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Technology, Skills and Internet Services in Korea: Moving Towards a Knowledge–based Economy

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ABBREVIATIONS AND ACRONYMS

BAM	-	Brooklyn Academy of Music
CEM	-	Contract Electronics Manufacture
GDLN	-	Global Development Learning Network
GIS	-	Geographic Information System
GRIs	-	Government-Funded Research Institutes
HKM	-	Hyundai-Kia Motor Corporation
HKPC	-	Hong Kong Productivity Council
IDA	-	Industrial Development Agency
IFSC	-	International Financial Services Center
IITF	-	Information Infrastructure Task Force
ITRA	-	Industrial Technology Research Association
KAIST	-	Korean Advanced Institute of Science and Technology
KCAF	-	Korean Culture & Arts Foundation
KDI	-	Korean Development Institute
KICA	-	Korea Information Center for Agriculture, Forestry and Fisheries
KITECH	-	Korea Institute of Industrial Technology
KTTC	-	Korea Technology Transfer Center
MCT	-	Ministry of Culture and Tourism
MEHR	-	Ministry of Education and Human Resources
MIC	-	Ministry of Information and Communications
MOCIE	-	Ministry of Commerce, Industry and Energy
MOST	-	Ministry of Science and Technology
MSC	-	Multimedia Super Corridor
NEA	-	National Endowment for the Arts
NRDP	-	National Research and Development Programs
NSTC	-	National Science and Technology Council
OECD	-	Organization for Economic Cooperation and Development
OEM	-	Original Equipment Manufacture
PISA	-	Program for International Student Assessment
PTRP	-	The Production Technology Research Program
SBC	-	Small Business Corporation
SBTI	-	Small Business Training Institute
SMBA	-	Small Medium Business Administration
SMEs	-	Small and Medium Sized Enterprises
TCK	-	Bosch Technical Center Korea
TNC	-	Transnational Corporation
UNITEF	-	University of Industrial Technology Force

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TECHNOLOGY, SKILLS AND INTERNET SERVICES IN KOREA: MOVING TOWARDS A KNOWLEDGE-BASED ECONOMY

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EXECUTIVE SUMMARY

Background

1. This report presents the main findings of three major studies carried out as part of the Republic of Korea (hereafter 'Korea) and World Bank 'Knowledge Partnership'. It is divided into three main sections: (a) a Strategic Review which integrates and summarizes the most important findings and policy recommendations for the Korean Government to consider; and (b) the three in depth studies (referred to as Parts A, B, and C) concerning Korea's transition towards a knowledge-based economy, (c) detailed annexes (referred to as Part D).

Objectives of the Three Studies

2. Korea faces complex challenges in moving toward a knowledge-based economy. Meeting these challenges will require inspired corporate strategies and government policies. The three studies represent an important 'triad' of issues which constitute a core part of the foundation of Korea's knowledge economy: the deepening of technological knowledge at the firm-level (dealt within Part A); the intensification of the use of internet enabled services by firms (Part B); and the educational implications for the upgrading of the workforce (Part C).

Key Findings

3. At the firm-level, further mastery of technological knowledge is essential for firms wishing to move further 'upstream' from their base in manufacturing towards higher value added activities based on research, development and new product innovation. Equally, moves 'downstream' to knowledge-based services will require the increasing use of the Internet by Korean firms. Both of these 'upstream' and 'downstream' moves towards more knowledge-intensive, higher value economic activities depend on the upgrading of the skills of the workforce which in turn will require educational reform.

4. For each of these three themes (firm-level innovation, Internet enabled services and educational reform), new empirical data are presented for understanding and promoting knowledge-intensive economic progress. These tools and the associated research findings are presented in detail in Parts A, B and C of the main report and summarized in the Strategic Review (in Sections A, B and C respectively).

5. The Strategic Review summarizes several difficulties confronting government policy makers in Korea wishing to promote advances towards knowledge intensive activities. These include the need to ensure: (a) that any new policies are consistent with existing policies designed to ensure good corporate governance, competition and transparency; (b) that private sector, market-based mechanisms play their proper part in any upgrading efforts (e.g. *via* training and consultancy providers); and (c) that further evaluation of the scope and effectiveness of existing policies in the three areas in Korea is carried out.

6. Given these caveats, the policy recommendations are presented at this stage as suggestions for the Korean Government to consider. They could also form the basis of further collaborations in the Knowledge Partnership.

7. The Strategic Review and the three Main Issues present, in detail, major new policy initiatives based on the data gathered during the research, the experiences of other OECD countries and various workshops with Korean Government officials, academics and industrial representatives.

Part A: Promoting Firm-level Innovation

8. In this area, five policy suggestions are proposed. These are designed to encourage high performing firms to become more creative and knowledge-intensive through increased competition, collaboration and networking:

- Suggests large firm research consortia to develop advanced new technology fields, share research and development (R&D) costs, and increase the supply of human resources for advanced R&D;

- Argues for measures to increase inbound high technology foreign direct investment (FDI);

- Proposes support for promoting overseas science and technology (S&T) networks by Korean firms;

- Recommends measures to increase the presence of foreign capital goods' makers in Korea to compensate for weaknesses in domestic capital goods' supply; suggests support for 'clusters' of locally owned capital goods producers to upgrade existing capabilities.

Part B: Network-Enabled Services

9. Here, two related policy suggestions are put forward to help focus and lead current policy efforts to encourage the business community to use the Internet:

recommends improving business information services for small and medium sized enterprises (SMEs) among whom domestic deployment of ICT is weak, suggest a focus on promotion of domestic logistics portals.

Part C: New Skills and Educational Reform

10. In this area, four educational policy recommendations are proposed based on a survey of changing skill needs in high performing Korea firms. Each is tailored to ensure that the educational system is better equipped to meet the long-term demands of the knowledge economy:

- Suggests reform in K-12 curriculum, pedagogy and assessment to improve the match between what pupils learn in schools and what they need in the workplace;
- Presents ways to ensure a better alignment between high school vocational and technical education and changing business demands;
- Argues for increased public investments in higher education to make continuous learning by workers more affordable to both workers and employers;
- Proposes that the government should consider strengthening its role in the organization of lifelong learning to ensure leadership in this important area of the knowledge economy.

Next Steps

11. As noted above, the policy recommendations are suggestions for the Korean Government to consider. Although they are based on newly gathered empirical data, further discussions may well be needed to test the viability of the recommendations and to ensure they are consistent with other goals not addressed in this report (e.g. the need to ensure reforms in corporate governance). Also, while some evidence on the effectiveness of existing policies was assessed in the three studies, more analysis of existing programs would be necessary before embarking on major new policies. Nevertheless, we hope that both the empirical analysis and the policy suggestions will prove useful to the Korean Government and lead to further collaborations within the Knowledge Partnership.

STRATEGIC REVIEW

GUIDE TO THE REPORT

12. The purpose of this Strategic Review is to provide a summary of the main findings of three major studies carried out as part of the Republic of Korea (hereafter 'Korea') and World Bank 'Knowledge Partnership' (see below for details). The Strategic Review integrates the findings of the three studies and summarizes the most important policy recommendations for the Korean Government to consider. It also provides a review of the objectives, methods and justifications for the three main Reports (called Parts A, B, and C respectively) within the context of Korea's transition towards a knowledge-based economy and society. The strategic review is divided into three sections (Section A, B and C) which deal with the main Reports A, B and C in turn. Part D presents Annexes.

BACKGROUND TO THE STUDIES

13. In the summer of 2000, the Government of Korea and the World Bank signed a Memorandum of Understanding to promote a Knowledge Partnership. The partnership rests on two pillars. One facilitates the use of Korean development expertise in other countries in the region. The other partners with the government for further deepening the understanding of the knowledge economy in the Korean context to devise appropriate policy.

14. The three Reports respond to the second objective of the Knowledge Partnership, building upon 'Transition to a Knowledge-Based Economy' (World Bank, 2000, Report No. 20346-KO, June 29)[1] which took a macro/sectoral perspective on the knowledge economy to arrive at sector-wide policy recommendations. The World Bank (2000) report was well-received and stimulated interest among Korean policy makers in a follow up study that focused on knowledge at the firm level. In response to that interest, the three Reports summarized here bring into sharper relief firm-level challenges aimed at deepening the generation and use of knowledge. It also identifies opportunities for public policy to promote the move towards more knowledge intensive activities. The mission and field work for the three studies took place between April 2001- 2002.

RATIONALE

15. Korea faces complex but not insurmountable challenges in moving toward a knowledge-based economy. Meeting those challenges will require understanding and insight at both the firm strategy and government policy levels. The core knowledge economy themes analyzed in this study are: Part A: the deepening of technological

[1] World Bank (2000): Korea and the Knowledge-based Economy: Making the Transition, IBRD/World Bank/OECD, Report No. 20346-KO, June 29, Washington DC.

capability at the firm-level; Part B: the intensification of the use of the internet enabled services by firms; Part C: the repercussions for skills upgrading of the workforce.

16. These three firm-centered themes, represent a 'triad' that constitutes a central part of the foundation of the knowledge economy[2]. At the firm-level, the mastery of technological knowledge is essential for firms wishing to move further 'upstream' from their base in manufacturing towards higher value added activities based on research, development and new product innovation. Equally, moves 'downstream' to knowledge-based services will require the increasing use of the internet by Korean firms. In turn, both of these 'upstream' and 'downstream' moves towards more knowledge-intensive, higher value economic activity depend crucially on the upgrading of the skills of the workforce. Each of the three themes centers on the firm as the primary user and generator of knowledge for industrial and economic progress.

AIMS AND OBJECTIVES OF THE STUDY

17. Each of the three main Reports develops new tools for gathering evidence on Korea's moves towards the knowledge economy and applies these tools to gather new data on each of the three subjects, in order to make policy suggestions for the Korean Government to consider. In addition, the main Reports discuss how the tools might be used in the future to cover further important issues (for example the need for upgrading of small and medium-sized enterprises) which are not dealt with in detail in the reports, but are identified as centrally important to the knowledge economy transition.

18. The overall aim of the three main Reports therefore is to contribute to Korean policies for deepening technological capability, intensifying the use of internet enabled services and enriching worker skills. The key findings from each of the three Reports are now presented in detail.

[2] There are many other aspects of the knowledge-based economy which are outside the scope of this report. These include the provision of a sophisticated information and telecommunications infrastructure, the ability to use the English language to maximum effect, and the need for a vibrant local software industry to facilitate the use of information and communications technologies (ICTs). The triad dealt with in this study responds to key firm level issues identified by Korean policy makers and policy research centers on the needs of Korean firms in their efforts to upgrade knowledge based activities.

SECTION A: FIRM LEVEL INNOVATION IN THE KOREAN ECONOMY

A.1 The Role of Innovation in Korea's Knowledge Economy

19. Innovation is the successful introduction of a new or improved product, process or service to the marketplace. It includes the incremental changes which can lead to large gains in productivity, quality, process efficiency and structural change (Malerba, 1992)[3] and can best be viewed as a *process*, involving the application of new knowledge and skills. In Korea, innovation often occurs from 'behind the technology frontier' defined by leaders in the advanced countries. In order for Korea to catch up, rather than merely 'keep up' with the advances in the knowledge economy, substantial technological innovation is required.[4]

20. Innovation is underpinned by technological capability. Technology can be seen most importantly as a category of knowledge essential for firm level development and competitiveness.[5] In Korea, advances in innovation are central to firms' strategies towards more knowledge-intensive activities through: (a) moves 'upstream' towards new product design and research and development (R&D), the focus of Part A; and (b) moves 'downstream' to distribution, marketing and services, the focus of Part B. These upstream and downstream moves underpin Korean corporate strategies towards a more knowledge-intensive economy.

21. There is relatively little research on firm-level innovation in Korea, especially since the financial crisis of 1997 to 1998. Most recent studies are concerned with macroeconomic issues, sector-based surveys, the economic impact of the crisis, financial analyses, overall R&D spending and government policy issues (e.g. MOST, 2000; Woo and Sul, 2000; World Bank, 2000; Choi and Kang, 2000).[6] Therefore the aim of Part A is to complement these latter studies with an assessment of the technological capabilities of Korean firms.

22. A tool for understanding technological capabilities is developed and applied to a sample of leading Korean firms. The objective is to rank firms against nine key dimensions of technological capability in order to map them onto 'capability clusters', each cluster requiring a particular set of corporate strategies and, in some cases, policy interventions to encourage leading firms to move to the next level of capability.

23. The tool is situated within a framework which categorizes firms according to four capability categories or clusters, ranging from Type A ('passive'), to Type B ('reactive'), to Type C ('strategic) to Type D ('creative'). Clearly, not all firms aspire to be at the

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[3] Malerba, F. (1992): 'Learning by Firms and Incremental Technical Change', The Economic Journal, Vol. 102, July, pp.845-859.

[4] Technological innovation often requires complementary 'organizational' innovation. Although not the primary subject of Part A, the need for more flexible, innovative organizational structures is touched upon.

[5] Technology is, of course, not the only category of knowledge essential to firm competitiveness. Other categories include financial, marketing, and managerial knowledge.

[6] Annex 1 of Part A shows how the present study builds upon these recent studies by providing an in-depth micro-level focus.

leading edge of creativity in any country and there will usually exist a distribution of firms across the four types.[7] The tool itself is an analytical instrument for 'benchmarking' Korean firms according to capability levels which can, in principle, be applied to other countries in order to build up a quantitative appreciation of firm-level capabilities.

24. Although not all firms will seek to upgrade from one category to another, the most developed countries, by definition, will have a greater proportion of Type C and D firms, and follower countries will usually wish to promote the capabilities of as many firms as possible in order to upgrade their capabilities in order to gain the economic rewards from innovation. This applies to many leading Korean firms which are intent on moving from their stronghold in manufacturing to become knowledge-intensive competitors of the future.

25. The tool helps to achieve one objective of the Knowledge Partnership. While it is developed in the Korean context, the tool is deliberately generic and can be applied to other countries. The tool was presented at a regional workshop (the Asian Development Forum in Bangkok, June 2001) and a large number of participants expressed interest in applying it to their countries. The tool has been posted on the World Bank website and can be easily fine-tuned for application in different countries and particular sectors.

A.2 The Sample and Approach

26. The tool was used to conduct 25 detailed case studies of high performing Korean firms, providing a capability audit of Korean companies. High performing firms were selected because they could potentially provide useful insights into how far Korea's leading firms are from the technological frontier, and the strategies and investments they would need to make to reach the frontier. Given the in-depth case study approach required by the framework, the sample size had to be kept small to fit the resources available for the study. The findings are therefore illustrative and need to be extended to cover a wider range of firms, both in the 'leading' category and in the less advanced categories, particularly low performing small and medium sized enterprises (SMEs) which were not covered in this study, although they present considerable upgrading challenges (Nugent and Yhee, 2001)[8].

27. The in-depth case approach also enabled the researchers to gather firm-level views on key innovation issues affecting companies including the impact of the crisis, recent organizational restructuring, engineering and technical human resource needs, the value of interaction with public sector R&D investments (e.g. universities and government funded research institutes) plus key barriers facing firms in their moves towards knowledge-intensive activities.

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[7] Since the tool is a device to 'position' or benchmark firms, it cannot be a normative or prescriptive statement of what is desirable. Not all firms will progress from one group to another, and some may find alternative paths to growth and development. However, by providing a benchmark, these alternative paths can also be identified and studied using the tool.

[8] Nugent, J. B. and Yhee, S, J. (2001): South Korea's SMEs: Achievements, Problems, and Policy Issues of Relevance to Developing Countries, World Bank, Washington DC

28. Although small in number, the firm sample analyzed covers the 'commanding heights' of the Korean economy and represents a significant proportion of industrial output and exports. The firms include telecom service providers (*Korea Telecom, SK Telecom*), electronic products and component exporters (*Samsung, LG-Philips, LG Electronics, TriGem Computers*), capital goods and input suppliers to the electronics industry (*Dong Yang Semiconductor Equipment, C&S technology, 3M*), automobiles and input suppliers (*Hyundai-Kia Motor Corporation, Mando Corporation, Doowon Precision Industry, Korloy, Bosch*), foodstuff suppliers (*Daesang, Bolak, Hanil Feedmill*), new high technology start-up enterprises (called 'venture companies' in Korea), *n-Shaper Corporation, Techovalue.com*) and a range of other firms from key sectors (*LG Cable, Korea Zinc, LG Chem, Green Cross, Choonwae, Kuk Dong Co).* Detailed interviews (mostly lasting half a day) were conducted in each firm using the prototype tool which was then refined during the interviews, and later with Korean colleagues from the Korean Development Institute (KDI) and other research organizations.

29. Scores were assigned to firms according to nine capability dimensions which together make up a firms overall technological capability:

Awareness of the need to improve;
Search ability in relation to external threats and opportunities;
The building of distinctive core capabilities;
The development of a technology strategy to support the business;
The ability to assess and select the appropriate technological solutions;
The acquisition and absorption of the technologies in question;
The implementation and effective use of the technologies;
The ability to learn from experience in order to improve technological change capabilities;
The ability to form and exploit linkages with a network of suppliers and collaborating firms.

30. These scores were then mapped onto four 'clusters' or categories of technological capability ranging from very low (passive) to very high (creative), providing a technology audit of leading Korean firms. *The technology audit shows that most (21 out of 25) of the firms are grouped in the 'strategic' (Type C) cluster with two crossing over into the 'creative' (Type D) cluster, with a further two in the 'reactive' (Type B) category.* Put another way, 23 of the 25 firms audited were highly competent and strategic but not yet capable of contributing to the world technology frontier through R&D or the generation of radically new high value products. As was to be expected given the choice of firms audited, none of the sampled firms fell into the 'passive' (Type A) cluster. The remaining discussion therefore focuses largely on Type C firms.

A.3 Principal Findings: an Innovation Dilemma?

31. Korean industry sees itself in an 'innovation dilemma' as a result of its own success (although this view has been contested, see below, paragraph 34). The dilemma can be stated simply. On the one hand, the manufacturing intensive, catch-up model

which has served industry well in the past appears to be reaching limits in some areas, challenging firms to move beyond process innovation to new product creation. In the area of new product creation, most Korean firms, in most sectors, have yet to make their mark, particularly in higher price, more complex products, capital goods and services. On the other hand, attempts to move more quickly towards 'knowledge-intensive activities, such as new product and service creation, carry heavy costs and risks and may not be successful. In other words, the emphasis on the knowledge economy 'pushes the stakes higher' because it requires firms to move beyond the manufacturing centered strategies of the past.

32. Most firms in the sample highlighted this dilemma ("stick to the old successful manufacturing approach" *vs* "adopt risky new knowledge-intensive strategies"). They also recognized that faster moves towards product creation involve far greater investment in fundamental R&D, particularly in the R&D capable of producing new product generations based on new materials, radical designs and advanced information (especially software) technology.[9] Unfortunately, as noted in Part A.4 below, the recent financial crisis had led to cut-backs in fundamental research and moves toward shorter-term R&D in support of current and near-term business needs. In many cases, firms had yet to recover from this re-orientation forced upon them by financial circumstances.

33. To move towards product creation, and away from the successful 'imitate and improve' strategy will also require greater direct support from leading capital goods producers (including foreign suppliers). However, the more complex capital goods, design services, and key components are weakly represented in the Korean economy (as indicated by both users and producers of capital goods).

34. It is important to note that from an economic and historical perspective this 'innovation dilemma' view could be challenged. Similar views have been widely expressed in previous phases of Korean industrial history by academic observers and industrialists. However, it could well be that, as long as international markets for low cost, high quality hardware continues to expand (as they are likely to do, for example, in electronics) Korean firms may well continue their repeated cycle of 'behind the frontier' catch up product innovation, with leading US, Japanese and European firms remaining ahead in new product creation, especially in higher price, design-intensive, products, services and systems.

35. Therefore, in any major strategic attempts to move towards a knowledge economy through more knowledge-intensive activities, firms face a genuine dilemma which they are conscious of and have devised strategies to address. Put simply, in order to move to higher value added, more *knowledge-intensive* activities, Korean firms need to go beyond the mass production of relatively simple hardware to more complex hardware, as well as services and software (and 'solutions' comprising cutting edge hardware, software and services).

[9] In addition, major investments in brand name awareness (e.g. advertising) and distribution would also be required to establish Korean firms in 'high-end' overseas markets

36. The Korean Government shares the view of industry and is keen to promote moves towards the knowledge economy (World Bank, 2000), while acknowledging the risk involved in moving toward a knowledge-intensive economy (e.g. heavy additional investments in brand image, advertising, distribution, R&D and human resources). On the one hand, without these investments Korean firms could well remain within the catch up, manufacturing mode. On the other hand, there is no guarantee that such investments would be successful. They could fail and impose a heavy financial cost on Type C Korean firms. Ultimately, the merits of such major strategic investments can only be assessed at the corporate level by the companies themselves.

37. However, as discussed below in Section A.6, there are various policy options the Korean Government may wish to consider to help minimize the risks and costs facing those firms wishing to move from Type C to the more knowledge-intensive Type D 'creative' category.

A.4 Other Key Findings

38. *In telecommunications, regulatory changes have promoted industrial and technological progress among service providers, pulling forward the capabilities of major local systems suppliers.* Korean mobile service providers (e.g. SKT) underwent radical restructuring as a result of new regulations that allowed them to exploit digital technology and the internet. Major investments were made in strengthening their service capabilities, as service providers moved 'upstream' away from direct involvement in hardware and systems. As the large service providers moved upstream, they have helped to build up the systems capacity of Korean hardware suppliers, such as Samsung and LG in areas such as switches, routers and base stations. In some areas, service providers have felt that major international suppliers (e.g. Motorola and Lucent) were not sufficiently responsive to their needs. This increased domestic capability to supply systems and 'solutions', stimulated by foreign competition, is sometimes called a 'pacing horse effect', where competition from foreign leaders pulls forward the capabilities of local firms. In the case of the main line operator KT, regulatory reform affected virtually all areas of technology search, strategy and competence, leading to a greater involvement of local technology suppliers and closer working relationships with leading international vendors such as Lucent, Nortel and Ericsson.

