학과내에서 업무 (강의/학습/행정)방식에 어떤 변화를 갖습니까? 업무에 효율성을 주고 있습니까?

5. 학과내 (소속 단과대학 내) 전산장비가 최대한 이용된다고 생각하십니까?

6. 컴퓨터의 작업수행 영역이, 예를들면 다목적 컴퓨터의 이용으로 인해, 점차 통합 되어 간다고 생각하십니까?

7. 연구나 강의에 있어서 장차 네트워크 이용의 중요성을 어떻게 생각하십니까?

8. 전산 환경의 빠른 변화로 인해 어떤 문제점이 있습니까?

교육/훈련:

9. 선생님께서 (혹은 학과내 전산 담당자가) 충분한 전산지식을 갖고 계십니까?

10. 교수님들 및 대학원생들은 어떻게 컴퓨터 이용에 관한 상담을 받고 있습니까? 주로 상호 가르쳐 주고 있습니까?

11. 컴퓨터 센터의 어느 정도 수준으로 연관을 갖고 계십니까? 충분한 조언과 협조를 얻을 수 있으십니까? 혹은 그렇지 못하십니까?

앞으로의 정책:

12. 앞으로 연구/강의/학습을 위해 어떻게 컴퓨터 관련 자원 (예를들면, Multi-Media System, Simulation, Courseware 등)을 확보하실 계획입니까?

13. 연구와 강의를 위해 전산자원을 활용하는데 쓰이는 비용에는 어떤 항목/문제 점 (예, 하드/소프트웨어 구입, 유지보수비, 인건비, 공간관리 등)이 있습니까?
정보서비스 현황에 대한 이해:
1. 부총장님께서는 현재 교내에 있는 정보자원이 이용자(학생, 교수, 행정직원)들의 정보이용욕구를 모두 만족시킨다고 생각하시나요?

기구조정: 교내정보 정책 및 계획:
2. 교내의 전산정책은 어떻게 결정 됐나요? 국가정책과 어떤 연관성을 갖습니까?
3. 컴퓨터와 네트워크 교내 제반업무(1.행정 2.강의 3.연구)에서 실제로 이용하기 위해 정보 하부 구조 시스템을 갖고 계실히나요?
4. 이 정보 하부구조시스템은 어떻게 (1.캠퍼스내에서 2.교외적으로) 조작되어야 한다고 생각하십니까?
5. 교내에서 전산정보 서비스를 확대시키는데 있어서의 문제점은 어떤것들 입니까? (비용, 공간, 인력자원 등)
국가 정책 및 계획:
1. 국가적으로 교육 (혹은 연구) 전산화를 위한 기본 계획은 무엇입니까?
2. 국제적으로
3. 갑의 와 연구에 있어서 컴퓨터의 역할과 네트워크의 역할은 각각 무엇입니까?
4. 대학들이 동등한 수준으로 네트워크를 통해 전산자원을 잘 이용토록 하기 위한 정책은 무엇입니까 (예, BIDS, MADAS - Supercomputer 등)?
5. 귀 기관은 산업체 등과 어떤 연관을 갖고 있습니까?
6. 국가 전산자원을 개발시키는 리드 (Lead)는 어디로 부터 나옵니까?
7. 앞으로 2 3년내, 국가적으로나 국제적으로나, 어떠한 네트워크 서비스의 공급계획이 있습니까? (NISS, 한국서비스 확대 등)

교육/훈련:
8. 전산자원 활용을 촉진시키고, 이용자들을 훈련하기 위해 어떤 계획이 있습니까?