39. Although only a very small number of SMEs were included in our sample, the firms analyzed were highly competent in most areas of innovative capability including search, strategy, acquisition, linkage forming and learning. The evidence confirms other research reports (e.g. Kim and Lee, 2000) which show that *the growth of the Kosdaq, spin outs from the Chaebol and new policies to encourage SME start-ups have led to a burgeoning of entrepreneurial technology-based firms in Korea.* High technology micro-enterprises grew from a small base in 1998 to more than 6,000 in the 1999 with employment reaching nearly 200,000, and a contribution to GDP of around 4.8%. The Kosdaq stock market which includes the so called 'venture companies', as well as other high technology suppliers, began in 1996. By July 2000 the Kosdaq was valued at Won 45,226 million, equivalent to around 21% of the entire Korean stock exchange. Many of the new start-ups have focused on new information and communications technology

including the internet and web services. Some have proved to be highly profitable, but it remains to be seen how dynamic and durable this category of firms will be in the future, and the contribution they can make in the long-term to the knowledge-based economy. However, the very rapid growth of new entrepreneurial start-up technology-based firms was inconceivable in Korea even a decade ago and has confounded the recent concerns of expert observers (e.g. Nugent and Yhee, 2001)

40. On the negative side, *the Korean financial crisis of 1997 to 1998 proved to be a set back for large exporting firms (e.g. in electronics, automobiles and chemicals) in their efforts to move upstream towards more knowledge intensive research activities.* The evidence suggests that investments in basic research, in particular, are highly sensitive to industrial shocks and business cycles. For a decade or so prior to the crisis, leading Korean firms had been strengthening their basic research capabilities while reducing, to some extent, their dependence on sub-contracting and licensing. However, the crisis forced many firms to retreat from basic research, towards more applied R&D in support of near term business needs. The scientific research in several central corporate labs was cut back substantially in favor of the needs of business divisions. Other long-term and 'non-essential' operations were also cut back due to financial pressures. Some firms were forced to reduce their recruitment of doctoral-level researchers and to curtail investments in new research areas.

41. However, the crisis also created new opportunities for technological partnering among major Korean firms. In the past, Korea has remained fairly closed to foreign direct investment which restricted possible strategic options (e.g. partnerships for capital goods production). The crisis, however, forced some firms to rethink the 'go it alone' strategy. Post-crisis restructuring has demonstrated the potential advantages of carefully planned joint ventures. A case in point is the LG-Philips alliance established in 1999 with LG providing Philips with advanced manufacturing know-how[10] in exchange for financial capital and access to Philips fundamental research facilities in Eindhoven. In 2000, the joint company achieved number one market share in some major product areas.[11] This example hints at the potential benefits of strategic collaborations with foreign companies, especially as firms try to mitigate the costs and risks of moving upstream to knowledge-intensive production.

42. In electronics, automobiles and other export sectors, our analysis exposed severe weaknesses in the supply and integration of capital goods within the Korean economy. For example, from the point of view of leading motor manufacturers wishing to move towards a full service supply chain approach, only 5% of Korean supply firms were viewed as capable of meeting requirements. The rest were considered weak in terms of quality, technology and service. As large electronics and auto firms move further towards the product design frontier in global markets there will be an increasing need for domestically based capital goods and components suppliers within Korea. Given the

[10] For liquid crystal display (LCD) monitors for PC's and notebooks.

[11] The joint venture enabled LG to recover quickly from a one-year delay in investment in new production facilities, and then to forge ahead to a world leadership position. In year 2000 the joint company achieved a (leading) 15% share in LCD monitors for notebooks. The LG-Philips venture, with sales of US$26 billion, recorded profits of US$0.5 billion in 2000.

weaknesses of lower technology capital goods suppliers in the domestic market, many may well be supplanted by international investors with higher technology (e.g. Bosch in autos). In the capital goods sector, Korean firms continue to rely heavily on Japanese and, to a lesser extent U.S. suppliers of equipment, expertise and technology.

43. Other firm-level problems illustrated in Part A of the Main Report, include *a shortage of world class engineering, scientific and managerial talent.* For firms in the 'strategic (Type C)' cluster wishing to become more flexible, less hierarchical and more responsive to new markets, firms need a larger supply of the highest quality staff in all the above categories. The hall mark of 'creative (Type D)' firms is an organizational structure that is relative low in hierarchy, high in market and technological flexibility and rapid in the capture and implementation of new ideas. Even though some leading firms are moving in that direction, the majority of the firms analyzed remain hierarchical and age-, seniority- and qualifications-conscious. The latter are explicitly or implicitly rated as more important than the risk-taking, innovation capability of individual staff members. To move from Type C to Type D, company operations need increasingly to be based on creative combinations of different resources within and across firms and sectors. This theme is explored in part C in more detail.

A.5 Limits to Public Policy

44. The technology audit showed that most leading Korean firms were not yet capable of contributing to the world technology frontier through basic research or the generation of new high value products. It also identified several major challenges confronting Korean firms wishing to move from the Type C 'strategic' to the Type D 'creative', knowledge-intensive category. Key problems included:

- The risks and costs of faster moves towards product creation;
- The impact of the financial crisis, causing a retreat from basic to near-term applied research;
- A shortage of world class engineering, scientific and managerial talent;
- The need to develop more flexible organizational structures and become less hierarchical;
- Weaknesses in the supply and integration of capital goods within Korea.

The audit also demonstrated new opportunities, including:

- Crisis-induced, successful technological partnering between Korean and foreign firms;
- Organizational restructuring leading to improved service capabilities (e.g. in digital telecom);
- A rapid growth in high technology SMEs in Korea.

45. Furthermore, the audit revealed at least two significant problems with current public sector support for Type C firms. First, although major firms collaborated extensively with universities and government-funded research institutes, most felt that publicly-funded research was overly disconnected from the needs of industry. Some

argued that the policy emphasis on basic research in universities was misplaced, being poorly defined and not justified by local needs. There was a similar sense of 'disconnection' with government-funded research laboratories.

46. Second, most firms in the sample believed that government technology policies were formed without sufficient consultation and input from major industrial actors.[12] Not surprisingly, when asked, firms argued that government should provide more direct support for their activities by aligning public sector research investments more closely with their needs and, in effect, 'back up' corporate R&D. Suggestions included subsidized, shared research infrastructure, sponsored research consortia and an improved supply of human resources (see below for details). Firms also pointed to S&T policies in OECD countries, asking for similar types of support as received in the US (e.g. Sematech in semiconductors) and Europe (e.g. research consortia such as ESPRIT) and Japan (e.g. subsidized major collaborative research programs).

47. Before discussing possible policy options, it is important to point to several limitations and difficulties with government policy in this area. For example, in several of the key problem areas above (e.g. overly hierarchical structures and the need for highly trained managers), the most appropriate vehicle of improvement is probably the firms themselves, *via* in-house training and human resource development. If external support is required, then it is probably best provided by major consultancy companies which all run tailored programs of improvement and are all represented in Korea.[13]

48. An overriding aim of current policy is to curb the perceived excesses of major privately-owned firms, especially the *Chaebols* and enhance the fundamentals leading to systemic competitiveness. These firms have sometimes been accused of lacking in good standards of corporate governance, profiting from monopoly and cross-subsidizing weaker operations from more profitable ones. Under these circumstances, a central aim of policy, especially since the crisis of 1997, has been to ensure greater corporate transparency, a reduction in debt and reforms in the relationships between some major firms and financial institutions. Understandably, this has been the focus of much recent competition policy and financial regulation (World Bank, 2000).

49. Following success in corporate reform objectives which would serve to improve the incentives for improving competitiveness, the Korea Government may wish to attempt to assist firms to overcome the innovation problems described above and build on the opportunities identified. At least five policy measures for promoting Type C firms suggest themselves, based on discussions with the sample of firms and the experiences of leading OECD countries. These suggestions are offered in the light of the provisos above and only as a starting point for government to consider.

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[12] This is surprising given the various consultative exercises conducted (e.g. by MOCIE).

[13] Indeed several are regularly hired by major Korean firms.

A.6 Five Policy Recommendations

Policy Recommendation 1 - large firm research consortia

50. Potentially, subsidized large firm research consortia could address: (a) the need for more experimental and basic research; (b) some of the risk and high cost of faster moves to upstream R&D activities; and (c) the need to increase the supply of world class R&D talent.

51. During interviews, several Korean firms expressed interest in government support for setting up advanced research consortia (e.g. in the area of nano-technology) with shared technical facilities. Such consortia have been widely promoted by governments in Europe (e.g. ESPIRIT, JESSI and Eureka), in the U.S. (Sematech) and in Japan in earlier phases of development (e.g. the VLSI program for DRAMs, and the ICOT 5th Generation Computing Program). These programs seek to combine the capabilities of member corporations to develop future technologies. In the case of Korea, the government may wish to design programmes which include leading foreign corporations, given that many Korean firms could learn from the most advanced foreign companies. Foreign firms could be attracted by the local market or the advanced process technologies of the *Chaebol.*

52. Government, however, would need to be convinced that the potential benefits (or 'positive externalities') likely to emerge from such consortia could justify any financial subsidies. The government would also need to be satisfied that: (a) it had the competence to monitor and evaluate such programs; (b) potential problems of abuse could be prevented or penalized; (c) any consortia did not undermine policies to promote more transparency and competition. Furthermore, Korean policy makers might also wish to look critically at the benefits *vs* the costs of consortia type programs in other countries, as these initiatives have not always led to unqualified improvements to innovative or competitive performance (Hobday, 1997).

Policy Recommendation 2 - promoting inbound FDI

53. As the audit showed, foreign direct investment (FDI) can provide considerable partnering benefits and a 'pacing horse' (i.e. demonstrator) effect for local competitors. Foreign TNCs can inject new resources and capabilities into the technological infrastructure and potentially play a more important role in stimulating innovation in Korea, as it has done in many other countries. By deliberately targeting certain kinds of FDI, local Type C firms could be encouraged to climb the innovation 'staircase' described earlier. For example, in the R&D consortia suggested above, the government may wish to involve specific foreign participants with strong, complementary capabilities. This kind of policy has worked well in Singapore. By contrast, several early European programmes which excluded FDI could well have benefited from non-European foreign collaborations (Hobday, 1997).

54. In Singapore, Scotland and Ireland, governments have encouraged TNC subsidiaries to go beyond current production and set up advanced process and product

research. Foreign firms in some countries (e.g. Singapore) have also begun to set up R&D facilities naturally as a consequence of their upgrading over the years and their appreciation of the high quality of the infrastructure (Wong, 1995).[14]

55. Unfortunately, until very recently Korea has been viewed as 'closed to FDI' and this perception has been confirmed by the very low levels of FDI until 1998 (Woo and Sul, 2000; Choi and Kang, 2000). A process of FDI-driven technology upgrading may therefore take several years to take root and a concerted effort to overcome the perceptions of foreign governments and businesses would be needed. Active government promotion of FDI, along the lines of other countries (e.g. Scottish Enterprise) could perhaps overcome initial hesitancies in developing Korean-based partnerships between foreign investors and Korean firms.

Policy Recommendation 3 - promoting overseas S&T networks

56. Problems identified during the audit included a disconnection between the needs of firms and the public sector S&T system and an insufficient supply of world class talent. As well as reforming current public sector research activities (as described in World Bank, 2000), the government may also wish to consider a new type of policy designed to promote overseas technology networks for Type C firms. In order to overcome limitations of domestic universities, the government could encourage the *Chaebol* to invest more intensively in foreign universities and other overseas public sector S&T groups. Through its embassies overseas, the government has contacts with and knowledge of key S&T resources and might be able to facilitate access to these, helping Korean firms move further away from the current centralized R&D model, towards a more collaborative internationally networked approach, more typical of large Type D firms. This new class of policy to support outward bound foreign technology investments could complement the inward bound foreign technology investments into Korea.

Policy Recommendation 4 - improving the supply of foreign capital goods

57. To compensate for weaknesses in domestic capital goods, the government may wish to encourage more FDI within the capital goods sector to meet the needs of the large exporting *chaebol*. An increased local presence of leading capital goods suppliers would assist Type C firms to raise the level of their joint work with foreign firms on the design of equipment needed for new product creation, and help local firms master the use of advanced capital goods. If successful, this would also lower the high import bill for capital equipment and services.

58. While foreign investment in capital goods already occurs to a limited extent (e.g. with the location of companies such as Bosch and Siemens), it might be accelerated by the targeting of capable foreign suppliers and the provision of the kinds of incentives to

[14] Wong, P.K. (1995): Technology Transfer and Development Inducement by Foreign MNCs: the Experience of Singapore, paper presented at the International Conference on Industrial Strategy for Global Competitiveness of Korean Firms, Seoul Korea, 10 January.

locate often found in other countries (e.g. the UK, Ireland, Malaysia and Singapore). For this policy to succeed, the image of the past ('closed to FDI') would need to be dispelled by the Korean Government in collaboration with business leaders. Such policies would need to go beyond passive acceptance or toleration of FDI, towards a pro-active targeting of specific firms, supported by political groups, trade associations and regional governments, as occurs widely in the UK (e.g. *via* Scottish Enterprise and the DTI's Invest in Britain Bureau). Such strategic targeting would probably exceed the current mandate of organizations such as KISC (the Korean Investment Services Corporation) which was recently set up within KOTRA (Korean Trade Promotion Corporation).

Policy Recommendation 5 - support for clusters of local capital goods producers

59. Several weaknesses were identified among locally-owned capital goods' suppliers including the need to upgrade product development skills and the lack of support received from the public sector S&T base. These smaller Type C firms also complained of difficulties in accessing marketing and technological information. In response, the government might consider supporting networks or regional 'clusters' of machinery firms by part subsidizing technology networks, consultancy services and improvement 'clubs' of various kinds (as provided by the U.K. Department of Trade and Industry). Consultancy services could be provided by private companies, competent government research institutes and/or talented university groups. 'Benchmarking clubs' could be set up to assess various new product development processes, compare relevant new technologies, and evaluate alternative overseas marketing strategies. However, as stressed above, the government may first wish to undertake a critical assessment of current support mechanisms within Korea, and gain information on the effectiveness and value for money of overseas programs of this kind, prior to introducing any new policy.

SECTION B: KOREA'S NETWORK ENABLED SERVICES

B.1 A Key Policy Challenge

60. Many of the principal obstacles that developing countries often face in introducing information and communications technology (ICT) have been largely overcome in Korea. [15] Korea now aspires to be a knowledge-based nation powered by creativity and innovation. In early 2000, the government of Korea prepared a blueprint for creating an information society - *Cyber Korea 21*. In December 2000, it issued *White Paper 2000, The Informatization Vision for Constructing a Creative, Knowledge-Based Society*. To further the goals set out in those documents, the government has followed with a series of implementation strategies. The most relevant to the current analysis is the April 2001 *e-Business Initiative in Korea,* which lays out an ambitious and comprehensive action program to support the "e-Transformation" of Korean businesses, including specific target dates for achievable goals. The initiative recognizes that the next step to build on Korea's strong infrastructure is to deepen the connection between Korean businesses and the Internet.

61. Current government plans and a high level of Internet access are not sufficient to transform Korea into an information services-based economy. While the average Korean citizen is highly educated about the availability of information technology and aware of the potential of the networked world, there remains a low level of integration of network-enabled services into business activities, particularly in small and medium-sized enterprises (SMEs). A large majority of Korean SMEs that are already connected to the Internet, do not yet use the computer to manage their business or manufacturing processes. Firms in key competitors such as Japan, Germany, Italy, and the U.S., on the other hand, are experiencing higher adoption rates. A survey conducted by the Korean government in early 2001 concluded that "the extent of the informatization of Korean SMEs was evaluated as only 47.8 out of 100 points."[16] In its preliminary survey of the informatization of 25 SMEs conducted in July 2001, the KDI found that only five firms offered order placement and modification through their company web sites, and only one firm's site facilitated order tracking and the exchange of delivery and payment data. Eighteen firms were found not to engage in e-commerce sales at all, citing lack of integration between network access arrangements and internal information technology systems.[17] Thus, the government's real challenge lies in pinpointing the obstacles that are causing the slower than desired adoption of network-enabled services.

B.2 Network Enabled Services – E Features Attributes

62. Network enabled services are business functions and services that can be performed remotely and delivered electronically using telecommunication and computer

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[15] Korea's ICT sector has grown swiftly, rising from roughly five percent of GDP in 1992 to 11 percent in 1999. Its contribution to GDP growth is substantial, growing over the same period from 4.5 to 38 percent of GDP growth in 1999 (MIC, 2001).

[16] Korean Development Institute (KDI), Annex B3.

[17] See Annex B3, table B3.4.

networks. They vary from simple data entry to complex customer interaction, covering a range of labor-intensive and knowledge-intensive activities. Network enabled services are the most important emerging market in the global ICT industry.

63. Examples of network enabled services include call centers, medical transcription, animation and online games, distance education, telemedicine and back office operations. Internet sites, such as web portals, which offer a broad array of resources and facilitate the provision of businesses services, are an emerging example. Each service requires a different mix of capabilities in firms desiring to provide the services commercially, and different kinds of national infrastructure to support those firms.

64. A nation's 'E-Readiness' is the baseline from which firms launch their quest to be competitive in delivering network enabled services[18]. By measuring E-Readiness at the national level, governments can take the steps necessary to support firms in the global network enabled services marketplace. At the national level, there are five key E-Readiness attributes:

- Connectivity: Are networks (including transportation networks) easy and affordable to access and use?
- E-Leadership: Is E-Readiness a national priority?
- Information Security: Can the processing and storage of networked information be trusted?
- Human Capital: Are the right people available to support e-business and to build a knowledge-based society?
- E-Business Climate: How easy is it to do e-business today?

65. Korea's position on theses attributes can be briefly summarized:

1. Connectivity: as mentioned above, connectivity in Korea is high. Five million households now have high speed network access. Twenty-five thousand "PC Parlors" around the country enable almost anyone to enter cyberspace, and Internet access costs at $12-30 per month are reasonable. Significantly, nearly 85 percent of Korea's SMEs have internet access. However, as highlighted above, they are not fully e-commerce ready. That will require the firms to integrate network activities such as online transactions into their systems. Furthermore, for e-commerce to be fully operational, physical goods must also move quickly, which will require bringing on-line thousands of unconnected and fragmented logistics companies.

2. *E-Leadership* - The E-leadership provided by the Korean government is among the most comprehensive in the world but many challenges of inter-ministerial coordination (discussed below) remain in devising cost-effective strategies for promoting e-commerce.

3. Information security: Information Security in Korea deserves further attention. Korea is very strong on protecting information systems but somewhat weaker on

[18] See *Ready? Net. Go! Partnerships Leading the Global Economy*, McConnell International, 2001.

protection of intellectual property - the incidence of piracy, despite some recent decline, is still high.

4. *Human capital:* with 98 percent literacy, a strong industrial base of computer hardware manufacturing and assembly, and the surge of new internet companies, Korea has a strong human capital base. However, English proficiency is not high, and there is a growing concern that traditional Korean teaching promotes learning by rote and repetition which discourages creativity and originality. This broader educational issue is addressed in Part C below.

5. *E-business climate*: with promotion of foreign direct investment into ICT, privatization of Korea Telecom, a strengthened Korea Communications Commission and relatively open wireless markets, the E-business climate is becoming more transparent and predictable. The legal infrastructure to promote transparency in e-commerce business procedures, meanwhile, needs to be strengthened.

Despite the outstanding challenges, Korea performs well in international comparisons on most E-Readiness attributes (McConnell International, 2001).[19]

66. However, in comparison with other leading providers of network enabled services, Korea requires improvement in two key areas: Information Security and E-Business Climate. Table 1 summarizes Korea's current advantages and challenges in the network enabled service area.

Table 1: Korea's Advantages and Challenges in Network Enabled Services

Attribute	Advantages	Challenges
Connectivity	Broadband communications infrastructure widely available.	Integrating SMEs. Transportation and logistics infrastructure.
E-Leadership	Strong top-level leadership.	Coordination among ministries. Need for focus.
Information Security	Public key infrastructure. Systems security policies. Privacy policy.	Valuation of intangible assets Protection of intellectual property.
Human Capital	Well-educated population. Customer-service attitude.	English language skills. Software programming skills. Fostering creativity.
E-Business Climate	Strong entrepreneurial spirit. Emerging competition in communications and Internet services.	Transparency in business and regulatory transactions. Market openness. Legal infrastructure still unclear. Lack of product quality standards.

[19] McConnell International. (2001): Ready? Net. Go! Partnerships Leading the Global Economy, McConnell International, Washington.

B.3 The Role of Network Enabled Services in Korea's Development

67. Network enabled services can contribute to economic development in two principle ways: by increasing exports and by improving efficiency in the domestic economy, including core industries such as heavy manufacturing. The benefits of such internal, domestic use of network enabled services are three-fold:

- The development of indigenous domestic capacity creates a cadre of skilled information society professionals, an essential complement to the physical and policy infrastructure;
- Service-generated increases in productivity can decrease the costs of production for all goods, including exported goods, thus contributing indirectly to export growth;
- Focused delivery of network enabled services can provide direct benefits to poor and underserved populations. It can increase these populations' ability to participate as producers and consumers in the digital economy.[20]

68. The main argument of this study is that network enabled services can benefit Korea both domestically and *via* increased exports, but that domestic benefits will yield greater advantages in the near term. Therefore, promoting domestic e-services should be the principal focus of the Korean Government.

69. This approach is in contrast to countries that have focused primarily on export-led services. An effort by the Korean government to replicate these countries' export-led successes would be short-sighted. As described in detail in Part B of the main report, a variety of factors have led different countries to adopt appropriately different strategies to network enabled services. India and Ireland, for example, share three important qualities that favor an export-led strategy:

- Populations with strong English skills that have permitted them to serve the U.S. market;
- Low labor costs;
- A weak internal market for network enabled services that limits the benefits to domestic productivity and participation and upgrading of SMEs.

70. Because several of Korea's competitors, offering lower labor costs and other advantages such as strong English language skills, are better positioned to export key network-enabled services -- call centers, medical transcription, animation, geographic information services, back office operations, distance education, telemedicine, and tele-engineering -- it is essential that Korea focus instead on building domestic capacity.[21]

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[20] For example, a farmer can create or visit a virtual marketplace to learn current price information or to buy or sell goods directly. This can increase profits by saving travel time and improving his negotiating position over the 'middlemen' who normally operate on the basis of superior information.

[21] Call centers and medical transcription, in particular, require high English language proficiency. The provision of back office operations, distance education, telemedicine and tele-engineering services also require varying levels of language skill. In addition, Korea's relatively high labor costs present a challenge to the export of call center, medical transcription, animation, geographic information and back office operation services.

Encouraging an environment in which Korean firms readily recognize the benefits of interacting electronically should be a primary goal of the Korean Government.

71. Korea's high connectivity and 'net-savvy' population indicate that strong potential exists for domestic consumption of network enabled services.[22] By focusing on encouraging Korean firms to increase domestic service offerings before engaging in a campaign to market them to the rest of the world, the government would solidify the foundation necessary for sustained growth in the global knowledge economy.

B.4 Moving Forward in E-Business

72. In April 2001, the Korean Government released *e-Business Initiative in Korea,* the results of the Sixth Information Strategy Meeting of some 16 government organizations, including the Ministry of Commerce, Industry, and Energy, the Ministry of Information and Communication, the Ministry of Finance and Economy, the Ministry of Construction and Transportation, and the Ministry of Planning and Budget. The report argues that the last ten years have laid a foundation for Korean e-Business by creating an underlying infrastructure, promoting the ICT industry, and beginning to optimize manufacturing through the use of digitally controlled manufacturing technologies. This report followed on the heels of the December 2000 White Paper, which had included many provisions to improve Korea's E-Business Climate. While the December 2000 White Paper included relatively fewer target dates for its proposed accomplishments, the April 2001 strategy sets clear, measurable goals, including specific time frames for the completion of initiatives, in many areas.

73. The above report points out that, in order to move to the next stage, all industries must transform the way they work, and that the boundaries between traditional and ICT industries must be removed, thus permitting more efficient logistics management and increased value from network enabled services. It lays out five areas of work for stimulating these changes:

- Increasing security and reliability by reforming the legal and policy infrastructure;
- Improving e-business communications networks, technology, and human capital;
- Promoting the computerization of the public sector (e-government);
- Promoting business-to-business (B2B) services, especially among small and medium businesses and in technology parks;
- Promoting the electronic trading of imports and exports.

74. In addition, the report raises the concern that without significant progress by 2003 Korea could begin to lose competitiveness in the area of network enabled services. To oversee implementation of the work, a committee of ministries will continue to meet. In addition, an e-Business Roundtable, chaired by the head of the Federation of Korean

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[22] The domestic marketplace for back office operations is already burgeoning. Table B3.6 in Appendix B indicates, for example, that web page development and web page hosting are services commonly outsourced by Korean SMBs.

Industries, will work with the government, drawing on the examples of Japan and Canada.

75. The above report also identifies four principal challenges in promoting e-business:

- Lack of a cooperative culture among firms;
- Lack of confidence in e-business and low investment capacity among SMEs;
- Slow progress in management innovation and in increasing transparency of business practices;
- Need for more progress on standardization, human resource development, and electronic payment systems.

B.5 Many Challenges, But Is the Focus Right?

76. The Korean Government's ambitious strategy misses none of the major areas that need to be addressed. All aspects of E-Readiness are examined and the emphasis on e-business is appropriate. Yet the strategy's breadth and, paradoxically, its business focus, are also two sources of weakness. First, an even clearer focus and set of priorities would be helpful if the intended results are to be achieved in a timely manner. Second, a more inclusive view of the affected population is critical to support the overall move towards a knowledge-based economy.

77. With respect to focus and priorities, broad, comprehensive program have three major drawbacks.

- Breadth can mean that there is too much to monitor. In some cases the committee that oversees the effort is burdened with complex tracking systems that require and deliver more information than can be digested;
- When the task list is long, often the easier or more glamorous projects are given undue attention, regardless of stated priorities and real needs;
- Breadth can create overly high expectations. Because some goals will not be met, important stakeholders could become disappointed and disenfranchised. It is prudent to manage expectations early in the process.

78. With respect to inclusion, the strategy makes a brief mention of the 'digital divide' that affects small businesses, but does not give strong emphasis to involving underserved populations. The strategy's business emphasis, while it is absolutely essential, should perhaps be tempered with a vision that reaches more broadly and deeply into Korean society.

79. These shortcomings can be overcome by giving strong emphasis to a few key areas. Once those areas are selected, setting out a clear sequence of actions and establishing sound processes to accomplish them, will greatly increase the likelihood of successful outcomes. Industry and government must look for new ways to forge relationships that are mutually beneficial and that promote sustained e-business growth.

B.6 Leading Edge Services

80. While action is needed across a broad front, it is the core recommendation of this report that initial efforts towards the e-transformation of business in Korea should be led by leading-edge network enabled services focusing on business information services for SMEs, with particular emphasis on domestic logistics information services portals. It should be emphasized (as in Section A above) that the primary engine of change will be private sector rather than government. However, government can play an important role in facilitating and encouraging action by the private sector.

Policy Recommendation - Business information services for SMEs (with a focus on domestic logistics information services portals)

81. This recommendation concerns market information. The Government of Korea through the Ministry of Commerce, Industry, and Energy and the Small and Medium Business Administration should benchmark the business information services needs of SMEs, identify SMEs that have successfully utilized ICTs to grow, and encourage the development of business information services portals to propagate these successes across Korean SMEs. Within this context, encouraging the creation and promotion of domestic logistics information services portals should be the first priority.

82. Why choose these services as the leading edge? Increasing access to market information provides a badly needed focus for Korean policy making in this area, and will assist in overcoming the problems described in B.5 above. Furthermore, it satisfies the following important criteria:

- Builds on Korea's core strengths in Connectivity, E-Leadership, and Human Capital;
- Addresses some of the principal challenges (discussed below) facing Korea in its advance toward the knowledge-based economy;
- Involves a key segment of Korean society -- the small businesses community;
- Can be implemented relatively quickly because there is likely to be a positive appetite for and sense of ownership of these services among private sector stakeholders.

B.7 Process and Coordination

83. Recently the Korean Government established an e-Business Roundtable of Korean business leaders in order to encourage 'buy-in' from opinion leaders in the most affected sectors. A coordinated public information strategy to promote any new initiatives will be essential to success, as will be the building of partnerships with the private sector. It is for this reason that we recommend that private sector participation and consultation is emphasized in early discussions of the two recommendations.

84. The Korean Government's commitment to helping SMEs is evident through its outreach *via* such portals as Inno-NET (www.innonet.net) which is jointly managed and operated by the Small and Medium Business Administration (SMBA), The Korean Institute of Science, Technology, and Information, and the Ministry of Commerce, Industry, and Energy. In addition, the SMBA and its related institutes and public corporations operate numerous information services for SMEs, including Venture Net, Techno Net, Start-up Net, Small Business Net, Consulting Net, Export Support Net, Foreign Exchange Net, and Regional Specialization Net.

85. Most small Korean firms, however, remain unaware of constantly changing market information, are dependent on large suppliers of raw materials, and are engaged in passive relationships with their large customers. As one researcher notes: "Most Korean SMEs are in great peril indeed. Their ultimate competitiveness bases—sheltered markets, subcontracts with leading domestic companies, and low-cost production—will erode fast, facing a set of adverse forces such as market liberalization, globalization of parent companies, and relentless catching-up of the newly-industrialized economies, especially China. Surely, there are some favorable changes for SMEs such as increased demand for differentiated products and availability of new low-cost information technologies. But most Korean SMEs simply lack the abilities to capitalize on them" (Woo, 2001).[23]

86. While the internet cannot provide a 'panacea' for such problems, if used wisely and selectively it can be one useful tool for helping small firms gain data, discover new market channels and gather useful information on the strategies of other SMEs attempting to overcome similar challenges.

Business information services

87. This recommendation has two parts: business information services and domestic logistics portals. Regarding business information services, access to market information is essential for SMEs to make sound investment, production, pricing, and other business decisions. While market information is available in Korea through a variety of media, perhaps due to the myriad of channels of information distribution, SMEs generally suffer from limited uptake of such market information.[24]

88. So far, government-initiated campaigns to raise SME awareness of the potential benefits of the Internet have been successful to a degree. While more than 85 percent of Korean SMEs have an online presence few use on-line business information services. It is

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[23] Woo, C. (2001): 'Innovation Challenges to SMEs in Korea', Paper delivered at the Policy Seminar on Technology Readiness and Innovation, the 3rd Asian Development Forum, June 2001. The paper notes further that SMEs are falling further behind. In the machinery and equipment sector, total share of value-added increased between 1985 and 1995 from 30.6 percent to 45 percent, while among SMEs, the share went from 25.4 to 35.7 percent.

[24] An exception is information about agricultural commodities, where, like many national governments, Korea provides free wholesale pricing and sales information which is widely used by farmers.

not sufficient to simply encourage business owners to go online and assume that they will navigate for themselves among the wealth of informational sites available to help them improve their businesses.

89. Indeed, without concrete examples of what they stand to gain, and acknowledgement of the costs involved (e.g. finance, learning and human resource costs) busy small business owners will not take the time to assess the potential value of the Internet. Therefore, the launching of a promotional campaign centered on testimonials from SMEs themselves, regarding the specific areas in which 'bottom line' benefits have clearly arisen from Internet use may be helpful. Testimonials could show how successful users have managed the process of integrating the Internet into their daily business practices, giving an appreciation of how costs can be understood and managed and minimized in order to maximize value.

90. We suggest that the Ministry of Commerce, Industry, and Energy (MOCIE) should lead this initiative, in cooperation with the Korean Development Institute and the SMBA. It can bolster its current campaign to raise awareness of the benefits of ICTs and promote business information services portals for SMEs by:

- Benchmarking the current E-Readiness of Korean SMEs by expanding the recent survey conducted by the KDI.[25] An expanded survey could serve three purposes:

- To pinpoint key market information services that are needed and could be consumed online by SMEs;

- To identify success stories and acquire testimonials of SMEs that have experienced growth due to the use of online business information services;

- To illustrate the circumstances under which the benefits of using the internet outweigh costs through selective, focused usage and in-house skills development;

- Encouraging the growth of portals, targeted to SMEs, offering priority business information services, as determined by the results of the survey;

- Creating a marketing campaign based around these SME success stories (testimonials) as best practices and lessons-learned for less network-integrated SMEs, offering examples of how, why and where specific ICTs should be integrated into business activities.

91. As emphasized above, it is important that government involvement be held to a minimum. The government's 'market-making' activity should be designed to remove information barriers and market inefficiencies as opposed to displacing activity more appropriately conducted by the private sector. For this strategy to be successful, the government needs to take action on multiple fronts simultaneously, incorporate evaluation sessions into each phase, and re-focus efforts based on uptake as it proceeds.

[25] A summary of which is found in Annex B3.

By engaging the private sector, and demonstrating that the needs of multiple stakeholders are addressed, the Government of Korea may well be able to foster a sense of ownership of market information portals among firms, thus leading to greater sustainability and improved E-Readiness.

Domestic Logistics

92. The creation of a domestic logistics information services portal is the second part of the Market Information recommendation. Currently, a large impediment to cost-effective e-commerce in Korea is the slow and expensive domestic logistics system.[26]

93. Many of Korea's problems in this area have been caused by rapid urbanization. As the Fourth Comprehensive National Territorial Plan 2000-2020 notes, the population share along the Seoul-Busan axis has grown from 44 percent in 1960 to 74 percent in 1995. Manufacturing firms have seen parallel urbanization, with the percentage of companies located in the same region rising from 56 percent in 1960 to 80 percent in 1995. The Korean Government has already recognized that "distribution systems are inadequate ... [as] is the linkage among transportation networks." In addition, the report estimates that the cost incurred by traffic congestion has already topped 18 trillion won (4.4 percent of GDP) with expected growth of as much as 22.4 percent per year. According to the report, "The shortage of transportation facilities not only makes the daily life of citizens inconvenient but also hinders the nation's economic progress by causing staggering socio-economic costs.... All this points to a greater need to create conditions in the nation's territory that could accommodate future growth industries in the 21st Century."[27]

94. Creating such conditions presents a challenge, as Korea's transportation sector is currently dominated by numerous independently-operated SMEs. In total there are more than 188,000 firms in the transportation sector of which nearly 98 percent are SMEs, and 181,000 tiny firms employing between 1 and 4 staff. [28]

95. Korea's logistics infrastructure problem is exemplified by the experiences of a popular Seoul department store during a recent lunar holiday. Because so many customers took advantage of new online purchasing service offerings, the store was inundated with orders requiring timely delivery. Due to lack of adequate delivery infrastructure, the store was forced to pull hundreds of employees from the store floors to hand deliver goods at the last moment. The resulting transportation costs negated any efficiency gains from e-commerce. This is just one example of how Korea's disaggregated logistics industry is negatively affecting future e-commerce growth. Numerous interviews conducted with both private and public sectors suggested that

[26] Here logistics refers to the domestic cargo transportation infrastructure (primarily trucking), and the institutions and information systems that support that infrastructure.

[27] Fourth Comprehensive National Territorial Plan 2000-2020; p. 20, 23.

[28] For comparison, in the U.S., 76 percent of firms employ between one and nine staff and 62 percent employ between one and four. Data extracted from "Statistics on Korean Firms", http://www1.smba.go.kr/human/english/introduction.htm.

difficulty in getting goods to purchasers is one of the most significant barriers to successful implementation of e-commerce in Korea.

96. Currently, a number of Korea's large trucking and logistics companies offer information services to facilitate export and import transactions, yet few companies offer logistics information services over the Internet to assist domestic transactions. Where information services are offered to domestic shippers, they are generally limited to rate information. By contrast, larger firms, which dominate the U.S. market, offer online services such as order placement and door-to-door tracking, and industry-wide portals have featured load matching and sharing.

97. The Fourth National Territorial Plan acknowledges that Korea suffers from "weakening competitiveness due to inadequate infrastructure". It proposes numerous measures to alleviate the problem, for example, by "Intensifying investment in facilities for high-efficiency transportation". However, the plan does not elaborate on what form these facilities might take. Furthermore, "heighten[ing] the efficiency of logistics facilities through informatization and standardization" has been presented as an idea. The suggested method is to "build a database that includes electronic document exchange, facilities, and intermediary information plus a cargo transport information system to materialize vehicle tracking and remote control using wireless communication." [29] This data base could be made accessible to the logistics community at large through the creation and promotion of a domestic logistics services portal.

98. Such a portal should cater especially for SMEs from the trucking and warehousing industries. Delivering goods efficiently is particularly challenging in Korea because of the vast number of SMEs in this sector. Increasing the efficiency of Korean trucking firms could be of major benefit to domestic e-business in Korea, particularly for other SMEs in the agriculture and garment sectors.

Strategy and implementation

99. This report recommends that the government follows a combined strategy of encouraging the commercial provision of the service and promoting the service to the trucking community with the goal of stimulating collective action among firms. We recommend:

100. *First*, within three months, the government should specify the functionality for the service using a Request for Information (RFI) process to gauge industry interest. The RFI should:

- Specify that the service must provide an easy means for buyers, shippers, and truckers to collaborate on deliveries;
- Stipulate that the government will support the initiative by assisting the winning offeror in acquiring start-up capital, and by assisting in reaching out to the truckers (see below).

[29] Fourth Comprehensive National Territorial Plan 2000-2020; p.11, 113, 129-130.

101. Based on the responses to the RFI, the government should craft a Request for Proposals (RFP) that requires responses in three areas:

- A technology and management plan describing the functionality and operation of the proposed solution and how the offeror will assure success;
- A deployment and marketing plan to connect with the communities of interest (buyers, shippers, and truckers);
- A business plan to make the operation economically viable within three years;
- Selection of the service provider should be completed within nine months and should be based on a balanced evaluation of the three areas.

102. *Second*, the government should promote the project through the 50 SMBA support centers nationwide and MOCIE's Electronic Commerce Resource Centers. Outreach to Korean trucking associations will also be critical as will coordination with other, ongoing initiatives. This outreach should be coordinated with the publicity campaign recommended as part of the Business Information Services strategy.

103. As mentioned above, Korea stands to gain important lessons learned from the failure of many U.S. logistics information services, as well as from U.S. best practices. A useful avenue to gain key insights from the U.S. experience would be for Korean officials to visit American logistics enterprises, as well as major trucking companies, trucking and shipping associations, and universities such as the University of Maryland's Supply Chain Management Program offered through its business school, in order to formulate more concrete ideas of how the U.S. system could be best adapted to suit the Korean market.[30] Although the domestic logistics information services recommended above cannot and should not be offered by the government, knowledgeable government representatives could certainly act as catalysts.

B.8 Addressing the Principal Challenges

104. The recommendations above address, either directly or indirectly, the principal challenges that Korea faces in creating a knowledge-based economy. These challenges are of two kinds, those specific to e-business/e-transformation, and more general E-Readiness challenges. Both business information services and logistics services may serve to foster a more cooperative culture among firms, boost confidence in e-business, improve management in business processes, and promote transparency in business transactions. Ultimately, the promotional campaign designed to heighten awareness of the benefits of ICTs may serve to bolster technology investment among SMEs.

[30] See http://www.rhsmith.umd.edu/scmc/. Should representatives of the Government of Korea express interest, McConnell International would be willing to assist in the organization of the trip.

105. Possible benefits may come from several areas, the most important being the potential for higher domestic productivity in core industries served by business information services, benefiting from streamlined logistics services and the strategic leverage from increased participation in the knowledge-based economy by underserved portions of Korean society such as SMEs in rural communities.

106. However, these recommendations are not, by themselves, enough. Areas such as increasing market openness and clarifying the legal infrastructure are proceeding on separate tracks. Strong links between the people who direct this program and those with primary responsibility for other relevant areas are essential. The absence of such links could lead to duplication of effort or working at cross-purposes, detracting from the effectiveness of the focused approach.

107. It is worth noting that the implications of these proposals for market structure in Korea. Notwithstanding the *Framework Act on Small and Medium-Sized Enterprises*, which limits the activities of large firms in order to protect SMEs, competition in domestic markets remains restricted.[31] Thus, there is a continuing possibility that the exercise of market power by large conglomerates could inhibit the development of a flourishing domestic network enabled services sector. The Market Information services recommended here are designed to give immediate and direct support to SMEs in the most critical sectors.

108. Collaboration among ministries will be an equally important part of this strategy. A large number of programs already exist to assist SMEs. These programs need to be evaluated for their effectiveness and consolidated (or eliminated) where necessary. A streamlined program should be established that responds to market needs, targets specific industries, and creates synergies rather than wasteful duplication and overlap.

[31] In the longer term, the Act may need to be amended to cover network enabled services activities explicitly. However, that legislative effort is not recommended as a priority here for two reasons. First, efforts to legislate in the early stages of an emerging industry usually wind up creating unintended rigidities and can even distort the normal growth of the market. Second, such legislation would likely take several years to enact and longer to have its effects, considerably slower than the currently adopted time frame.

SECTION C: SKILLS THAT MATTER IN THE WORKPLACE

C.1 Educational Advances in Korea

109. Korea has attained remarkable achievements in education over the past three decades and the quality of its basic education has been internationally acclaimed. Total education expenditure has increased from 8.8% of GDP in 1966 to 13.3% in 1998, the highest share for any country at this level of development. Illiteracy reached near zero in 1997, primary school enrollment has been 100% and secondary school enrollment is almost universal.

110. At the tertiary level, Korea ranks third among OECD countries in the educational attainment of its population with 84% of its high school graduates entering a university or college in 1998. Although countries like the United States, Australia, and Finland are ahead of Korea in terms of enrollment rates, it is noteworthy that Korea has overtaken Japan and the UK. Female tertiary enrollment has also surpassed Japan and Singapore. Korea also boasts the highest growth rate in scientific publications among the OECD countries.

111. Student performance has consequently improved. Korean students at the 4th and 8th grades performed significantly better than the OECD average. In mathematics in particular, Korean students obtained the highest scores among all participating countries, followed by Japan.

C.2 Issues of Concern

112. There are however some issues of concern for Korean policy makers and business alike. While public expenditure per student as a percentage of GNP per capita in Korea has increased for primary and secondary education it has been stagnant for tertiary education. It is only recently that the government has launched an ambitious project, known as Brain Korea 21, which provides competitive grants to tertiary institutions. Slower population growth rates have resulted in a decline in the population aged 15-24, forcing attention onto the quality as well as the quantity of labor.

113. In addition, following the economic crisis of 1997, the government urged corporations to liquidate unprofitable businesses and to proceed with mergers and acquisitions to accelerate corporate restructuring. As a result, many workers were laid off and Koreas long-practiced life-long employment customs came to an end.

114. Since then, the economy has recovered quickly, and the unemployment rate which now stands at 3.6 percent (pre-crisis level) has again been on the rise with ongoing restructuring. Currently, South Korea's labor market is relatively rich in human resources with a higher selection standard due to the economic recession and corporate restructuring.

115. Finally, the demands of a knowledge-based economy have placed special emphasis on the ability of Korea's workforce to bring about industrial and organizational innovation which are becoming central to competitiveness. Evidence from other countries suggests that the new knowledge-based economy requires a different type of organization of production, which calls for changes in the relationship of worker to work, worker to worker, and worker to consumer, and seeks to stimulate continuous improvements through sustained skill investments and enhancements. To maintain relevance, education and training institutions, in turn, need to become more market orientated in the sense of planning for and responding to the needs of employers and students alike.

C.3 Scope and Objectives of Part C

116. Section A above has shown that Korean firms are still lacking both upstream and downstream capabilities and, as such remain, in a catch-up mode of development. To overcome these weaknesses would require, among other things, good quality scientists/engineers and better communications between academia, industry and policy groups. Leveraging business creativity would also allow the development of novel solutions involving NES discussed in Section B, hence transforming the Korean economy into a knowledge-based one.

117. In essence, recommendations from both Sections A and B could be buttressed by educational reform. The next logical step towards tailoring and speeding up educational reform is to understand the direction and magnitude of change that has already taken place in the workplace. The purpose of this section is to take some initial steps towards this goal, by investigating the hiring, retention, training and reward practices of high performing firms. In doing so, this section puts forward the views of the private sector, often absent from policy discussions on educational reform efforts at the secondary and tertiary levels.

C.4 Methodology

118. The method applied is to 'backward map' from what employers say are important skills and attributes for workers across a variety of positions. The establishments in the sample come from the both the manufacturing and service sectors. While there continue to be many low skill, low wage jobs in the Korean economy, this section, like Section A, focuses on the frontier by selecting firms that are characterized by high performing work practices.

119. For the purpose of this study, a firm is considered a high performing workplace if it is ISO certified or it can clearly articulate the process by which it selects workers using a formal test instrument, and continues to invest in worker development through formal training (in-house and outside); or it has a structured quality program and continues to invest in worker development through formal training (in-house and outside).

120. The sample includes major establishments with more than 300 workers. Sectors represented include telecommunication, automotive, electronics, distribution, tourism,

and banking. The instrument was designed to include both open-ended questions with follow-up probes as well as a number of more structured questions that required the respondent to rank their response to certain questions using a Likert scale ranging from a response of 1 (not important) to a response of 5 (very important).

121. In depth interviews were held with the general manager, a supervisor, the director of human resources, and the training manager at relevant establishments. In some (smaller) firms, often the general manager and a supervisor responded to all questions as there was no formal head of human resources or training. Most questions focused on recruitment, selection, worker qualities and training. Employers were also asked to discuss the characteristics of outstanding workers.

C.5 Organizational Change Within Firms

122. There is some evidence that high performing firms in Korea are rapidly changing the way they organize work, make decisions, carry out functions, and produce goods and services. Some of these firms are moving towards a more decentralized 'flatter' organization, with less hierarchy, more team work and faster decentralized decision making. Since the economic crisis of 1997, leading Korean companies have been forced to change and restructure their business practices. Some companies surveyed have systematized and restructured their internal organization in order to cope with rapid changes in industries and new macroeconomic instabilities.

123. One common trend is that traditional hierarchy is being replaced by task/project teams through delegation of authority and networking. Korea's major companies have traditionally been organized around a pyramid management structure with multi-level decision-making. Today, more companies have introduced a team system, eliminating many middle-management positions. Smaller companies, service firms and newer companies are quicker to adopt new management structures.