문제점/장애:
9. 대학들과 귀 기관을 네트워크하는데 있어서 어떤 문제점이 있습니까? (대학 자체적인 제반문제, 대학간의 수준격차, 그룹 Access에 대한 제한 등)
10. 국가의 컴퓨터 네트워크 정책 추진에 대해 귀 기관이 갖고있는 완결점은 무엇입니까?
마케팅 전략 및 배경:
1. 국가네트워크 정책에 대한부장님의 의견은 무엇입니까?
2. 고객의 대상은 누구입니까? 또한 네트워크시장의 연간 성장율은 어떻게입니까?
3. 대학에서 전산기기 구입에 대한 최근의 추세는 무엇입니까?
4. 현재 컴퓨터 및 정보통신장비에 대한 전략으로는 어떤 것이 있습니까?
5. 컴퓨터와 네트워크 장비 마케팅에서의 현재의 한계는 무엇이라고 생각하십니까?
6. 전산장비 마케팅에 대한 앞으로의 계획은 어떤 것이 있습니까?
7. 판매성장을 위해서 네트워킹의 중요성을 어떻게 생각하십니까?

교육시장에 대한 특별전략:
8. 현재/앞으로 학교기관에 대한 특별한 판매전략이 있으십니까?
9. 귀사는 대학들과 함께 공동연구를 하거나 전산관련 연구원(직원)채용에 대한 어떤 연관을 갖고 계십니까?

연수/훈련: 장비판매후 지원:
10. 대학에 장비를 판매한후 운영기술의 유지 향상을 위해 어떤 지원을 하고 계십니까?
APPENDIX IV  Cover letters / reminder letters for survey

Cover letter:

April 1995

Dear Sir:

The present study is being conducted to investigate the current position of the electronic networks and information services on the campuses. Based on the result of the study, suitable recommendations will be made for designing a better information system for your campus.

The aim of this questionnaire is to collect factual data about users' current experience of the computer network usage, trends and expectations of the information units (computer centre, library, departments etc.). So your opinion and experiences are important, even if you do not use the computer network. Interviewing with the top management levels as the information providers from these units will be carried out soon in order to obtain their opinion, expectations etc.

I hope that you will aid me in this project by completing the attached questionnaire and sending it to me in the enclosed self-stamped and addressed envelope. Data on individual respondents will, of course, be kept confidential. If you are interested in the survey findings and conclusions, I will be glad to send them to you.

Thank you for your time and co-operation in this study which should be beneficial for Korean academics.

Yours sincerely,

Kyung-Mook OH

Department of Information and Library Studies
Loughborough University
Loughborough, Leics.,
LE11 3TU
England, U.K.
Reminder Letter:

Dear Sir:

You may remember that I sent you a questionnaire about three weeks ago. I do not seem to have had a reply from you. Your opinions are important, even if you do not use computer network.

Based upon this investigation, suitable recommendations will be made for a better information service for your campus. I would therefore be most grateful if you could see your way to completing the questionnaire in the further copy enclosed and mail it to me in the enclosed self-stamped and addressed envelope as soon as possible.

Yours sincerely,

Kyung-Mook OH

Department of Information and Library Studies
Loughborough University
Loughborough, Leics.,
LE11 3TU
England, U.K.
Formal letter for informing
and requesting an interview:

Re: Request for the interview

Dear ________________:

My name is Kyung-Mook OH. At present, I am a research student in the Department of Information and Library Studies at Loughborough University. For the past few years, I have had the opportunity to learn of new developments in computer networks and information services for academics in the U.K. Consequently, I am researching in this field for a PhD with particular interest in the application of IT for campus information systems for Korean academics. Based on the result of this research, suitable recommendations will be made for designing a better information system for Korean universities.

The aim of the interview is to collect the opinions and expectations of information providers, covering three aspects below: (1) the existence of campus IT resources; (2) computers and networking systems between information units; (3) university planning related to the use of IT in administration, research and teaching.

I would be very grateful if you would allow me to have an interview for half an hour. Since only 6 institutes will be contacted, your experience and opinions on this topic are crucial to the completion of this project. Data on individual respondents will, of course, be kept confidential. If you are interested in the survey findings, I will be glad to send them to you as soon as this study has been carried out. If you do not mind I will contact you arranging an interview time by telephone some time next week.

Thank you very much for your time and co-operation in this study, which should be beneficial for Korean academics.