124. Increasingly, for production workers, the teams involves: (a) worker–technician–team leader–head–director; and (b) for clerical workers, worker–deputy manager–head–vice chief–chief–director–CEO. In some companies four to five layers replaces a previous system of eight to nine layers between worker and head of the organization. Another important trend is that computerization has reduced the time gap between decision-making and implementation, and as a result new methods are more quickly adopted at work sites. This has involved the adoption of on-line approval systems in some companies to eliminate much 'excess' paperwork.

125. Some work processes have been computerized to the extent that notices, communication between workers, complaints, suggestions and grievance procedures are processed on-line for horizontal information sharing. In addition, there are several examples of innovative activities within manufacturing with leading firms making efforts to 'flexibly control' the work process. Increasingly, workers are expected to have more comprehensive knowledge relevant to their job function. High performing firms expect their new workers to be familiar with electronics and computers because production lines

are being automated. One bank noted that calculating and accounting skills are today far less important than consulting skills, customer relations and various service skills.

C.6 Changes in Human Resource Management

126. High performing firms are attempting to shift away from traditional human resource management practices. This emerging trend is seen at every stage of human resource management from recruitment to the reward system, the main focus being on reinforcing competence and performance.

Flexible and decentralized recruitment

127. The patterns of employment and recruitment have rapidly changed in major enterprises in Korea, since the economic crises of 1997. In the past, firms recruited a large number of workers through once-a-year regular employment season. The economic crisis has forced firms to turn to a 'quality approach' to human resource management where the efficient use of the existing workforce is seen as more important than large scale new recruitment. Firms now tend to prefer to fill vacancies whenever necessary, instead of having fixed recruitment seasons as in the past. They also tend to prefer more experienced workers who are ready to be assigned to work immediately.

128. One important new trend is that human resource management has moved towards shop/front-line managers and away from personnel departments. While the personnel department is still responsible for overall recruitment processes, the actual recruitment is determined by shop floor managers. Another trend is that the terms of employment are changing, new entrants should increasingly expect to be offered contractual employment instead of tenure-track positions. This is a feature of post-economic crisis which placed emphasis on promoting flexible employment and lowering labor costs.

Upskilling, and pursuit of competences/worker attributes

129. The survey conducted in Part C shows that high performing firms with the exception of production workers are no longer hiring so many high school graduates, and instead they prefer workers with college or above level education. Managers of high performing firms insist that education level and occupational skills were not viewed as the sole criteria for recruitment decisions. Most notably, desirable competences and quality attributes are examined and assessed through in-depth interviews and aptitude tests to assess traits such as creativity, problem-solving and teamwork abilities.

Less job rotation and better rewards for new ideas, training and performance

130. Most companies surveyed do not enforce job rotation but make efforts to train and encourage workers to acquire core skills and competences. The survey confirms that companies normally do not conduct job rotations except for some particular cases. Instead, they attempt to equip workers with specified yet multi-faceted skills.

131. In addition, training and the resulting increase in competence are well rewarded by the high performing firms. Most employees can expect to be continuously evaluated rather than the old practice of once a year evaluations. Also, increasingly employees are rewarded for undertaking proactive measures to improving their skills.

Increasing investment in on-the-job training (OJT)

132. For high performing firms, training costs has risen enormously compared to past standards. Most companies surveyed have created, in addition to personnel departments, separate divisions and officers for education and training to develop a variety of training programs for their workers. Companies with multiple business units and factories also have independent education programs on site. Mostly head offices provide the guidelines for education and training, but when necessary, delivers training programs directly.

133. OJT is provided to all employees: office workers, production and sales workers and executives and managers. In the past, managerial workers were excused from these sessions, but nowadays, they too are attending courses. Training programs for leadership skills, counseling skills, managerial skills and motivating skills are increasingly offered to managerial workers. The skill areas covered by OJT for workers is very diverse: job and skill training, service skills training, language or IT training, attitude training and management training. There is also retraining and improvement training in various job areas.

134. OJT is delivered through various modalities including on-line lectures, traditional training programs and courses at external institutes. Occasional OJT sessions are also offered by senior workers and visiting instructors. Most importantly, however, firms have started to provide e-learning. High performing firms use internal intranets to deliver online lectures to employees of all ages and even to production line workers. In the service-oriented companies surveyed, in-house instructors (senior managers or experienced trainers on the payroll of the firm) play an important role in the education department. In-house instructors have been proven to motivate workers and are able to effectively introduce new tactics and knowledge.

C.7 The Demand for New Skills

Skills for entry level workers

135. Changes in workplaces have created demands for new sets of skills for labor market entrants. Rapidly changing technologies require workers to possess strong work-related specialized knowledge including IT related skills. However, it is nearly impossible for workers' inherent skills to match up with the changing needs of the workplace, hence the 'trainability' of workers by the firm has become important. Firms believe that much of the knowledge an employee applies during a task is learnt on-the-job, hence they try to gauge the level of trainability of prospective workers.

136. In order to foster an innovation prone work environment, the ability of workers to get along, communicate with other team members, and cooperate in the face of radical

organizational and technological changes is key. Managers in high performing firms tend to select workers with a sound character because it translates into a good work attitude and performance. Managers argue that workers with good attitudes are more 'trainable' even when they lack professional skills.

Skills for existing workers

137. At the same time, existing employees are seeing changes in the way their performance is measured and rewarded. This places an even greater emphasis on continuous upskilling or lifelong learning, and also on teamwork, knowledge sharing and learning from each others mistakes. While general clerical, problem solving, computer/information processing skills, and teamwork skills are widely required, there are some variations by occupational type (e.g. production line, clerical, and sales workers).

138. In manufacturing, the trend in Korea is consistent with modern management practices in other countries which focus on quality control and error detection and avoidance. This places new demands on employees. Whereas previously an employee did his/her job and passed it on to the worker at the next stage, now each worker is expected to participate in the full process by learning the mechanics as well as the business consequences of manufacturing decisions.

C.8 Relevance of Skills Acquired Through School and University Education

139. Regarding the usefulness of schooling, the survey results indicate that many workers feel what they learned in schools is only partially utilized in the workplace. Workers felt that computer and ICT skills were 'inadequately' taught at school; English and foreign language at 'medium to low'; basic knowledge and skills including mathematics, logical skills, composition and problem solving at 'medium to low'. Interviewees said that they were sometimes unable to apply their knowledge of foreign language or mathematical skills, because of inadequate school training and practice.

Table 2: Personnel managers and workers ranking of the difference between skills/competences acquired in universities and those required at worksites (percent of respondents)
1 indicates no mismatch, 5 indicates highest mismatch

	1	2	3	4	5	Total Number of respondents
Personnel managers	2.2	13.4	43.6	34.5	6.2	100% (417)
College graduated workers	1.6	9.5	23.5	53.4	12.0	100% (442)

Source: Korea Research Institute for Vocational Education and Training (KRIVET), 2000. A study on the business firms' satisfaction of university education (in Korean). p. 105.

140. Managers also warn that as the demands for education become greater, the existing university curricular are becoming less relevant to the world of work. In a separate survey, managers and workers were asked to rank the level of mismatch between skills acquired at university and those required in the workplace. Table 1 presents the results which show that a majority of workers and managers perceiving the discrepancy to be quite high.

C.9 Four Policy Recommendations

141. Among the important trends which emerge from Report C's survey of high performing firms are that:

- Leading firms are attempting to change their organizational arrangements towards less hierarchical, more team work, quicker decentralized decision making, more knowledge-intense production and quality product oriented management;

- Human resource management is moving towards: (a) flexible and decentralized recruitment; (b) upskilling and pursuit of competences rather than academic credentials; (c) better rewards for ideas, training and performance; and (d) increasing investment in OJT for competences;

- Increasingly the most needed skills include basic training in ICT skills, the ability to work in groups, adaptability to the changing work environment and 'trainability' on the part of workers;

- Traditional subjects learned at school and university are becoming less relevant as newly required skills are learned through OJT.

These trends lead on to our four policy recommendations.

Policy recommendation 1 - Reform to the K-12 curriculum, pedagogy and assessment

142. While basic conceptual and technical subjects need to form a cornerstone of any good education, Korean schools could benefit from shifting the focus away from the rediscovery of facts towards the application of analytical concepts and technical knowledge. For instance, national curriculum could focus on a few core subject areas while local education authorities and schools could have more discretion in the teaching of other work related subject matters. This would require a substantial deregulation and decentralization of curriculum policy.

143. Also required are changes in the practice of pedagogy and student assessment. To perform well in a knowledge-intensive environment, individuals need to possess problem-solving skills, team working abilities skills as well as communication and behavioral skills. Desirable pedagogy should encourage experimental learning, group learning and team work, while methods of student assessment need to move towards ongoing evaluation of performance. Policies should provide incentive mechanisms for

teachers to boost desirable practices including the acquisition of group learning skills. These measures would entail an overhaul of teacher training practices and teacher incentives, as well as changes to college admission policies which traditionally emphasized cognitive achievement over behavioral development.

Policy recommendation 2 – Align high school vocational and technical education more closely with industry needs

144. Managers from high performing firms are seeking workers who are more amenable to training and learning. Broad-based general knowledge is now a central requirement for high paying professions. Policies are required to restructure upper secondary education to become more responsive to industry demand shifts. It may be time for traditional vocational high and technical high schools to add to their specialization new skills including ICT and languages. More could also be done to provide support and incentives to vocational schools in the re-training and redeployment of teachers.

Policy recommendation 3 – Increase public investment in higher education to make it more affordable to workers and employers

145. The survey results show a strong demand for continuous learning by workers and for training by employers. Workers are willing to undertake further education and training as they are increasingly recruited and evaluated by competence and performance. While Korea has been successful in privatizing higher education, alternative means of financing such as student loans could be considered to increase the participation of adult workers in various learning opportunities offered by universities and colleges. To make the system more responsive to market, performance-based funding and/or competitive financing schemes could be considered.

Policy recommendation 4 – strengthen the government's role in leading the lifelong learning process

147. New skills that matter at workplace cannot be acquired unless the government and other key actors work together to meet the challenges and opportunities set by a knowledge economy. Under the present scenario, Korean firms need to undertake training for their workers, almost on a continuous basis. This will entail a major investment over and above formal schooling. In addition, schools and colleges should be more attuned to industry needs to prepare individuals for the specific skills they will eventually need in their careers. Obviously, a balance needs to be struck between general *vs* specific education/training in a formal education system and new learning opportunities of all kinds (including distance education and e-learning by network enables services) need to be considered by the educational sector. In order to build partnerships and create more intensive 'stakeholder dialogue' between teachers, trade unions, non governmental organizations and business firms, the government could act as a proactive convener (or facilitator) as well as a regulator of the education and learning system.

PART A: FIRM-LEVEL INNOVATION IN THE KOREAN ECONOMY

1. INTRODUCTION

1.1 Most studies of Korean industry focus on policy issues, sector and industrial surveys or macroeconomic analyses. There are relatively few studies of firm-level innovation management, especially since the financial crisis of 1997 and 1998. This study complements existing policy, sector, macro and financial studies with an assessment of the technological strategies and capabilities of Korean firms, including World Bank (2000), MOST (2000), Woo and Sul (2000) and Choi and Kang (2000)[1].

1.2 At the firm-level, further mastery of technological knowledge is essential for firms wishing to move further 'upstream' from their base in manufacturing towards higher value added, knowledge-intensive activities based on research, development and new product innovation (World Bank, 2000). These are essentially 'innovative' activities, defined here as the successful introduction of a new or improved product, process or service to the marketplace.

1.3 Data on firm-level innovation are needed to inform government policy-making to enable government to respond to the changing needs of industry. However, there is little micro-level research on operational restructuring in Korea and very few methods for generating the firm-level information needed for policy-making. This study therefore develops and applies a new method for acquiring data on the capabilities of firms (Bessant et al., 2001)[2] to a sample of 25 firms operating within Korea. The data from this sample show that the crisis, policy responses to the crisis, and several other factors, have together induced considerable technological restructuring among firms in Korea and brought about changes in corporate strategy, foreign collaboration, R&D organization and new company start-ups. In designing policies for Korean industry, these changes need to be understood and responded to.

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[1] World Bank (2000): Korea and the Knowledge-based Economy: Making the Transition, IBRD/World Bank/OECD, Washington DC.; Woo, C. and Sul, K. (2000): Industrial Upgrading in Korea: Process and Prospect, Korea Development Institute (KDI), Seoul, Korea.; MOST (2000): Ministry of Science and Technology (Korea); 'R&D Budget Statistics, MOST, Seoul, Korea.; Choi, N. and Kang, D-Y. (2000): A Study on the Crisis, Recovery, and Industrial Upgrading in the Republic of Korea, Chapter 11 in Asian Corporate Recovery: Findings from Firm-level Surveys in Five Countries, World Bank; Washington DC.

[2] Bessant, J., Rush, H. and Hobday, M. (2000): Assessing Technological Capabilities: An Audit Tool, Report to World Bank; Project on Korea and the Knowledge-Based Economy; Also CD-RoM version and internet: www.johnbessant0catch.com

1.4 Chapter 2 summarizes the approach and method of the study as detailed in Bessant et al (2001) and presents a simple framework for assessing firms according to their level of technological capability. From this framework an audit tool is developed which enables an assessment of individual firms according to nine key dimensions of technological activity. Although Korea remains a manufacturing-led economy, firms have attempted to move 'upstream' (towards research and development, R&D) and 'downstream' towards distribution, marketing and brand value development. These moves support the transition towards a more knowledge-intensive economy, as described in World Bank (2000). Korea is an economy in a 'catch up' mode of industrial development which has moved progressively towards higher technology exports and own brand products.

1.5 However, the new government policies and corporate strategies towards knowledge-intensive business activities 'pushes the stakes higher' because they implicitly argue for a break with the manufacturing-centered approach of the past. In this sense, moves towards a knowledge economy introduces a 'dilemma' for firms: do they stick to the successful strategies of the past and continue their gradual process of technological upgrading? or do they take on the considerable risks and costs of moving away from manufacturing-centered innovation towards new product creation, services and software, based on far greater investments in R&D.

1.6 Chapter 2 goes on to present the sample of 25 firms chosen for the application of the audit tool, describing the sample's rationale and limitations. The sample deliberately focused on high performing firms across a range of sectors, in order to confront issues facing firms at the 'highest' stages of development in Korea. These are important companies because they are the types of firms leading growth and innovation in Korea. However, further study is required to generate policy lessons for lagging companies especially in the various categories of small- and medium-sized enterprise (SMEs).[3] Chapter 3 presents the results of the application of the audit tool in order of sector group, highlighting the capabilities, strengths and weaknesses of individual companies. This chapter shows how leading firms have continued to innovate in the recent past and how they have responded to the crisis and other major events.[4] The results show the continuing impact, both negative and positive, of the crisis, on companies in Korea. Firm-level interviews also reveal the strategies by which firms have attempted to move beyond their current advantages in manufacturing process innovation, towards new product creation, a major transition which requires a greater depth of R&D capability, as well as a more sophisticated and dynamic capital goods sector.

1.7 Chapter 4 discusses the wider company strategy and government policy implications arising from the evidence, focusing on product creation challenge, the role of capital goods and the need for increased participation of foreign firms within the Korean economy. This chapter also touches on the importance of the burgeoning of new

[3] However, some suggestions based on apparent 'best practice' OECD policies are suggested in Part 5.

[4] The report avoids the term 'restructuring', as this often refers to financial restructuring and, in particular, the exit (or not) of non-viable firms. These issues are not assessed in this report although individual company takeovers and the expansion of foreign direct investment are touched upon. See World Bank (2000a) and Woo and Sul (2000) for an analysis of crisis-induced restructuring and policy responses.

entrepreneurial start-up technology-based firms, inconceivable in Korea even a decade ago. It draws conclusions from the 'bottom up' firm-level evidence for the role and performance of universities and government-funded research institutes, questioning general calls for more basic research within the economy.

1.8 Because the audit was limited to advanced firms, Chapter 5 touches on some of the constraints faced by all others types of firms, based on other research. It uses the basic framework developed in Chapter 2 to comment on the likely needs of lagging firms, especially SMEs. It also suggests how policy recommendations could be arrived at through further use of the tool and more information on the effectiveness of existing innovation support policies and programs in Korea.

1.9 The majority of firms analyzed during the audit fell into the 'Type C', strategic group. Although highly capable, these firms cannot yet contribute to the technology frontier due to constraints in their own technological and organizational capabilities. Chapter 6 identifies corporate strategy and government policy measures that could assist these firms in making a transition to leading edge 'Type D' creative firms. Although these firms made many suggestions in relation to government support, many of the upgrading actions which need to be taken can only be taken by the firms themselves in the market place. In addition, Chapter 6 suggests that the corporate reform aims of policy should normally take priority over technological support. As and when the government is satisfied that Korean firms have restructured sufficiently (e.g. in terms of financial debt), then they may wish to consider the five new policy suggestions put forward for consideration, as many other countries (e.g. the U.S., Japan and in Europe) have adopted similar support measures.[5]

[5] It would also be wise for government to look critically at the real outcomes and costs of these support policies (e.g. subsidies for collaborative R&D) before embarking on any new ventures in Korea.

2. METHODOLOGY, KNOWLEDGE ECONOMY CONTEXT, AND FIRM SAMPLE

2.1 In order to place the study in context, this chapter presents the simple innovation capability model and describes the arena in which many Korean firms operate. Section 2.1 of this chapter presents the basic technological capability framework, while section 2.2 discusses the audit tool, derived from the framework, which has eight dimensions of technological capability against which to assess firms. Section 2.3 briefly examines the challenge facing Korean firms within the knowledge-based economy approach (World Bank, 2000). Section 2.4 presents the sample of firms chosen for study using the tool (Annex A2 provides a summary, self-assessment, version of the tool and defines each of the nine dimensions of capability).

2.1 The Innovation Framework: Four Categories of Innovating Firms

2.2 The framework for assessing firm-level innovation in Korea (see Figure 2.1) is based on studies of technological learning and innovation, in both developed and developing countries.[6] The innovation framework below is reproduced from the accompanying report (Bessant et al, 2001). As the latter study notes, research has consistently shown that firms differ widely in their technological capabilities, strategies and absorptive capacities.[7] The simple model in Figure 1 represents firms on a scale which differentiates between: (a) the degree to which firms are aware of technological issues and (b) how well the firm is prepared and able to improve in practice.

2.3 The four categories are represented on a 'staircase' of capability level, from Type A to Type D (described below). While this model was developed for this particular study, similar notions can be found in other studies of organizational and technological capability.[8] Firms, of course, are not static. They may well progress over time through the various stages, depending on how successful they are. They may also move 'backwards' if the management and leadership skills decline. Also, within each category there is a fairly wide band of capabilities. In the Korean results (see section 4.1) most firms were within Type C 'strategic'. However, within this band there were considerable

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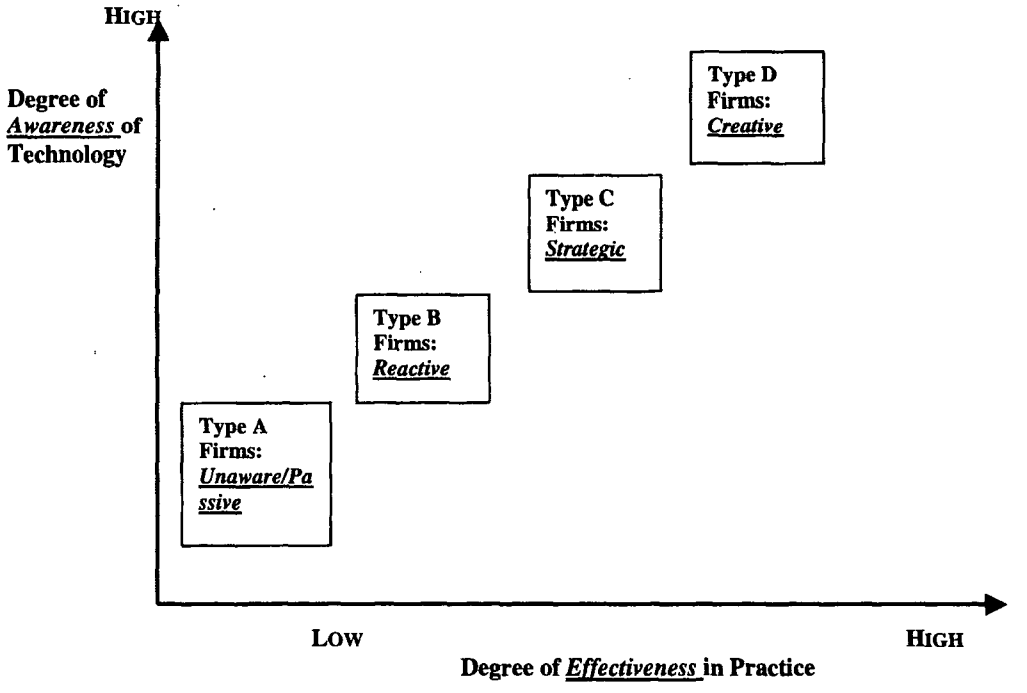
[6] The present study builds upon recent work by Arnold, E., Bell, M., Bessant, J. and Brimble, P. (2000): Enhancing Policy and Institutional Support for Industrial Technology Development in Thailand. Vol 1: The Overall Policy Framework and the Development of the Industrial Innovation System, World Bank/National Science and Technology Development Agency (NSTDA) of Thailand, Washington DC.

[7] Why this matters for economics and management research is discussed by Nelson (1991).

[8] See for example, Baden-Fuller, C. and Stopford, J.M. (1994): Rejuvenating the Mature Business, 2nd Ed., Thomson Business Press, London; and Arnold, E. and Thuriaux, B. (1998): Developing Firm's Technological Capabilities, Mimeo, Brighton, Technopolis.

difference among firms, ranging from the 'barely strategic' to 'extremely capable' in all strategic matters.

Figure 2.1: Groups of Firms According to Technological Capability



2.4 The framework can be applied to an entire firm, or to a division or subsidiary of a transnational corporation (TNC). TNC subsidiaries often reflect the values, strategies and capabilities of the parent company and there is likely to be significant differences among them, depending on overall corporate strategy and the particular abilities of local management. Taking each of the four types in turn, it is possible to broadly characterize firms according to their capability levels.

2.1.1 Type A Firms: Unaware/Passive

2.5 Type A firms can be characterized as being 'unconscious' or unaware of the need for technological improvement. They do not realize or recognize the need for technological change in what may be a hostile environment and where technological know-how and ability may be vital to survival. They do not know where or what they might improve, or how to go about the process of technology upgrading. As such, they are highly vulnerable to competitive forces. For example, if low cost competitors enter - or the market demands faster delivery or higher quality - they are often not able to pick up the relevant signals or respond quickly. Even if they do, they may waste scarce resources by targeting the wrong kinds of improvement.

2.1.2 Type B Firms: Reactive

2.6 These firms recognize the challenge of change and the need for continuous improvements in manufacturing and other technological capabilities. However, they are unclear about how to go about the process in the most effective fashion. Because their internal resources are limited - and they often lack key skills and experience in technology – they tend to react to technological threats and possibilities, but are unable to shape and exploit events to their advantage. Their external networks are usually poorly developed. Most technological know-how comes from their suppliers and from observing the behavior of other firms in their sector. They may well be 'keeping up' with other firms which have similar weaknesses and limitations in technological capability. Typically, this group treats symptoms rather than root causes of problems - for example, dealing with bottleneck operations by replacing machinery only to find that the problem gets worse because the root cause is, in fact, in production scheduling.

2.7 Overall, these companies have poorly developed capabilities in most areas of technology strategy, search, acquisition and capability building. However, there are some strengths upon which to build.

2.1.3 Type C Firms: Strategic

2.8 Type C firms have a well-developed sense of the need for technological change. They are highly capable in implementing new projects and take a strategic approach to the process of continuous innovation. They have a clear idea of priorities as to what has to be done, when and by whom, and also have strong internal capabilities in both technical and managerial areas and can implement changes with skill and speed. These firms benefit from a consciously developed strategic framework in terms of search, acquisition, implementation and improvement of technology. However, they tend to lack the capabilities to re-define markets through new technology, or to create new market opportunities. They tend to compete within the boundaries of an existing industry and may become 'trapped' in a mature or slow growth sector, despite having exploited technology efficiently within the boundaries of the industry. Sometimes, they are limited in knowing where and how to acquire new technologies beyond the boundaries of their traditional business.

2.9 Overall these companies have strong in-house capabilities and think strategically about technology in the medium and long term. In some areas, these firms may be behind the international technology frontier but they have important foundations upon which to build.

2.1.4 Type D Firms: Creative

2.10 Type D firms have fully-developed sets of technological capabilities and are able to help define the international technology frontier. In many areas, they take a creative and pro-active approach to exploiting technology for competitive advantage. They are at ease with modern strategic frameworks for innovation and take it upon themselves to 're-

write' the rules of the competitive game with respect to technology, markets and organization.

2.11 Strong internal resources are coupled with a high degree of absorptive capacity which can enable diversification into other sectors, where their own skills and capabilities bring new advantages and re-define the ways in which firms traditionally compete, or wish to compete. Their technology and market networks are extensive so that they are kept informed about new technological opportunities and remain in touch with suppliers of equipment and ideas.

2.12 There are only a few firms in this category and they are generally seen as 'risk takers' although, like most businesses, they tend to avoid unnecessary or uncalculated risks. Some creative firms emerge from traditional and mature sectors to challenge the way business is conducted. For example, Nokia, the Finnish company, moved from pulp and paper into electronics and eventually became a world leader in mobile telecommunications, showing that it was possible to make very high margins in the production of handsets within the developed countries, when most competitors believed it was impossible to achieve this goal (e.g. Ericsson and Motorola viewed handsets as low margin commodity products). Another example is IBM, which transformed itself from being a 'dinosaur' of the computer industry, to one of the fastest growing, most highly profitable information technology companies in the world, capable of leading the advance of 'e-commerce' technology in the late-1990s.

2.2 Using Firm-Level Data to Inform Policy Making

2.13 Data on the technological capabilities of firms can provide an important input into policy making. One of the main objectives of policy making in industrializing countries is to encourage and stimulate firms to 'climb the technology ladder' in order to become more innovative and competitive. Policies should also seek to remove barriers to progress. However, policy objectives differ widely according to where groups of firms are positioned on the technology staircase outlined in Figure 2.1.

2.14 Before commenting on the policy needs of the four groups of firms, it is important to stress that policy-making needs to take into account at least four other important factors which impact on firm performance and opportunities:

(a) The impact of indirect or 'implicit' technology policies (e.g. educational, trade, competition, economic and industrial policies are often more important than 'technology policies' in encouraging or discouraging firms to climb the technology ladder);
(b) Other non-policy conditions facing firms (e.g. the macroeconomic context, the business cycle of particular sectors and the strengths and weaknesses of local entrepreneurial capabilities);
(c) The available modes of support for firms (e.g. private sector, market-led mechanisms, government direct support, and government indirect self-help support mechanisms);
(d) Evidence of success (or otherwise) of technology policy initiatives in other countries (e.g. OECD) where relevant.

2.15 Within these overall parameters it is possible to target support according to the specific needs of firms and groups of firms according to the four categories of firm. Chapter 5 recommends policy initiatives for the Korean case, focusing on leading (mostly 'Type C') firms analyzed during the field research

Type A Firms: Unaware/Passive

2.16 These companies are weak and ill-prepared in all major areas of technology acquisition, use, development, strategy and so on. A thoroughgoing basic improvement program is usually urgently needed. Help is required in: enabling these firms to recognize the need for change (the 'wake-up call'); developing a strategic framework for manufacturing and other activities; identifying relevant and appropriate changes; acquiring and implementing necessary technologies. They also require assistance in sustaining this process of change over the long-term. In lower income countries, in manufacturing, these firms probably focus on assembly and have yet to move on to production engineering. The need is therefore to improve assembly capabilities and begin to develop engineering skills in order to improve efficiency and productivity and to provide opportunities for moving on later to process innovation and new product development.

Type B Firms: Reactive

2.17 The needs of this group center first on the development of a strategic framework for technological change, so that key priority areas can be addressed. Allied to this, are needs in searching wider for solutions, in exploring new concepts (for example changing production layout rather than simply acquiring new machinery), and in acquiring and implementing new product and process capabilities. In the longer-term, such firms could be expected to develop an internal capability for strategic upgrading and require less and less support. In manufacturing, these firms may well have moved on from assembly and have technician and engineering skills upon which to build. Their next 'stage of development' could well be to develop the capabilities to innovate with process technology.

Type C Firms: Strategic

2.18 The needs of this group are essentially around providing complementary support to internal capabilities and challenging existing business models. Improving access to specialist technical and marketing expertise, enabling access to new networks of technology providers (for example, overseas sources) can assist them to think 'outside' of the industrial box they find themselves in, should the need arise. Such firms may also benefit from occasional, project-based support from consultancy companies or from specialist research and technology organizations, locally or internationally. They may benefit from improved access to graduates and from linking up with universities which offer new ideas, access to advanced technology and new skills. Typically, in manufacturing, these firms will have acquired process innovation skills and new product

development capabilities. The next step is to build up the R&D capabilities necessary to launch challenging new products on the international stage.

Type D Firms: Creative

2.19 The needs of this group are mainly centered on complementing existing internal capabilities with outside sources, assessing risks and uncertainties and sustaining their position as market 'rule breakers'. They tend to be open companies which collaborate and learn from partners in the external environment and invest in developing new technologies and resources, for example in leading universities around the world. From time to time projects emerge with threaten to disrupt their existing businesses and they are often in a strong position to convert such threats into new market opportunities. Such firms may need to develop new contacts with specialist groups (domestic and overseas) in order to resolve complex technical problems and generate new opportunities. These companies can be useful contributors to governments as they try to position and develop their national systems of innovation for the future (e.g. the Singaporean and UK Governments often discuss policy with leading industrialists from such firms).[9] Typically, these firms will have strong R&D capabilities in house, or alternatively they will have the internal skills needed to outsource R&D and new product design (e.g. Dell, IBM and Cisco Systems).

2.3 THE INNOVATION CAPABILITY AUDIT TOOL

2.20 In order to assess where firms lie on the 'staircase' of capabilities, Bessant et al (2001) present a tool derived from studies of innovation.[10] The term 'technological capability' refers to those activities which enable firms to choose and use technology to create competitive advantage. There are at least nine of these activities:

1. Awareness of the need to improve
2. Search ability in relation to external threats and opportunities
3. The building of distinctive core capabilities
4. The development of a technology strategy to support the business
5. The ability to assess and select the appropriate technological solutions
6. The acquisition and absorption of the technologies in question
7. The implementation and effective use of the technologies
8. The ability to learn from experience in order to improve technological change capabilities
9. The ability to form and exploit linkages with a network of suppliers and collaborating firms.

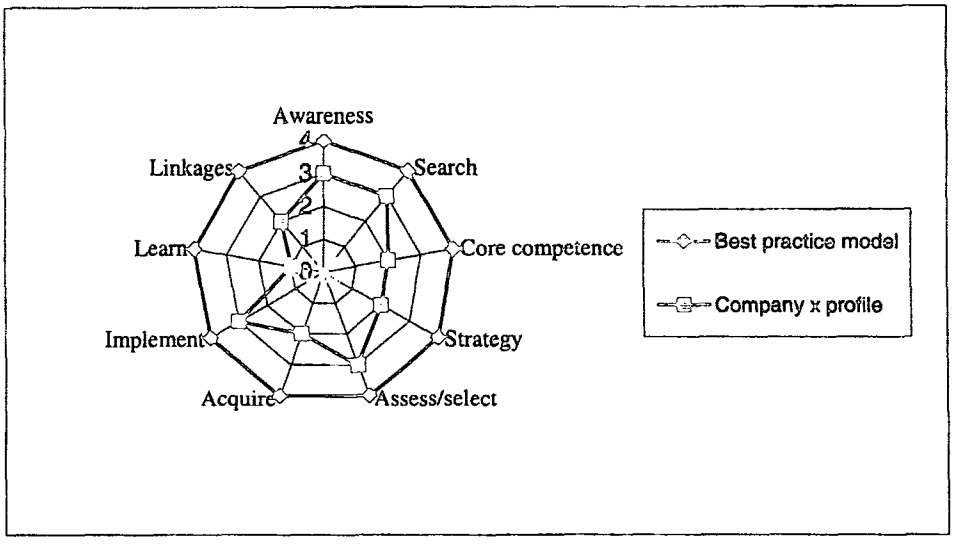
2.21 A short, self-assessment version of the tool is presented in Annex A2. Other versions allow different groups (e.g. highly trained researchers and consultants on the one hand, and inexperienced and junior researchers/consultants on the other) to rapidly assess

[9] For definition and discussion of national systems of innovation, see Lundvall (1988) and Nelson (1993).

[10] See footnotes 3 and 5 above.

the technological capability of firms. The tool provides a mechanism for: (a) rapidly auditing the capability of individual firms; and (b) identifying the strengths and weaknesses of individual firms, against a notional 'benchmark' (or 'best practice' model) of the most advanced firms operating in the West and Japan (Type D firms). The latter questions concern the links of the firm with external support services sometimes provided by government as part of the 'national system of innovation'.

Figure 2.2: Nine Dimensions of Technological Capability



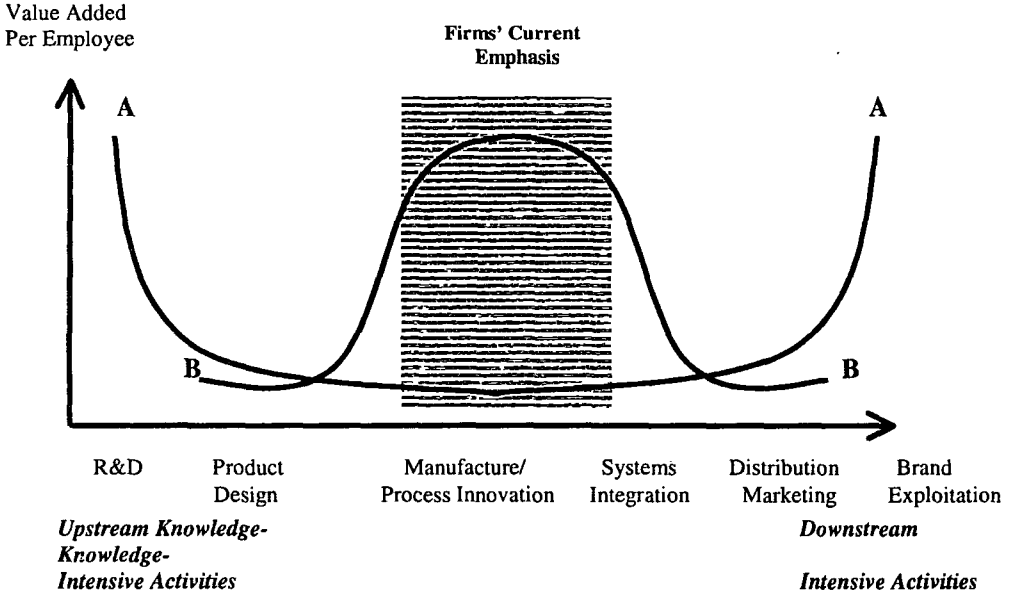
2.22 Figure 2.2 shows how, using the tool, a profile of capabilities can be generated for each firm and provides an example (company X) which reveals weaknesses in some key areas (e.g. learning and linkage forming) and strengths in others (e.g. awareness and selection). The average score of the capabilities against the 9 dimensions, enables one to categorize the firm according to the four main categories of firm: passive, reactive, strategic and creative. Section 4.1 presents the results of the Korean study of 25 firms according to these four broad categories.

2.23 The tool has been designed so that it can be applied to countries at different stages of development with different industrial structures (e.g. concentrated and dispersed) and to small and large firms, as well as foreign, local or joint venture companies. The aim of the tool is to support the gathering of structured information on innovation capabilities within firms to generate firm-level insights into the development process, in order to complement the more conventional macro-level, sector and policy studies. If applied widely, it also, potentially, provides the basis for a comparable, quantitative assessment of firm innovation capability.

2.24 The design of the tool suggests that one might expect to find significant differences among firms operating under similar policy and macro conditions, resulting from their choices, strategies, priorities and capabilities. In other words, firm-level behavior is not entirely a consequence of the macro or policy environment. In the Korean

case (see Chapter 3) this report provides interesting evidence on firm-level innovation capabilities and the response to the recent crisis and ensuing policy changes.

Figure 2.3: Korean Firms and the Knowledge-Based Economy



AA: Typical Value-Added Curve for World Leader (Level D)
BB: Typical Value-Added Curve for Korean Exporters

Source: Developed from Tyndall and Cheen (2000) pp15-16: Industrial Policy Experience: the Case of Malaysia, Malaysian Institute of Economic Research, KL, Malaysia

2.4 A FIRM-LEVEL MICRO PERSPECTIVE ON THE KNOWLEDGE-DRIVEN ECONOMY

2.25 As noted in the introduction, the study can be seen within the broader context of Korea's policy moves towards a knowledge-driven economy (World Bank, 2000). Historically, Korean exporters have progressed from basic assembly to technology-intensive manufacturing. Figure 2.3 shows how firms have attempted to move further from their core manufacturing advantages in two distinctive knowledge-intensive directions: (a) upstream towards research and development (R&D); and (b) downstream towards distribution and marketing and the exploitation of brand awareness. Our study focuses on (a), especially considering the efforts of the Korean Government to encourage firms to move towards more basic research activities.

2.26 There are various strategic reasons for moving towards knowledge-intensive upstream and downstream activities. According to research on US companies, value-

added per worker tends to be higher in upstream and downstream activities, as opposed to manufacturing and assembly operations.[11]

2.27 As a result of the perceived lack of value-added in manufacturing operations, competition and the diffusion of highly efficient process technologies, many leading US and European firms have attempted to increase their value added per worker, and their profitability, by shifting both downstream and upstream. In some cases (e.g. IBM, Hewlett Packard and Ericsson), this has involved the extensive outsourcing of manufacturing to specialized 'contract electronics manufacture (CEM) producers based in the developed countries (see Hobday, 2001)[12]. In others, manufacturing is conducted offshore in lower cost South East Asian operations, or under original equipment manufacture (OEM) arrangements with Korean and Taiwanese firms.

2.28 For many years, and with mixed success, Korean firms have attempted to break the cycle of catch up manufacturing, by developing own brands, and carrying out new product development supported by R&D. They have made strenuous efforts to reduce the value risk of being confined to the manufacturing-related activities. In some notable cases firms have made considerable progress (e.g. Samsung is a recognized world leader in DRAM design production). However, in other cases firms remain locked into manufacturing activities under OEM or license arrangements, and much of their production remains focused on the manufacturing of hardware of various kinds for export.

2.29 In terms of Figure 2.3, Korean firms have moved upstream along the value chain (curve AA) by acquiring and developing technology. At the same time, some have moved downstream to undertake marketing and distribution by investing in their brand image in overseas markets (e.g. Hyundai). However, the move to own brand products has proved extremely risky and difficult and many leading firms still produce a proportion of their output under OEM sub-contract arrangements with Japanese and US firms, who then market the products under their own brand name, through their own distribution channels, gaining the post-production value added. As the evidence in Chapter 3 indicates, the move from advantages based on manufacturing process to that based on product creation, backed up by R&D, still remains a major challenge to all but the most advanced Korean producers in the limited range of products where they boast international leadership capabilities.

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[11] See Wise, R. and Baumgartner, P. (1999): 'Go Downstream: the New Profit Imperative in Manufacturing, Harvard Business Review, September-October, pp133-141 for evidence and new business models incorporating downstream services. Also note, there are various economic and managerial definitions of value-added. Here value-added refers simply to the value the firm adds to its inputs by deploying labor, material and capital. See Tyndall, P. S. and Cheen, L.C. (2000): Industrial Policy Experience: the Case of Malaysia, Malaysian Institute of Economic Research, KL, Malaysia.

[12] Hobday, M. (2001): 'The Electronics Industries of the Asia–Pacific: Exploiting International Production Networks for Economic Development', Asian-Pacific Economic Literature, Vol. 15, No. 1, May, pp13-30.

2.30 Strategies for moving upstream include moving assembly activities into areas where higher value-added can be earned at the manufacturing stage (e.g. in more complex, design- and technology-intensive production). Another upstream strategy is to gain control of product design and development. Regarding downstream strategies, there are various models of building in services into product offerings (including maintenance, service, support), depending on the nature of the product or system. Also, by establishing control over marketing and distribution outlets and by advertising to build up brand image, manufacturing firms are able to gain more of the post manufacturing value stream. Productivity improvements *via* process innovation can also increase the value added per worker.

2.5 THE SAMPLE AND ITS CHARACTERISTICS

2.31 Table 3.1 presents the sample of 25 firms which were analyzed during the research. As noted in the introduction, the sample focused on high performing firms in the context of Korea and was therefore not representative or randomly distributed. The reasons for focusing on high performing firms are the following:

a) the resources of the study were limited and the work needed to be focused.
b) more innovative firms are likely to be leading the transition towards a more knowledge-intensive economy (the context in which the study was undertaken).
c) such a sample could help illustrate where leading firms in Korea stand in relation to the technology frontier (defined as Category D) firms, and help identify the necessary steps for moving closer to the frontier.
d) leading firms tend to contribute most to overall growth and innovation within the economy (Harberger, 1998).[13]

2.32 The main limitation of this approach is that the sample does not allow conclusions on the overall position of Korean industry, or the problems and opportunities facing the many SMEs in Korea. However, the sample was constructed to cover a range of major industrial sectors, as well as examples of local, foreign owned and joint venture firms. The aim was to choose industries on the basis of export importance (e.g. electronics and automobiles), technology-intensity (ranging from high to low-intensity, the latter including basic capital goods and foodstuffs) and export *vs.* local market orientation.

2.33 By adding individual examples of firms outside the main groups (see 'other firms') including zinc production, medical equipment, medicines, cables and chemical processing, this report hopes to gain a fairly wide spread of firm-level perspectives in order carry out comparisons and point to general levels of industrial capability. The sample also included examples of small, medium, large and new micro (or 'venture') firms, as defined in Table 1 below. Given the small size of the sample, the findings are indicative rather than conclusive even with respect to leading firms, although as discussed in Chapter 4, they point to some fairly consistent results regarding the level of

[13] Harberger, A.C. (1998): A Vision of the Growth Process, American Economic Review, March, Vol. 88, No 1, pp1-32.

technological capabilities among Korea's leading companies and the challenges facing them.[14]

2.34 The sample of 25 included ten large or very large firms, including several of the major *chaebol*: Korea Telecom, SK Telecom, Samsung, LG Philips, LG Electronics, Mando Corporation, LG Cable, Korea Zinc, Hyundai-Kia Motor Corporation, and LG Chemicals. It included a further 6 medium size companies employing between 300 to 3,000 staff: TriGem Computers, Doowon Precision Industry, Korloy, 3M, Green Cross and Daesang. The seven small firms were: Dong Yang Semiconductor Equipment, C&S Technology, Bosch, Choonwae Medical, Bolak, Hanil Feedmill, and Kuk Dong Co. Finally, two new micro-enterprises were included n-Shaper Corporation and Techovalue.com.

2.35 Firms from six sector groups were included: (1) telecommunications services (Korea Telecom and SK Telecom); (2) electronic goods and components (Samsung, LG Philips, LG Electronics, TriGem Computers, and 3M; (3) capital goods and design services for electronics (Dong Yang Semiconductor Equipment and C&S Technology); (4) automobiles and the auto supply chain (e.g. Hyundai-Kia Motor Corporation, Mando Corporation, Doowon Precision Industry, Korloy and Bosch); (5) foodstuffs (Daesang, Bolak and Hanil Feedmill) and (6) micro enterprises/venture firms (n-Shaper Corporation and Techovalue.com). Other firms included LG Cable, Korea Zinc, LG Chemicals, Green Cross (medicines), Choonwae (medical equipment) and Kuk Dong Co (loading equipment).

2.36 Table 3.1 presents the 25 firms according to their sector grouping. The table includes data on sales, employment, R&D effort, main product lines, ownership, as well as technology strategy and key sources of technology, from the interviews presented in Chapter 3.

[14] Another limitation is that the evidence is largely 'snapshot', relying on interviewees' memory of recent history, rather than a thorough analysis of past events using other types of data, such as company documentation.

3. FIRM LEVEL INNOVATION-CAPABILITY ASSESSMENT

3.1 This section presents the results of the interviews in order of sector group, summarized in Table 3.2, focusing on the capabilities, strengths and weaknesses of individual companies. The following chapter (Chapter 4), draws out the common themes and wider implications of the firm-level innovation findings.

3.1 GROUP 1: TELECOM SERVICE PROVIDERS

3.2 Telecommunications service providers are often overlooked in industrial technology discussions. However, they potentially play an important role in the technological development of an economy. They can represent an important technology resource, as well as a major source of supply and demand for systems, software, and technically- trained staff. Depending on their capability, service providers can assist in setting the pace of technological change, through infrastructural 'leapfrogging' – the installing of an advanced information and communications infrastructure capable of providing advanced services for use in business and the home.

3.3 In the case of Korea, the two cases examined Korea Telecom (KT) and SK Telecom, (SKT) did indeed play this dynamic role in technology generation and diffusion. These two large firms (with a turnover of US$7.8 billion and US$6 billion respectively) represented an important national technological resource and a major source of training and skill development. Both were dynamic companies which had responded to, and taken advantage of recent technological advances. Both had been deeply affected by the changing regulatory environment in South Korea, especially in relation to mobile telephony.