Yours sincerely,

Kyung-Mook OH

Research Student
Department of Information and Library Studies
Loughborough University
Loughborough, Leics., England, UK
Appendix 5  Details of the people interviewed in South Korea during the course of this research project. (Initial is used to protect them)

<table>
<thead>
<tr>
<th>Name</th>
<th>University</th>
<th>Position</th>
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</thead>
<tbody>
<tr>
<td>L</td>
<td>SNU</td>
<td>Head of Networking &amp; Computing</td>
</tr>
<tr>
<td>K</td>
<td>SNU</td>
<td>Network manager</td>
</tr>
<tr>
<td>P</td>
<td>SNU</td>
<td>Director of the Library service</td>
</tr>
<tr>
<td>K</td>
<td>SNU</td>
<td>Head of library automation</td>
</tr>
<tr>
<td>K</td>
<td>SNU</td>
<td>Head of Planning department</td>
</tr>
<tr>
<td>L</td>
<td>SNU</td>
<td>Computing manager of Engineering PC lab.</td>
</tr>
<tr>
<td>C</td>
<td>SNU</td>
<td>Professor of Chemical Engineering</td>
</tr>
<tr>
<td>K</td>
<td>YSU</td>
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<tr>
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<tr>
<td>S</td>
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<td>Network manager</td>
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<tr>
<td>K</td>
<td>YSU</td>
<td>Chief of the library</td>
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<tr>
<td>C</td>
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<td>Head of library automation</td>
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<td>YSU</td>
<td>Head of information service</td>
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<tr>
<td>N</td>
<td>YSU</td>
<td>Head of Planning department</td>
</tr>
<tr>
<td>C</td>
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<td>Computer Manager of Electronic and Electrical Engineering</td>
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<td>TGU</td>
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<td>Computer Manager of Chemistry department</td>
</tr>
<tr>
<td>B</td>
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<td>Head of KREONet</td>
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<td>K</td>
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<td>Manager of KREN</td>
</tr>
<tr>
<td>Y</td>
<td>SAMSUNG</td>
<td>Head of Computer Systems Division (Network Team), Samsung Electronics Co., Ltd</td>
</tr>
<tr>
<td>K</td>
<td>SAMBO</td>
<td>Manager of TriGem Computer, Inc.</td>
</tr>
</tbody>
</table>

*Keyword:* SNU: Seoul National University  
YSU: Yonsei University  
CNU: Chonnam National University  
CAU: Choongang University
CJU: Chongju University
TGU: Taegu University
KREONet: Korea Research Environment Open Network
KREN: KoRea Education Network
SAMSUNG: Samsung Electronics Co., Ltd
SAMBO: TriGem Computer Inc.
Appendix VI  Formal systems model

The Formal systems model for checking and assessing conceptual models contains ten elements as follows:

1. The system (S) has an on-going purpose or mission. This may be something which can be pursued but perhaps never achieved, or it may be more tangible and hence describable in terms of goals and objectives.

2. S has a means of assessing its performance with respect to its purpose or mission. The system must therefore be able to monitor its actual performance and assess that performance in relationship to some measures of performance.

3. S has a regulatory, or decision-making, function which can take operational action in the light of elements 1) and 2) above, to ensure an acceptable level of performance.

4. S is made up of components which are themselves systems and hence have all the attributes of a system.

5. The components of S show some degree of interaction, or connectivity. In the case of conceptual models this connectivity is based upon the idea of logical dependency.

6. S can be separated from the wider systems and from the environment in which it operates. The use of Customers, Owner, and Environment within CATWOE formalises this attribute for human activity systems.
7. S is separable from its environment and wider systems, because within S the regulatory function has the power to take direct action rather than merely try to influence things. There is therefore a conceptual boundary between the system and its environment based upon the power to act.

8. S has resources which are at the disposal of the decision-making function. The human resources of the system are already covered by the notion of actor in the CATWOE framework.

9. S has some basis for continued existence and stability. The system will have some ability to recover stability if disrupted by an outside disturbance.

10. There is an observer who considers the system to be of interest. In SSM this is handled by the notion of Weltanschauung.

Formal systems model can be summarised in figure as follow (Source: Patching, 1990, Practical soft systems analysis, p.18).