3.4 In terms of technological awareness and search, both companies scored highly (on a par with leading service providers worldwide). KT had been through a painful process of re-structuring over the past three to four years, as the company moved towards privatization and felt the impact of competition, particularly from mobile phone providers (a market to which it was excluded as in most countries). Its R&D department of around 800 staff, had been forced to 'open itself up' to the wider world in order to access new advanced technologies both from sources within Korea and globally, in order to offer new digital services capable of competing with mobile providers and supporting the diffusion of internet technology.

Table 3.1: Company Sample by Industrial Grouping

Firm and Industrial Grouping	Start Date	Size of firm Sales and Employment 2000[15]	R&D Spend/Employment (E) 2000[16]	Domestic (D), Export market (E)[17]	Ownership[18]	Main Product Lines	Current Technology Strategy	Source of Technology
Group 1								
Telecommunications services								
****Korea Telecom	1984	US$7.8 bn, 1999	E=800 US$62 million (8% of revenue)	D	L	Land-based telephone services	Move downstream from systems to services and network solutions	Internal R&D, plus extensive national and international linkages
****SK Telecom	1985	US$6 bn E=3000	E=400	D	L	Mobile services	Downstream to network service R&D	In-house R&D; projects with *chaebol*
Group 2								
Electronic goods and components								
****Samsung	1938	US$70 billion E=150,000	US$500 million E=900	X	L	Electronic goods and components	Towards strong basic research	In-house R&D; extensive international sourcing
****LG Philips	1999	US$26 billion E=50,000	E=250 US$130 m. (4.5% of sales);	X	JV	LCD Monitors for PCs and notebook computers	Research-based global leadership	In-house R&D, combined with Philips
****LG Electronics	1958	US$54 billion E=100,000	E=700	X	L	Electronic goods and components	Business focused R&D	In-house R&D plus global network
***TriGem Computers	1980	E=1500	E=170	X	L	PCs, mobile notebooks	Fast follower product innovation	In-house R&D, buyers
Group 3								
Capital goods/inputs for electronics								
**Dong Yang Semiconductor Equipment	1981	US$15 million 99	E=25 US$1.2 m. (8% of sales)	D	L	Testing and handling equipment for semiconductors	Follower product improvement, cost reduction	In-house engineering, customers, suppliers
**C&S Technology	1993	E=110	70	D	L	Semiconductor product designs	Fast, high quality designs	Own skills, clients, search
***3M	1980	E=680	69	D	F	Surface mount equipment; tape, graphics and optical film	High quality, new products from 3M	In-house, plus 3M companies worldwide

Size of firm: ****Large Firms (including *chaebol*) above 3,000
***Medium Size Firms 300-3000
**Small firms 50-300
*Micro Enterprises 49 or below

[15] Data not always available: T + turnover in US$ or Won: E = total employment in 2000/2001

[16] For large firms, figures refer to those employed within R&D department and not elsewhere in the organization as with employment figures, unless otherwise stated. For small firms without R&D labs, figures refer to total researchers and technical staff employed.

[17] Primary focus, X=Export; D=Domestic Market

[18] F=Foreign; L=Locally-owned; JV=Joint venture

Table 3.1: Company Sample by Industrial Grouping (continued)

Firm and Industrial Grouping	Start Date	Size of firm Sales and Employment 2000	R&D Spend/Employment 2000	Domestic (D) Export market (E)	Ownership	Main Product Lines	Current Technology Strategy	Source of Technology
Group 4								
Automobiles and supply chain								
****Hyundai – Kia Motor Corporation	HK- 2000 HMC – circa 1974	US$90 billion	E=1100	E (also D)	L	Automobiles	Move to product creation on global stage	Mistubishi. In-house engineering R&D; global networks of suppliers
****Mando Corporation	1962 (as Hyundai Internat-ional	US$800 million E=3,300	E=398 US$32 million 4% of sales	D	F	Auto components: brakes, steering, motors	Imitate and improve, fast follow, low cost	Hyundai, in-house R&D and engineering
***Doowon Precision Industry								
***Korloy	1966	US$40 million E=400	US$4.8 million E=50	D (also E)	L	Tooling for machinery (autos, aerospace etc)	Imitate and improve, fast follower	Clients, in-house R&D, engineering
**Bosch	1991	E=70	E=64	D	F	ABS, electronic control units, fuel injection systems, environment stds.	Fast introduction of Bosch technology, localisation	Bosch parent and other group companies
Group 5								
Foodstuffs								
***Daesang	1956	E=3,000	E=100	D	L	Seasoning, farina, citric acid, food processing	Fast follower, price, quality and speed	In-house resources, recruitment of new staff
**Bolak	1959	US$20 million E=200	E=35	D (some E)	L	Food additives, flavors, fragrances, cacao	New processes, low price, products	In-house R&D, licensing, distributors
**Hanil Feedmill	1968	US$43.2 million E=85	E=9	D	L	Animal foodstuffs for chickens, cows, pigs	Quality and product diversificatio n	Japanese partners, in-house efforts, equipment supplier
Group 6								
Start-up Micro-firms ('venture firms')								
*n-Shaper Corporation	2000	E=15 (US$ 2 million, start up capital)	E=12	D	L	Management and financial support to new start ups	Provide new start-ups with managerial sills	Venture funders, plus local network
*Techovalue.com	2000	E=9	E=4	D	L	Business consultancy for new start-ups	Rapidly learning intermediary	Korean S&T network, including universities

Table 3.1: Company Sample by Industrial Grouping (continued)

Firm and Industrial Grouping	Start Date	Size of firm Sales and Employment 2000	R&D Spend/Employment 2000	Domestic (D) Export market (E)	Ownership	Main Product Lines	Current Technology Strategy	Source of Technology
Group 7								
Other								
****LG Cable (Telecom and other cables)	1947	US$160 million E=3,800	E=400 US$3.2 million per annum	D/E	L	Telecom cable, including optics, esp. ultra high pressure cable	Product imitation and improvement,	In-house R&D, foreign collaboration
****Korea Zinc (Zinc and its by-products)	1974	US$7.9 billion	E=55	D/E	L	Zinc, lead, silver, cadmium and other metal	Scaling up quickly from lab to full-scale production.	Engineering supported by applied R&D, and international network
****LG Chem (Chemicals and related)	1947	US$ 5 billion	N/a	D/E	L	Wide range of pharmaceutical products	Fast discovery, rapid early development	Overseas education, US science advisory board, R&D
***Green Cross (Medicines and related)	1967	E=1,200	100	D	L/F	Plasma fractions, including hepatitis B renal syndrome vaccines	Fast process improvement, quality and speed of delivery	In-house expertise, and R&D
**Choonwae (Medical Equipment)	1972	E=228	E=24 5% of sales	D/E	L	Incubators, X-ray machinery, CAT scanners, operating tables	Co-development with Hitachi, rapid in-house learning	Foreign partners, in-house R&D, collaboration projects
**Kuk Dong Co (Material handling equipment)	1983	US$5 million E=65	20 (7 in R&D; 13 in engineering	D/E	L	Electric chain hoists, chain blocks and cranes	Move from price and quality to new product development	Reverse engineering, R&D, university collaboration

Table 3.2: Sample of Firms According to Sector

Group 1: Telecom service providers
Group 2: Electronic products and components exporters
Group 3: Capital goods for electronics industry
Group 4: Automobiles and input suppliers
Group 5: Foodstuffs
Group 6: New start–up enterprises ('venture' companies)
Group 7: Other firms

3.5 Regarding technology strategy, KT had shifted away from in-house development of hardware and software towards a far greater reliance on outsourcing to local and foreign firms. It had built up new teams of researchers capable of future network scenario analysis, and technology search and acquire capabilities. Organizationally, KT had moved from a traditional, functional based organization to a project-led company organized around clusters of customer demand.

3.6 Systems were in place for knowledge capture and learning, and the company worked closely with leading international suppliers of equipment and technology, such as Lucent, Nortel and Ericsson, with which it had strong technological linkages. KT's main task was centered on the integration of the various systems in order to deploy the new technology effectively in the network and offer new services. In this move 'downstream' towards systems integration (away from upstream product and system technology) the company was following an international trend, and was forced to develop new capabilities to offer novel 'solutions' on the network. Overall, the firm was approaching the world technological frontier, strategically very capable (in the higher band of level 3 overall) but perhaps not yet in the world leading 'creative' class which some telecommunications operators have achieved in the US.

3.7 SKT provided an interesting contrast to the more traditional KT. SKT began as part of KT in 1985 and in 1995 was sold to the SK Group and, in effect, privatized and free to compete in mobile. It had grown to become a highly successful technologically advanced mobile service supplier. In all eight key technology areas, SKT scored very highly and 'creative' in most. It was first in the world to implement several new mobile internet services and had a strategy and vision firmly fixed on the future, a future increasingly dominated by internet mobile services. Around half of its 400 staff worked on mobile internet services.

3.8 SKT had moved progressively downstream from technological involvement in systems and products to network service solutions and associated research, which involved searching out, and helping to define, new systems for the network based on the latest technologies (e.g. switches, routers, base stations, customer care software), and testing these out in the Korean market. Being a relatively small operator worldwide it had found that the major international vendors (e.g. Motorola and Lucent) were less responsive to its need (e.g. in terms of speed of delivery) than local firms. It had therefore switched to local suppliers such as Samsung and LG who were prepared to work more quickly and give more attention to SK's particular needs. In these activities it had helped pull local suppliers forward technologically and, in many cases, had been involved in the co-specification and development of the vendors systems.

3.9 In the area of technological learning, SKT demonstrated highly advanced knowledge management systems, similar to those found in leading firms in the US and Europe. SKT had close links with universities in Korea and abroad. It employed around 20 PhDs and 150-200 Masters holders in its R&D division, which constituted a strong source of innovation. In the areas of learning and review, the company also scored very highly as it did in each of the categories running from awareness, to search, source, implement and build capability. Overall this was a creative, highly ambitious company which benchmarked itself, quite rightly, against the world leaders in mobile service provision.

3.2 GROUP 2: ELECTRONIC PRODUCTS AND COMPONENTS EXPORTERS

Box 3.1: Samsung: A World Leader in Electronics

Samsung is the leading, most advanced electronics producer in Korea. It spent around US$500 million on R&D in year 2000, within its 900 strong corporate lab (SAIT), more than the entire Korean Government spent on basic research. It had a sophisticated portfolio of R&D activities across a range of technologies. The corporate lab used a technology roadmap with a 5-10 year time horizon to support new product development and associated research in the business divisions, which tended to have 3-5 year time horizon. The 1997 crisis reduced R&D spending by 10%, which led to equivalent staff reductions. However, the company's technology strategy remained the same as before the crisis. SAIT produced 200-300 patents per annum, indicating an internationally strong technological capability. It was also to point to many specific in-house technological developments (e.g. DVD, DVDR, new generation DRAMs) which had gone on to become major new businesses for the company. It recently introduced a promotions/incentive scheme (amounting to around 10-20% of salary) based on performance, responding to labor market competition and the 'lure' of new start up firms. At least eight new companies spun off in the past two years, focusing on developing applications from Samsung's new technology. Teams of SAIT engineers regularly left to join the business divisions, taking their skills and knowledge with them. Looking to the future, Samsung believed that nano-technology and perhaps other materials could challenge the silicon basis of electronics, once silicon reaches its physical limits. Overall, Samsung had reached or was approaching the world technology frontier in many areas related to its core manufacturing business. It had also invested in overseas R&D facilities to access leading edge technology (e.g. in the, UK the Samsung Electronics Research Institute employed 80 or so British engineers to develop the 2.5G and third Generation internet mobile telephone chips for the European market).

3.10 The second cluster of firms, electronics goods and components, represented the largest exporting group of firms in South Korea. Together, the sample firms interviewed employed more then 260,000 workers, boasting annual sales of more than US$160 billion, mostly for export. In some major export areas (e.g. DRAMs, LCDs, TFT-FPDs, DVD/DVDR[19]) these companies were international leaders, although they tended to compete in lower price ranges than their Japanese and European competitors. Each firm had large, highly advanced internal technological resources. Together they spent around US$1 billion on R&D per year within their corporate labs. Samsung alone spent US$500 million per annum in year 2000 within its corporate R&D laboratory, Samsung Advanced Institute of Technology (see Box 1 for details of Samsung).

3.11 Regarding the technology audit, in the areas of technology awareness, search and capability, these firms mostly scored highly, in the upper band of strategic level 3, although most were not yet at the 'creative' level 4 class. Research was still based on the central or corporate lab model, which leading US firms have tended to replace, or integrate within a network model which is able to access highly advanced technology

[19] These are respectively dynamic random access memories (a semiconductor product), liquid crystal displays (a component), thin film transistor-flat panel displays (an advanced display used in notebook computers and PCs), digital video disk player and DVD recorder.

actively from many sources around the world (Iansiti and West, 1997;[20] Gassman and Zedwitz, 1999).[21] However, each of the firms had begun international technology networking, in countries such as the US, UK, Russia and Israel, making strategic investments in key groups such as the MIT's Media Lab.

3.12 In terms of product, these firms had not yet moved far 'downstream' to knowledge-intensive services and 'solutions', as had many leading US manufactures (cite HBR article). Nor were they yet very strong in international brand image, distribution or marketing, all of which are important value-adding activities. While some had reached the technology frontier in specific product areas, in key areas of electronics and information technology these firms were not yet capable of defining advanced complex systems, or contributing to the world frontier in terms of new materials or radical new product designs. They tended to lag behind the major Japanese firms in consumer electronics, US firms in computing technology and European firms in telecommunications.

3.13 However, in the mass production of relatively simple hardware products (e.g. DRAMs as opposed to microprocessors, and telecom handsets as opposed to telecom switches and base stations) they were clearly world leaders. R&D was largely oriented to support next generations of hardware products (e.g. consumer electronics and components) rather than complex systems, services or capital goods. Nevertheless, within their hardware domain these firms were extremely effective, well-organized and internationally competitive. They were increasingly bringing new product generations to the world market place (e.g. in DRAMs and TFT-FPDs) in the way Japanese firms had done a decade or so earlier, but had yet to create radical new products.

3.14 Regarding technology strategy, most were making a transition from competitive advantage based on process capability to one based increasingly on product innovation capability. Samsung, was looking forward 5 to 10 years to the emergence of nano-technology products and had a broad technology program in this particular area. Regarding selection and sourcing, again firms scored highly mostly in the upper band of 3 'strategic'. However, the interviews revealed continuing weaknesses in capital goods, both within the firms themselves and within the Korean economy more generally (see Chapter 4 below). In many areas, electronics producers remained heavily dependent on Japanese suppliers for capital goods and key components, imposing a high import cost structure on the firms.

3.15 Finally, in terms of learning, review and implementation, firms again scored highly in the upper band of 'C' (strategic). Most were not yet utilizing advanced knowledge management techniques and some worked along traditional functional or matrix lines. However, in the mass production areas they compete in, these firms had

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[20] Iansiti, M. and West, J. (1997): 'Technology Integration: Turning Great Research Into Great Products', Harvard Business Review, May-June, pp69-82.

[21] Gassman, O. and Zedwitz, M. von (1999): Organizing Virtual R&D Teams: Towards a Contingency Approach, Conference Paper Presented at, PICMET-99, July 25-29, No378.

robust routines for new project specification, evaluation, monitoring and review. Some were aware, and were deploying, the latest management techniques deployed in the US.[22]

3.16 Regarding overall strengths and weaknesses, electronics firms core strengths still centered on manufacturing process technology, with firms benefiting from worldwide growth in demand for mobile telephony, consumer electronics, notebook computers and so on. However, firms were not yet at the 'creative' stage where they are able to re-define markets, contribute radical new products and services through advanced R&D. Nor were they able to challenge existing business models (e.g. by moving downstream into services). They tended to follow behind the leaders with innovative, lower cost follower designs. There was also still a significant proportion of production carried out under OEM sub-contract arrangements with market leaders in Japan and the US, placing Korean firms behind the leaders in the international division of production.

3.17 In their efforts to move beyond process innovation to product creation, electronics firms could also be threatened by the new trend in the US and Europe, which began in the early to mid-1990s, towards CEM, where leading companies such as IBM, Lucent, HP and Ericcson have outsourced their production to new CEM specialist partners based in the developed countries (e.g. SCI, Flextronics, Celestica and Solectron). These CEMs develop new process technologies in close partnerships with the major buyers and orient new processes towards latest generation products. If this trend continues (it represented around 18% of electronics production in the US in 1999, growing at 25% per annum) it could restrict the technology advance of Korean firms in certain areas, by limiting their direct access to IBM and other purchasers (Hobday, 2001). Potentially, the CEM trend could force Korean firms into a subordinate position within the international division of labor, restricting them to less advanced processes and designs for follower products.

3.3 Group 3: Capital Goods and Input Suppliers to the Electronics Industry

3.18 Group 3 contained three suppliers of capital goods and high technology design services, as well as basic equipment for the large electronics firms. The group included three very different types of firms: C&S Technology was a high technology design supplier, which had spun off from Samsung; 3M was a foreign supplier of equipment and technology, operating in Korea for 20 years or so; and Dong Yang was a traditional SME, supplying basic capital goods to the semiconductor industry.

3.19 C&S Technology (see Box 3.2) was an example of one of several highly capable SMEs which spun off from the *chaebol* to supply high technology services (in this case new product designs) to Korean exporters. Overall, the company scored highly on the audit (3 or 4 in most areas), situated between 'strategic and creative'. Like many other

[22] Seeley Brown, J. and Duguid, P. (1996): 'Organizational Learning and Communities of Practice: Towards a Unified View of Working, Learning, and Innovation', in M. D. Cohen and L. S. Sproull (eds), Organizational Learning, Sage Publication, California; Davenport, T.H. and Prusak, L (1998): Working Knowledge: How Organizations Manage What They Know, Harvard Business School Press, Boston MA.

small spin-off firms, its advantages were in speed to market and improvements on existing designs rather than creative new designs.

3.20 By contrast 3M was an example of an early foreign entrant (circa 1980) into Korea, supplying equipment and components (e.g. surface mount technology and optical products). Of its 680 employees, around 10% were engineers or technicians, working with local buyers on new equipment requirements, modifying 3Ms products, and providing support and maintenance services to users in Korea. Like other foreign subsidiaries in Korea, the majority of its technology links and sources were with other companies in the group (in this case 40 or so overseas 3M divisions).

Box 3. 2: C&S Technology: Designing Chips for Major Electronics Producers

C&S is a creative SME which span off from Samsung with just four engineers in 1993. It supplies chip design technology (one of four or five such firms in Korea). Today, C&S offers around 100 designs, employs around 110 people, and serves ten or so different clients. Its technological environment and its company fortunes are largely shaped by its largest customer, Samsung. C&S has a clear strategic view of technology management and a well articulated vision. It receives a good supply of engineers from SNU, KAIST and other Korean Universities who are then trained, mostly 'on the job'. The firm's core capabilities lie in rapid time to market and ease of implementation, rather than creative new design offerings. It is an innovative, 'behind the technology frontier' company. C&S has a clear view of its special technology advantages, as important to small as to large firms.

3.21 3M Korea engaged in regular conferences and meetings with group companies and frequently sent staff abroad for training. The company had few links with government research institutes, but some connections with local universities where most of the technical staff were from. While the firm had a strategic five year plan, it tended to support other 3M products rather than develop its own goods locally. As far as the audit was concerned, the company was generally a '3', technically competent with well-developed search and acquire capabilities, strong in process technology, efficient at technology absorption, and adept at learning and competence building. It had a professional approach towards project management, human resource development, cross functional integration of project teams, and knowledge management systems. Overall, this was a technically competent firm able to transfer technology from other 3M locations to Korea.

3.22 Dong Yang was an example of a small, more traditional capital goods supplier. Established in 1981, it employed 99 staff in 2001. The company began by importing and re-engineering testing and handling equipment for semiconductors, and later moved into 3D automation systems and visioning equipment. Like many SME capital goods suppliers in Korea, its strategy was based on low price, high quality offerings, rather than new product innovations. Most of the key components were imported and other firms in the region offered similar products. In terms of the audit (generally scoring mid-level 3), the company had well-developed international search capabilities and a coherent technology strategy, which involved continuing up the technology ladder towards higher

value, more complex products. This, in turn, required more R&D capability within the firm. Dong Yang's strategy was 'import, improve and adapt' to local needs, making it a valuable niche player in this sector.

3.4 GROUP 4: AUTOMOBILES AND INPUT SUPPLIERS

3.23 The automobile industry was the fourth cluster. The leading auto producer Hyundai-Kia Motor (HKM) Corporation was included, along with four suppliers of auto components, capital goods, technology and design services, ranging in size from the Mando Corporation, with around 3,300 employees, to Doowon Precision (1,000 staff), to Korloy (with 400 staff), to the foreign Bosch Technical Support Center with 74 employees in 2001. Individually, each of these firms performed well against our audit, revealing well considered technology strategies, impressive and growing technological competencies, and well-honed search and acquire capabilities.

Box 3.3: Hyundai - Kia Motor Corporation: Becoming a Global Competitor

HMC was established around 25 years ago with investment and technical assistance from Mitsubishi. Since then it has transformed from a low cost assembler to having ambitions to becoming one of the top five global producers within the next five years. As a result of the crisis, HMC recently merged with Kia to create the largest Korean auto producer and the company is still going through a process of assimilation. For example, there are currently around 24 platforms but the eventual aim is to concentrate down to seven. Similarly, there is considerable effort going into R&D, as well as component parts rationalization and facilities integration. The firm has R&D facilities in several locations in Korea and also in the US, Japan and Europe. HMC company has a high commitment to R&D with around 1000 MSc and 100 PhD researchers in the main Technical Center alone, and many other R&D staff employed in other parts of the company. The company is strong across a broad technology frontier, ranging from product design (e.g. new concepts for fuel and engine options), styling and design technology (such as 3D CAD and simulation). There is also extensive work with the local supply chain to move to a shared approach to component R&D. The company scored highly on the innovation audit in almost all areas. Strategically, it planned to move further 'up the technology ladder' towards product and technology creation, involving special purpose facilities such as the new wind tunnel. Mechanisms for technology intelligence include a variety of R&D collaborations and joint ventures, as well as co-operation agreements with key component suppliers such as Delphi to ensure that the firm is kept close to the international frontier. HKM recognizes the problems it has had in the past in transferring technology from R&D into production and has developed a number of mechanisms to reduce delays, including new cross-functional teams and the use of a pilot plant facility to provide an opportunity for learning and product/process development. Current technology priorities include new fuel sources and IT integration into new car concepts. Currently, the company has around 50 collaborative projects with universities in Korea and 40 with government institutes, spending around US$15 million per annum on these activities. Most of these projects are feasibility studies, concept elaboration and software development. One major development is the Next Generation Vehicle Project, a company established for the purpose of developing a university-linked (Seoul University) program. In addition, HKM runs training courses to promote new skills development, with 300 people so far having completed the program. Overall, this is a strong company which has survived the crisis and is now in a strong position to increase its market share. Its past technological strength come from the classic 'copy and improve' approach. HKM is now at the technological frontier and intends to move more fully into product and process creation. The commitment to R&D supports the view that this is a feasible ambition.

3.24 Overall, the automobile industry presents a similar picture to the electronics industry. The leading international exporters have reached the stage where they wish to move beyond manufacturing process towards new product design as their core competitive advantage. However, like the major electronics producers, firms such as HKM are poorly supported by the local capital goods industry and rely heavily on foreign imports.

3.25 Beginning with HKM, this firm boasted a wide range of strong technological capabilities (see Box 3.3) and had collaborations with major R&D and component suppliers around the world. With ambitions of becoming one of the five largest producers worldwide, the company had recently absorbed the ailing Kia Corporation which went into receivership following the economic crisis. As Box 3 shows, HKM was a technologically strong company which had survived the crisis and was preparing to further develop products for the international market. In the past, its technological strengths derived from the 'imitate and develop' approach, common among Korean exporters. However, HKM had now caught up with many international producers and was able to operate at the technological frontier. Its next stage was to move more fully into a mode of new product creation, supported by a major commitment to R&D.

3.26 Bosch Technical Center Korea (TCK) was a small but impressive technical support center for the German Bosch, supplying car components to Hyundai and other local car producers. TCK began in 1991 when deregulation allowed Bosch to by land. The Center had gradually built up a range of technical capabilities by transferring technology (e.g. for software) from the German parent, where at least one of the directors had worked for many years. Although small, Bosch TCK was an important specialist in capital goods and services, supporting Hyundai's efforts to enter advanced markets (e.g. by providing emissions technology and environmental standards consultancy). Like many other foreign suppliers (e.g. 3 M), the company's technology environment and strategy was largely defined by its parent and the other companies in the Bosch group. It had few connections with universities, and none with government research institutes as these were not seen as relevant to the advanced applied technology required by industry.

3.27 Mando, by contrast, was originally set up in 1962 as Hyundai International, a manufacturer of car components. In 1999 it was sold to a consortium of UBS and Chase Manhattan and renamed Mando. Mando employed 3,300 people and sold around US$800 million in 2000. The company produced brake, steering, suspension, motors and other components, but since the buy-out had concentrated on chassis parts only. Like many other local component suppliers, it was heavily dependent on Hyundai-Kia, and almost all production was for the domestic market (only 4% was exported). As with other Korean manufacturers, the technology strategy has been one of copy, develop and improve. Mando employed 398 people in R&D, with 210 in a central facility at Asan and the rest allocated across divisions.

3.28 While there was a division between product and process development, the company had retreated somewhat from the technology frontier (e.g. on ABS), finding it difficult to compete with high R&D spenders such as Bosch and, as a result, decided to

continue their follower strategy, focusing on quality and price rather than product sophistication.

3.29 In terms of searching for new technology, Mando was extremely capable at assessing competitor activities, making extensive use of the Internet, and using visits and exhibitions to their advantage. The company had worked on the scientific basis of NVH (noise reduction) with Seoul National University for the past six years. Mando's core competence was in integrated chassis components where it enjoyed some competitive advantage. Despite being a medium-sized company, Mando boasted more than 3,300 patents, placing it among the top 15 patent holders in the country.

3.30 Like other firms reaching the technology frontier, Mando was at a crossroads. The strategy of being a fast follower, quickly reproducing and improving on new products had worked in the past and, although wishing to progress further, the company realized the risks and difficulties of becoming a product creator: "if you create a new technology within Korea then who will be the customer?" At the same time, its capacity for low cost product imitation could be challenged by larger players with similar strategies, for example from China, as they enter the field.

3.31 This vulnerability was also present in Doowon which had built a strong market position by staying close to local customers, especially Hyundai. In conventional products (e.g. mechanical fuel injection systems for diesel engines for cars, trucks and agricultural vehicles) Doowon boasted clear price and quality advantages and had some success into third markets (e.g. China). However, in new generation higher technology products the options for copy and develop/imitate were constrained by the reluctance of technology holders (such as Bosch and Lucas) to license. Doowon's ability to develop its own variant products (e.g. for electronic pumps) was further constrained by the significant cutbacks in R&D which followed the crisis. In the short-term, Doowon was in a strong position to supply products for the growing vehicle industry. However, in the long-term it could become increasingly difficult to match lower cost Asian competition in conventional products, while defending strategic moves to higher technology areas.

3.32 Korloy, which faced similar difficulties, had managed to develop a strong position in the design and production of tooling for machinery used in the automotive, aerospace and machine building sectors. The company ranked itself 20th in the world in terms of technology, including powder metallurgy and surface treatment (especially PVD coating). Its distinctive competence lay in a mixture of price and quality, combined with good service and fast delivery. Like other Korean capital goods suppliers, Korloy pursued a strategy which was neither a 'blind follower' nor a technology leader. Korloy estimated that it was between one and five years behind the new product capabilities of very advanced companies, but it had significant time-to-market and price advantages. Overall, this firm had a good track record in technology and whilst it adopted a follower approach it did more than simple imitation. By mastering process technologies such as sintering and surface treatment, it had developed a distinctive competence. Again, however, in the longer-term, the company faced a growing competitive threat from China and other regional players. In its view, this trend could only be counterbalanced by a

stronger internal commitment to technology which would enable the firm to move up the technology ladder, towards more proactive product innovation.

3.5 GROUP 5: FOODSTUFFS

3.33 Foodstuffs, the fifth group, was included as it appeared to represent an example of a traditional low technology (albeit important) Korean industry. The sample included three firms, Daesang, Bolak and Hanil. In fact, these firms utilized new technology in their processes and had fairly well-developed capabilities for search, acquire and implementation of technology, scoring around the mid-band of Type D (strategic) against most of the technology criteria. Their problems and strategies were remarkably similar to those highlighted by domestic market suppliers in the other groups.

3.34 Daesang, established in 1956, was an example of a medium to large company with around 3,000 staff producing a range of foodstuff, including seasonings, farina, and citric acid. Like other firms in the foodstuffs industry, the company was 'caught in the middle' between lower cost Asian producers (especially China) and product leaders in Japan and the West. Upgrading *via* R&D (e.g. on micro-organisms for fermentation) was seen as a means of competing via quality improvement, but the crisis had reduced the funds available for R&D, exposing the firm to low cost competition and posing a major problem to the strategy of technology upgrading.

3.35 Bolak, which began in 1959, was a small supplier (with 200 staff) of food additives, flavors, coloring and processed cacao. Like Daesang, it had an internal R&D department, capable of searching, acquiring and improving the quality of products and processes, as well as reducing costs and introducing product modifications to suit the local market. Also like Daesang, the firm was surprisingly technology-intensive, in this case with 35 staff (18%) devoted to R&D and a portfolio of 30 patents. Bolak had an impressive process for strategy formulation and problem brainstorming as well as highly developed international and national search and acquire skills. The company maintained good links with 20 or so professors, mostly in Korea, in order to identify and assess future (five to ten year) technology requirements. It also had good basic systems for project introduction, evaluation and learning.

3.36 Finally, Hanil was a small firm with 85 employees, nine of whom worked in R&D. As Box 3.4 shows, R&D had increased in recent years and the company was capable of following international trends and developing its own products. The company worked closely with two Japanese partners to produce new mixing technologies for the local market. Although small, Hanil also worked with firms in the US, Mongolia and Indonesia. Like most other companies in this sector, production equipment tended to be imported from either the Japan or the US.

Box 3. 4: Hanil Feedmill Co: Improving Product Quality with Japanese Partners

Hanil, established in 1968, manufactures an assortment of animal foodstuff (primarily for chickens, dairy cows and pigs). It employs 85 people and has a turnover (in 1999) of around US$43.2 million. It is the largest domestic producer, with a 10% market share. The firm competes on the basis of product quality rather than price and most of its R&D effort is dedicated to improving its products. Regarding technology strategy, Hanil is continuing to diversify from cow feed to chicken feed and up-dates its knowledge base through visits to Japan, internet searches and the scientific literature. Of the 85 employees, nine work in R&D. The company faces difficulties in recruiting specialists from local universities. However, R&D projects enable Hanil to follow trends in the market and develop new products based on the management's strategy and competitor analysis. Hanil works closely with two Japanese companies to produce new mixing technologies for chicken and cows. Like many Korean firms, it relies on Japanese firms for new product ideas as well as technology transfer. Although a small company, Hanil collaborates with firms in the US, Mongolia and Indonesia, as well as a local university. Most testing is carried out in-house, with some contracted out to the Korean Science Analysis Center (a private company). Like other firms, most capital equipment is imported and quality, fast product introduction and competitive price constitutes the strategy, rather than new product creation based on advanced R&D.

3.6 GROUP 6: NEW START–UP ENTERPRISES ('VENTURE' COMPANIES)

3.37 Group 6, the two micro enterprises, were examples of the many new high technology start-up firms. In Korea these are called 'venture' firms. Although they are generally not venture capital suppliers, some do perform this function. These firms represent a new 'breed' of mostly small start-up companies which have emerged in the last three or four years. They now constitute an important 'innovation experiment' within Korea's traditionally, large-firm dominated industrial structure.

3.38 As Lee and Kim (2000)[23] show, the number of venture companies expanded from only 304 in May 1998 to over 6,000 in March 2000. Their output in 1999 amounted to around 4.8% of GDP and employment stood at 180,000. The plan of the Korean Government was to increase their share in GDP to 18% in the medium-term. Their emergence coincided with the upswing in the Korean economy in 1999, which experienced a 9% growth in GDP. The growth of new firms was partly in response to policy measures such as the Special Law on the Promotion of Venture Companies and various incentives, including tax benefits. This all occurred under the policy goal of moving Korea from a *chaebol*-led to a venture-led economy (Lee and Kim, 2000).

3.39 The Office of Small and Medium Sized Enterprise promulgated a five year plan for the vitalization of venture companies. To qualify as a venture company there were four criteria: (a) venture capital must represent at least 10% of the total capital; (b) at

[23] Lee, K. and Kim, S. (2000): Characteristics and Economic Efficiency of the Venture Companies in Korea: Comparison with the Chaebols and other Traditional Firms, Seoul Journal of Economics, Vol 13, No. 3, pp335-360.

least 5% of sales should be allocated to R&D; (c) at least 50% of revenues must derive from products based on new patents or new technology; or (d) the firms passes a special review or inspection.

3.40 The Kosdaq stock market, another encouragement, was established in 1996. This grew rapidly and at the end of 1997, 359 firms were listed. By July 2000 this had grown to 479 of whom 202 were classified as venture companies. The value of the Kosdak grew from Won 7,068 billion (around US$ 5,890 million) at the end of 1997 to Won 54,271 billion (US$45,226 million) in July 2000, equivalent to around 21.2% of the entire Korean Stock Exchange.

3.41 Many firms emerged from universities and government funded research institutes. Others span out of the *chaebol* and other large firms, spurred on by new opportunities. So far the venture sectors has proved to be highly dynamic and profitable (Lee and Kim, 2000). However, many are very young and are still at the start-up experimentation stage. Our two case examples provide insights into the nature of some of the activities performed by the new companies.

3.42 Technovalue, with 9 employees, was a one year old start-up. This particular company span off from a government research institute (STEPI, the Science and Technology Policy Institute under the Ministry of Science and Technology) and had continued to benefit from STEPI's wide range of contacts in the Korean S&T community. Its strategy was to assist new S&T start-ups by providing management, business, technology and financial services. Support services included the development of business plans, on-line management education, and techniques for competitor analysis.

3.43 Like many others, Technovalue emerged as a response to new government policy schemes and incentives which had begun two years ago and in response to the dynamism created by the growth of the Kosdaq. The company learned rapidly through its network of contacts, about management services and consultancy. It was still at a very early stage of development, covering a broad range of sectors including bio-technology, information technology and the environment. It was searching for its own particular niche and had not yet focused down on any particular sector or service offering. The case indicated that public sector organizations can be a source of competent spin–offs, which can then benefit from the network of S&T specialists open to them. It also revealed the demand for management and business services among the many micro-enterprises now in the economy. Companies and support agencies providing advice and training appear to be in short supply in Korea. While Technovalue indicates that recent government policies have stimulated entrepreneurial innovation in Korea, it was unclear why recent policies succeeded so dramatically while earlier policies had achieved far less success..

3.44 The second case, N-Shaper, revealed further dimensions of the new start-up industry in Korea. N-Shaper began in 2000 and employed 15 staff in 2001. Like Technovalue, it provided management services. It also provided financial services and venture capital packages to other new start-ups. Unlike Technovalue, N-Shaper was initiated by three large Korean companies attempting to benefit from the new technology-based opportunities in Korea. This firm focused on information and communications

technology start ups and has already received more than 100 new business proposals in search of consulting assistance and funding. The company directors believed that the venture company explosion was primarily a response to support from the capital market and private sector firms. Most large firms had experimented in this area through spin-offs and financial investments in other companies. However, many had failed and there was some doubt over the success or otherwise of the many hundreds of other start-up firms. Most were following business models developed abroad (e.g. e-commerce, internet and IT support offerings), rather than developing new products and new business models. N-Shaper had developed a framework for its consultancy services based on a risk management approach, which incorporated technology, market, financial and personnel risks. Services also included identifying financiers, financial advisors and experienced managers to complement the technology-driven approach of many of the new firms.

3.7 Group 7: Other Firms

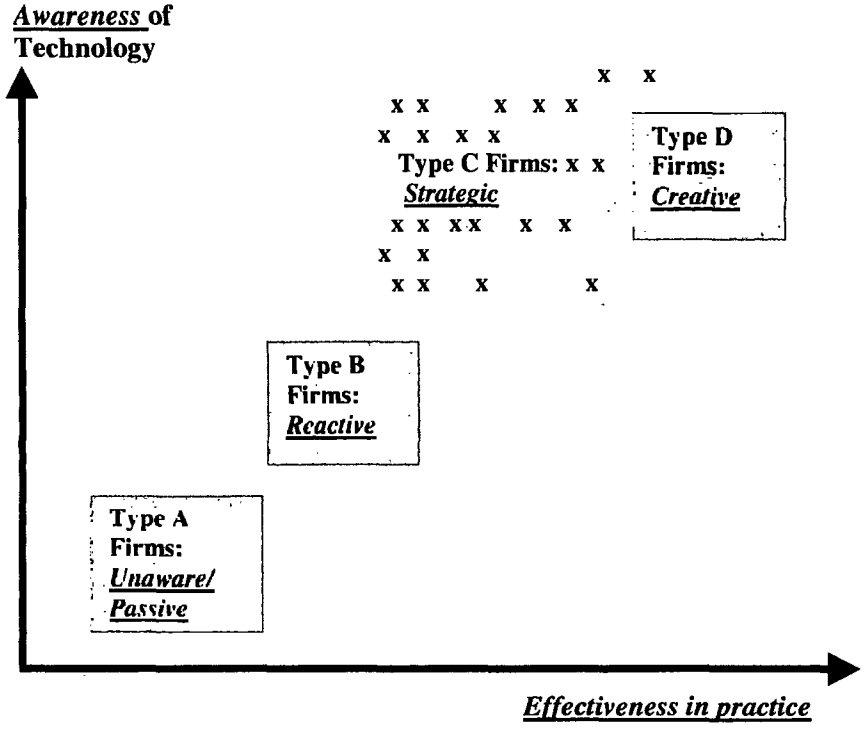
3.45 In addition to the six groups of firms above, six other firms from a wide range of other sectors (including cable production, metal processing, medical equipment, chemicals, medicines and loading equipment) were interviewed to gain additional perspectives on innovation processes within Korean firms and to see if the findings were consistent with other types of firms and sectors. Selected findings from these firms are presented in Annex A3.

4. RESULTS AND IMPLICATIONS

4.1 Chapter 3 focused on the innovation within Korean firms, examining capabilities and strategies, strengths and weaknesses. This chapter presents the wider issues arising from company interviews together with implications for firm strategy and government policies in Korea. Policy recommendations are discussed in Chapters 5 and 6.

4.1 OVERALL RESULTS FROM THE KOREAN AUDIT

Figure 4.1: Korean Sample Firms According to Technological Capability



4.2 Figure 4.1 presents the results of the individual firm audits, clustering them according to their technological capability. The majority of the sample of 25 firms were spread around the lower, middle and upper band of Type C ('strategic'), beyond 'passive' (Type A) and 'reactive' (Type B). In applying the audit tool, it became clear that within the 'strategic' category, there was a great deal of difference between barely strategic firms and firms which had mastered strategy formulation and execution. It is likely that there is also a wide spread between the upper and lower performers in each category.

Also, given the subjective nature of the data collected, small differences between firms within and between overall categories cannot be considered significant in any way.

4.3 Within the Korean sample, only two firms scored highly enough to be in the 'creative' (Type C) category and a further two were in the Type B 'reactive' category. Therefore, 23 of the 25 firms were not yet capable of contributing to the world technology frontier through R&D or new generation high value products. Chapter 5 provides a policy analysis and suggestions for this category of firms based on the OECD experiences.

4.2 An Innovation Dilemma: From Process Innovation to Product Creation

4.4 In some respects Korean industry finds itself in an 'innovation dilemma' as a result of its own success. The catch-up model which has served industry well in the past is reaching limits in some areas, challenging firms to move beyond process innovation to new product creation.[24] In the area of new product creation most Korean firms, in most sectors, have yet to make their mark, particularly in higher price, more complex products and capital goods and services.

4.5 While most firms highlighted this dilemma, they also recognized that faster moves towards product creation poses serious risks and costs. But without these moves, firms will increasingly confront lower cost competition from other highly capable Asian economies, especially China. In other words, firms are 'squeezed' between higher technology leaders in the US, Japan and Europe and lower cost competitors elsewhere in Asia.

4.6 The strategic move to product creation from an 'imitate and improve' strategy faced many companies in our sample. However, to move in this direction successfully, firms will require greater direct support from leading capital goods producers (including foreign suppliers), as the more complex capital goods, components and services sectors are weakly represented in the Korean economy, as indicated by both users and producers of capital goods.

4.7 The move to product creation also requires far greater investment in fundamental R&D, capable of the capacity to produce new product generations based on new materials, radical designs and advanced information (especially software) technology. Unfortunately, while this requirement is widely recognized in industry, the recent crisis led to cut-backs in fundamental research and a move towards shorter term R&D in support of current and near-term business. In many cases, firms have yet to recover from this re-orientation, forced upon them by financial constraints.

[24] Note that from an historical perspective this view could be challenged. It has been widely expressed in previous phases of Korean industrial history by academic observers and industrialists. However, it could well be that, as long as international markets for low cost, high quality hardware continues to expand (as they are likely to do, for example in electronics) Korean firms may well continue their repeated cycle of 'behind the frontier' catch up product innovation, with leading US, Japanese and European firms remaining ahead in new product creation, especially in higher price, design-intensive, complex products and systems.

4.8 Firms also feel, rightly or wrongly, that Korean universities and government-funded research institutes are not 'in tune' with their short, medium, or long-term needs. In particular, in government policies for more 'basic research' in the public sector, industry felt that this mis-specified and over generalized real needs. Most of our interviewees felt that the public sector could be far more effective in: (a) supporting industry's moves towards product development and creation; (b) formulating strategy with industry, rather than *for* industry; and (c) supporting the large R&D activities in the private sector with relevant investments in universities and government-funded research institutes. The latter did not link well into industrial innovation needs, according to many of the firms interviewed.

4.9 Equally, policies to encourage more basic research within industry were also criticized for being 'out of touch'. Firms felt that the real needs were for nearer-term, more focused and applied research which supported their strategy of moving towards new product development. In other words, more attention needed to be given by policy makers to firms as major suppliers of technology, and as major 'demanders' of technology. Firms believed that they represented the 'heart' of the national system of innovation within Korea, but that their needs were less well serviced than in competing economies such as Taiwan, Japan, the US and Europe where they pointed to large joint programs of technology development and shared facilities, funded by government.[25]

4.3 Technological Progress and the Crisis

4.10 Over the past decade or so, many leading Korean firms have caught up further with Japanese competitors, building up their process capabilities and reducing, to some extent, their dependence on sub-contracting, licensing and OEM. They have strengthened their R&D capacity and broadened the range of export products in which they occupy a world leadership position. This represents a continuation of the catch-up model described by Amsden (1989)[26], Kim (1997)[27], Hobday (1995)[28] and others, which has led on to greater competence in product design and associated R&D.

4.11 However, the crisis which began in 1997 resulted in a number of difficulties and continuing repercussions and setbacks to the broad strategy. Several firms reported a 'retreat' from basic, towards more applied research in support of business divisions, caused by the loss of revenues and cut-backs in long-term and non-essential operations. One very large firm had been forced to re-orient its entire corporate R&D laboratory from a basic research, science–led center (with programs defined, in the main, by scientists), to

[25] While it could be argued that firms were merely representing their own interests in putting forward these kinds of arguments, other studies also point to a continuing disconnection between the needs of industry and the activities of government-funded institutes, universities and the major national R&D projects (see World Bank, 2000, Chapter 5).

[26] Amsden, A. (1989): Asia's Next Giant: South Korea and Late Industrialization, Oxford University Press, New York.

[27] Kim, L. (1997): Imitation to Innovation: the Dynamics of Korea's Technological Learning, Harvard Business School Press, Boston Mass.

[28] Hobday, M. (1995): Innovation in East Asia: the Challenge to Japan, Edward Elgar, Aldershot, England.

a strategy in which 70% of spending was in direct support of the shorter-term product needs of the business units. This company regretted the move, and had been forced to lose around 30 scientists in the first wave of cut-backs. This event, and many others like it, illustrates how upstream moves toward knowledge-intensive basic research activities are highly sensitive to industrial shocks and business cycles. Many other firms had reduced their recruitment of doctoral-level researchers and had been forced to curtail investments in new research areas.

4.12 These moves towards shorter-term R&D were not generally viewed as desirable, and went against the espoused strategies of most major firms. In some cases the firms planned to move back to more science-led research when circumstances permitted.[29]

4.13 In other cases the strategy of basic research remained in place, but budgets had been cut for the first time in recent memory (e.g. by 10% in the case of one leading firm, which had also experienced redundancies in R&D for the first time).

4.14 It is also important to note that the impact of the crisis on technological innovation is still ongoing and not only confined to R&D. For example, the major automobile producer Hyundai-Kia is still in the process of reducing it quantity of automobile platforms from 24 to five, a rationalization partly caused by the take over of Kia, following its collapse as a result of the crisis. Considerable rationalization is also still occurring in the purchasing of parts and components, as described earlier.

4.4 Increasing Foreign Participation

4.15 In the past, Korea has remained fairly closed to foreign direct investment and Korean firms have not formed many equity partnerships with foreign firms within the Korean economy. Business with foreign firms has tended to be conducted under OEM and licensing deals, with some partnering and acquisition abroad. Certainly, when compared with the economies of South East Asia, Korea has relied extremely heavily on locally-owned firms for export, rather than the subsidiaries of foreign investors. This reluctance to engage with foreign firms within Korea may have closed off possible strategic and innovation options (e.g. partnerships for capital goods' production) in the past.

4.16 The recent crisis, however, has forced some firms to rethink their 'go it alone' strategy and, in some cases, has demonstrated the potential advantages of carefully planned complementary joint ventures within Korea. In other cases, the crisis had forced companies in search of investment funding into joint ventures with foreign firms which otherwise, almost certainly, would not have occurred. One extremely successful foreign

[29] Note that similar trends occurred in the US in the early-1980s when firms such as ATT, DEC and IBM were forced to rethink their 'Central Laboratory' model of research. Eventually, this led to a reconfiguration of R&D, in favor of more applied research, networked in smaller units across countries, with more responsiveness to business divisions. See for example, Iansiti, M. and West, J. (1997): 'Technology Integration: Turning Great Research Into Great Products', Harvard Business Review, May-June, pp69-82.

alliance was the case of LG-Philips which was established in 1999 in response to financial difficulties caused by the crisis. LG provided Philips with advanced manufacturing process know-how for liquid crystal display (LCD) monitors for PCs and notebooks, while Philips (the Dutch electronics maker) provided access to financial capital and its fundamental research facilities in Eindhoven.

4.17 The combination of LG and Philips enabled LG to recover quickly from a one-year delay in investment in new production facilities, and then to forge ahead to a world leadership position. In 2000 the joint company achieved a world number one market share in some major product areas (e.g. a 15% share in LCD monitors for notebooks). The LG-Philips venture, with sales of US$26 billion and profits of US$0.5 billion in year 2000, enabled LG to gain a leading world status in product and well as process technology, backed up by fundamental research in support of new product generations. This case points to some of the potential advantages of foreign collaboration.

4.18 In other cases firms were taken over because of the crisis. The Mando Corporation, for example, was sold off in 1999 to a consortium of UBS and Chase Manhatten Bank. Also, Green Cross, was in the process of downsizing and selling off divisions to TNCs. These types of restructuring also occurred among other firms and in other sectors (e.g. automobiles) opening up the strategic 'mindset' of Korean companies to some of the benefits and, no doubt, difficulties of large scale foreign partnerships, previously avoided in the past. Indeed, one potential 'way out' of the process innovation, catch-up business model, could be more extensive partnerships with foreign firms within Korea, where Korean companies trade their strong manufacturing process advantages for access to capital, new markets and fundamental research capability. This strategy could also counter the potential threat posed by the emergence of contract electronics manufacturing within the leading economies.[30]

4.5 Other Drivers of Organisational Change

4.19 Most firms had responded to the crisis in one way or another. However, other factors had also produced major industrial changes in the recent past. For example, in the case of telecommunications, service providers had undergone radical restructuring in the past four years as a result of new regulations governing mobile services and new opportunities offered by digital technology and the internet.

4.20 In the case of the main landline operator, KT, these drivers for change had affected virtually all areas of technology search, strategy and competence. The new strategy had led to a far greater involvement of small firm as suppliers to KT and close co-working with leading international vendors, such as Lucent and Cisco, leading to

[30] Korean firms' strong position in process technology could be challenged by a new breed of 'contract electronics manufacturers' (CEMs) based in North America and Europe (e.g. Solectron and Celestica). Although international trends towards CEM are not entirely clear, as more firms such as IBM, HP and Ericsson move towards services and complex products they, in turn, have outsourced their internal manufacturing to the new CEMs with whom they work in close partnership. This trend could exclude Korean firms from first-tier participation in some new hardware markets, as the CEM innovate with the most advanced process technology (Hobday, 2001).

stronger technology channels with US telecommunication technology suppliers in this important area. On the negative side, total revenues had declined, along with budget allocations for R&D forcing a rationalization of strategy and a more open approach to technology sourcing and partnering, demanding increased foreign participation.

4.21 Similarly, SK, the private mobile service provider, had also re-structured radically. In this case the company had grown rapidly as a result the burgeoning expansion in the use of mobile telephony in Korea. Again, innovation activities were shaped more by market growth and regulation than the crisis. In KT and SK, both companies had successfully moved downstream towards service and solutions supported by new network R&D, in line with leading trends in the US, Japan and Europe.

4.6 Emergence of New High Technology Micro-Enterprises

4.22 Other forces for change include the growth of the NASDAQ and new strategies to encourage the start-up of high technology small firms, both on the part of major firms and the Korean Government. These strategies have led to a burgeoning of entrepreneurial technology-based firms, inconceivable even a decade ago.

4.23 The evidence from the small firms in our sample indicates that new technology based firms can be successful but it can take a considerable period of time for firms to become established as niche suppliers (e.g. eight years in the case of C&S). Success often depends on support from the major buyers of services and technology. However some, but not all, of Korea's large firms enthusiastically accept the venture firm experimentation currently underway. In other cases, major firms have already benefited from the focus, flexibility and speed that highly motivated, high technology SMEs can bring to the market place.

4.24 The two micro enterprises examined were examples of the new high technology start-up 'venture' firms. These firms represent a new breed of entrepreneurial companies in Korea, most of which emerged in the last three or four years. They now constitute an important 'innovation experiment', contrasting starkly with the hierarchical, large-firm dominated model of development in Korea.

4.25 The number of these start-up firms expanded from a very small base in 1998 to more than 6000 in 2000, with employment approaching 200,000. These firms emerged partly in response to the downsizing during the crisis, and partly to new opportunities as the economy recovered in 1999. Many focused on new information and communications technologies, including internet and web services. Start ups were also encouraged by new policy measures and incentives for the promotion of venture companies, and the opportunities opened up by the Kosdaq stock market which began in 1996 and by July 2000 was valued at Won 45,226 million (US$37.8 million).

4.26 Many of these firms originated from the universities. Others span out of the *chaebol* and other large companies. So far, they have proved to be highly dynamic and profitable (Lee and Kim, 2000). However, as with any start-up companies, it is to be expected that many will fail in their first five years or so, especially if there is a slow

down in the growth of the Korean economy, which itself is highly dependent on the health of the US economy for exports. In addition, many of the new start-ups were led by scientists and engineers without a great deal of management experience and expertise. However, some of these companies are likely to grow rapidly and become large firms in their own right. Regardless of the fortunes of individual firms, there can be little doubt that the new venture phenomenon is an extremely important, unpredictable new feature of the innovation landscape in Korea. If the experiment is successful on a sufficient scale, the new upcoming firms could considerably strengthen the Korean economy which for decades has suffered from a small and weak SME sector and an underdeveloped entrepreneurial start up culture.

4.7 Weaknesses in Capital Goods

4.27 In electronics, automobiles and other export sectors, our analysis exposed severe weaknesses in the supply and integration of capital goods within the Korean economy. From the point of view of the motor industry, wishing to move towards a full service supply chain approach, an estimated 5% of Korean firms were capable of meeting requirements. The rest were weak in standards for quality, technology and service. As large electronics and auto firms move further towards the product design frontier for global markets there will be increasing pressure on local capital goods and components suppliers within Korea. Lower technology suppliers currently in the domestic market may well be supplanted by international investors with higher technology (e.g. Bosch in autos).

4.28 From the major exporter perspective, capital goods weaknesses included: (a) a lack of direct access to capital goods' technology and their producers within Korea, important for the next stage of product development; (b) heavy dependence on Japanese and, to a lesser extent, US suppliers for capital equipment, expertise and technology; (c) ambiguity in terms of strategy towards capital goods. Some firms had considered entry into capital goods, by integrating backwards into their design and production. However, they also realized this could incur very high costs and risks, not least due to the likelihood of conflict with existing foreign suppliers. Electronics producers were concerned that capital goods' production 'was not their business' and would extend their competencies into yet more domains at a time when they needed to curtail diversification. Others firms were concerned that developing local capital goods capacity could cause delays in accessing the latest generations of process equipment needed for mass production.

4.29 However, in some cases (e.g. mobile telecommunications) purchasers within Korea had used their buying power to bring on the capital goods capacity of firms such as Samsung and LG in areas such as switches, routers and base stations because they found that the major international vendors (e.g. Motorola and Lucent) were less responsive to their needs for co-development and fast delivery. In this case, the buyers had acted to 'pull' local technologically forward, engaging with suppliers in co-design and specification of fairly complex systems.

4.30 Some firms had co-working arrangements both within Korea and overseas with leading capital goods producers. Some, in electronics, had acquired the capability to co-

design and develop important production and testing facilities. However, equipment import costs remained a heavy burden on these firms. Some argued that the import duty on capital goods was too high, being higher than the average import duty, imposing unduly high costs on exporting firms.

4.31 From the viewpoint of traditional, local capital goods producer within Korea (e.g. for autos and electronics) some found that as they approached the technology frontier they found it became increasingly difficult to compete with the capability and R&D spending of international competitors such as Bosch and Lucas. As a result, some had pulled back to lower technology options (e.g. mechanical as opposed to electronic components for automobiles) where they had proven advantages in terms of price and quality. In the higher technology areas, unable to match the high technology investments, they had retreated to a follower strategy. The same producers also felt threatened by the likely emergence of a low price capital goods and components emerging in China.

4.32 Overall, in cases such as automotive and electronics, as the major product exporters approach the technology frontier, the trend is for them to source globally in search of the highest technology suppliers. Increasingly, this will involve forming partnerships with foreign capital goods producers abroad, relegating local producers to low technology fields and small niches.

4.33 For example, with the introduction of electronic diesel pumps by the international technology leaders, the share of local firms in the market had fallen considerably. Local firms believed that the domestic car makers will place much more emphasis on new product technology and that the main competition will center on electronic pumps. Several small local capital goods producers felt they suffered a credibility problem even if they were able to master the technology. By contrast, international suppliers boast a strong reputation supported by clear technological strength. In new product technologies, reputation and credibility are important for getting acceptance by the major Korean manufacturers. Whilst in the short-term, China and other lower cost regional suppliers may not yet be capable of producing complex mechanical products, being 'sandwiched' between lower cost regional producers and the high technology leaders poses a serious challenge for 'behind the frontier' capital goods makers in Korea.

4.8 The Role of Universities and Government-Funded Research Institutes

4.34 Most large firms collaborated extensively with universities and had strong links with individual professors in several of the top universities in Korea, which they valued considerably. The Korean Advanced Institute of Science and Technology (KAIST) was frequently cited as an excellent source of research and know-how. Universities were viewed chiefly as the main source of graduate and post graduate recruits for industry.

4.35 However, most firms felt that overall university research was overly disconnected from the needs of industry. Some argued that the policy emphasis on basic research in universities was misplaced, and that university research should be more closely connected to the more applied research needs of firms, in support of their progress towards higher technology new product creation activities. Firms believed that university

research in Korea did not link up well with either the corporate *supply* or the corporate *demand* for technology, which they viewed as the driving force of the 'national system of innovation'. Many firms felt that key policy questions remained unanswered. These included: in which specific areas should universities conduct basic (and applied) research? and why? how much research should be undertaken by universities? what were the respective roles of universities and industry, given the technology strategies of industry? Partly because these questions were unanswered, it was unclear to private companies how the basic research activities of universities contributed to economic development or competitiveness.

4.36 Regarding human resources for research, some firms felt that is was very difficult to attract PhD-level researchers because they preferred to remain in universities where they received greater job security and more work freedom. Two interviewees felt that universities were actually draining human resources *from* the private sector, and that the flow of personnel in recent years had been from the private sector to universities, which offered attractive, less pressurized positions.

4.37 Although major firms had many links with universities, they were less aware of, or connected to government-funded research institutes or national technology programs. These institutes and programs were often viewed as too remote or unresponsive to be directly relevant, although there were some exceptions. Some companies felt that government laboratories tended to be staffed by academic types, with little industrial experience. Some smaller firms had received funding for collaborations with government funded institutes but had found a major gap between their own applied work and the more basic research of the labs. Several firms were concerned that both government funded institutes and university research lagged behind the work of equivalent groups around the world.

4.38 In relation to government R&D policy, the view of most major firms is that government does not properly recognize or support the technology developers in the private sector. By contrast, they argued that Japan and Taiwan did provide infrastructure and support for future technologies, linked to emerging and prospective competitive strengths.

4.39 Government collaboration programs, such as ESPRIT in Europe, might help build bridges between the research community in Korea, breaking down barriers and misunderstandings between government, academia and industry. However, they would not satisfy calls for major programs of future-oriented technological developments, targeted in areas of private sector interest.

4.40 Overall, firms perceived that government policy was formed in isolation, rather than with the major industrial actors, despite the existence of various industrial consultation exercises performed, for example, by MOCIE. Not surprisingly, when asked, firms argued that government should align public sector research with the needs of industry and 'back up' corporate R&D with infrastructure, including shared facilities, government-funded joint programs and improved human capital. Suggestions for improvement included: (a) improve access to information about university and

government funded research; (b) begin government supported international missions or visits to centers of excellence abroad, comprising teams of industry and academics (as in the UK); (c) track technology and market trends *via* research funded or supported by government, on behalf of smaller firms; (d) place public sector research activities within a strategic, long-term framework which accounts for the medium and future needs of business, rather than the general production of knowledge via basic research.

4.41 While some of these views could be treated as 'special pleading', reflecting the interests of private firms, there is clearly a highly critical view within some elements of business concerning a lack of coherence in current strategy for public sector research, combined with the need to improve the contribution of public investments in R&D to the national science and technology agenda.

5. POLICIES FOR SUPPORTING TYPE A AND B FIRMS

INNOVATION BARRIERS FACING TYPE A AND B FIRMS

5.1 To develop suitable policies that support innovation among firms of all categories, a full and detailed analysis of current policies and their effectiveness, not possible here, would need to be undertaken. However, it is possible, using the framework and tools developed in Chapter 2, to outline the main innovation problems which tend to face firms in Type A and B categories and to point to typical policies, focusing on apparent best-practices world wide. This section presents typical policy approaches using the nine dimensions of capability referred to in the model of technological capability development illustrated in Figure 4.1 above. In addition, section 5.2 provides an approximate 'roadmap' of current Korean innovation policies in case the Korean Government wishes (a) to assess their effectiveness and (b) consider any new policy options based referred to in Section 5.1.[31]

5.1 TYPE A FIRMS: PROBLEMS AND POLICY RESPONSES

5.2 Focusing first on Type A firms, it is possible to outline typical problems faced and policy solutions delivered by government agencies in OECD countries. Since these companies are ill-prepared in all major areas of technological capability a systematic improvement program is needed. Outside assistance of various kinds can help these firms: (a) recognize the need for improvement (the 'wake-up call'); (b) develop a strategic framework for manufacturing and other activities; (c) identify the relevant and appropriate technologies needed; and (d) acquire and implement the required technologies.

5.3 Type A firms are likely to require assistance in order to sustain any improvement over the long-term, otherwise the gains from initial improvements could soon be lost. In manufacturing, firms are probably most concerned with assembly and have not yet progressed on to production engineering. Their need is to improve existing assembly capabilities and to begin developing new engineering skills in order to improve productivity and to prepare for developing deeper manufacturing innovation abilities.

5.4 Policies to enhance technological capabilities of firms in categories A currently considered to be 'best-practice' around the world can be aligned with the specific

[31] It would also be wise for Korean policy makers to analyze in some detail the apparent 'best practices' presented here, as very few rigorous evaluations of program costs and effectiveness exist. Most evaluations focus on benefits and positive outcomes, rather than cost, effectiveness, efficiency and value for money.

weaknesses in the nine capabilities referred in Chapter 2, or packages of services can be provided which address some or all of the nine dimensions of capability. Table 2 provides a list of policies and programs often cited as best practice in this area. It is helpful to consider policies first in relation to the nine dimensions of capability.

1. Awareness

1. Firms in this category, typically, 'don't know that they don't know' and need to become aware of the challenges facing them in order to begin a process of improvement. Sometimes, such a process occurs because of an external crisis (e.g. loss of market share). In others cases, firms may become aware because of the negative reactions of customers or buyers or suppliers. Under these conditions, firms need a 'wake-up call', as well as assistance in establishing a strategic framework for improvement which identifies immediate priorities. These firms will probably need help in working through a strategy and in its implementation.

2. Sometimes 'outreach' or 'missionary' services are provided where firms are approached by field agents or counselors to help them recognize and identify improvement needs (e.g. in MEP, IRAP and TEKES, Table 5.1). Sometimes these types of agencies provide benchmarking and other measurement techniques to help the targeting of manufacturing priorities.

2. Search

5.5 Search capabilities include the ability to explore the range of technological options available (there may be several competing solutions to any particular problem including alternative machines, different technologies and alternative supplier options). Category A firms tend to suffer from a very limited understanding of which technologies are available in the wider environment. In such cases, consultancy and other forms of support for awareness raising is required, as in the case of 'awareness' above.

5.6 Various countries operate 'technology brokerage' arrangements relying on third party agents or consultants who are skilled in targeting priorities and dealing with enquiries effectively. One example would be the TEKES Networks program in Finland (Table 2).

Table 5.1: Examples of Policies for Technological Capability Building for Type A and B firms

Delivery option	*Example of provision*
1.Outreach/ 'missionary' services where firms are approached by field agents or counselors to help them recognize and identify needs for change	MEP USA IRAP Canada Steinbeis Foundation Germany CIM Centers Switzerland TEKES Finland
2. Benchmarking and other measurement/comparison processes which enable targeting of manufacturing development	New Brunswick Research and Productivity Council (Canada) IRAP Canada
3. Strategic development process which enables firms to create a framework within which change will be located	CIM Centers, Switzerland New Brunswick Research and Productivity Council TEKES Finland Competitive manufacturing, and Making IT pay, UK, DTI
4. Support for technology search - where problem is not clearly articulated	Real services centers - e.g. CITER, Italy Canadian Technology Network German Manufacturing Technologies Support Program
5. 'Technology signposting' - facilitating access where problem is clearly articulated	Canadian Technology Network Inside UK Enterprise Scheme (DTI)
6. Facilitating access to funding for specific projects	TEKES Finland
7. Access to demonstration projects	Technology Diffusion Programme, Australia CIM Centres Switzerland
8. Support for technology transfer - short-term access/consultancy	Canadian Technology Network CIM Centers Switzerland
9. Support for long-term technology transfer (e.g. from local universities or technology institutes)	CIM Centers Switzerland Real services centers - e.g. CITER, Italy UK Teaching Company Scheme, DTI
10. Access to specialist equipment on occasional basis - e.g. specialist test services	Real services centers - e.g. CITER, Italy Fraunhofer Institutes - Germany
11. Facilitating experience-sharing, networking with best practice examples, and learning	Quality Support Network , Germany Ottawa-Carleton Manufacturers Network UK Industry Forum 'Masterclass'[32]
12. Assistance with training and development	Real Services Centers (e.g. CITER, Italy)
13. Major technical project/ contract research[33]	Fraunhofer Institutes - Germany Materials and Manufacturing Ontario UK Teaching Company Scheme, DTI

Source: Amended from Hoffman et al (1997).

[32] In this case a group of firms and business professionals focus on global manufacturing competitiveness and productivity. The forum provide events, a newsletter, job opportunities, and manufacturing-related activities for firms in the Ottawa-Carleton Region.

[33] This includes various research, training and industry-university programmes.

3. Build competence

5.7 Type A firms often fail to appreciate how the building of a 'distinctive competence' can improve a companies competitive performance. Many rely on cost-based, 'me too' strategies regardless of their potential value added contribution. Consultants sometimes provide support in re-defining market and competitive priorities, and help to bring a degree of strategic focus to Type A firms. Again these firms would benefit from basic counseling in strategies for technological improvement.

4. Technology strategy

5.8 Unaware firms are often dominated by a repeated pattern of 'crisis management'. They need to shift from short-term behavior to strategic and planned business development. Advice on how to formulate technology strategies and how to link this with wider business strategy can assist. Comparisons with the behavior of more strategic firms can also assist in formulating strategies with technology priorities. Examples of strategic processes include the 'Competitive manufacturing' and 'Making IT Pay', programs in the UK.

5. Assess and select

5.9 To assess and select the appropriate technology, involves comparing the available options professionally. Type A firms often lack the capability to make a critical assessment of available options and may well have a poor record in selecting appropriately. They may 'follow fashion' or invest in ineffective systems because they lack a shared and well-understood rationale for adopting a particular solution. In these cases, the scope of exploration is often limited. For example, in manufacturing the preference may be for purchase of new machinery without considering how to make better effective use of existing equipment or alternative plant layout. Similarly, the firm may invest in new information technology systems without first considering precisely what management information is required to compete effectively.

5.10 'Technology signposting' can help select a technology but only when the problem or opportunity is clearly articulated. Demonstration projects (e.g. the 'Inside UK Enterprise' scheme) are used in several European countries to allow companies to explore technology with successful users, rather than simply try and evaluate concepts or sales proposals. Assistance with feasibility studies and evaluations can also assist. For example, the German Manufacturing Technologies Support Program offers firms public funding support, on the condition that they develop (with a designated consultant) a feasibility study and detailed implementation plan.

6. Acquisition

5.11 Acquisition of technology can occur through mechanisms such as direct purchase, licensing, in-house development, learning under a contractor arrangement (e.g. OEM) or a joint venture, or a mix of these. However firms in category A often lack finance, skills and other key resources needed for technology acquisition. They may also lack

assessment capabilities and are probably disadvantaged by a lack of skilled human resources. Type A companies tend to be weak at negotiating the terms of a technology transfer deal and license clauses, and they may see the objective as primarily a purchasing task rather than a central issue of how to absorb and make effective use of the technology in order to achieve the goals of the business.

5.12 Given sufficient resources and a will to improve, in some cases Type A firms can be upgraded with the support of funding for specific projects aimed at technology transfer (e.g. the financing of short-term access to expert consultancy services). However, further assistance may well be required to ensure the firm engages actively in the transfer process and allies the process with the strategic goals of the firm.

7. Implementation

5.13 Implementation of the technology within the firm often requires extensive project planning and management skills, involving both the configuration of the technology and changes to the organization to ensure maximum benefits. However, Type A firms lack basic project planning and management skills. Under these conditions, firms often run into delays, costs escalate, and projects fail to meet original targets. In addition, during implementation unexpected problems often 'emerge' requiring further specialized (e.g. testing) equipment or skills. Without these implementation capabilities expensive projects can be abandoned during the implementation phase.

5.14 If there are particular weaknesses in this area, the firm may benefit from support in project planning and management as well as training and skills development. One example of support for long-term technology transfer and implementation capability is the UK Teaching Company Scheme of the DTI, which provides part of the funds for an employee to study at a center of expertise at a university, usually in the field of engineering or science. Also, specialist equipment can be made available, along with consultancy expertise, on an occasional subsidized basis (e.g. specialist testing services) as occurs in the Hong Kong Productivity Council (HKPC) in Hong Kong.

8. Learning

5.15 Learning is the central process by which internal capabilities are developed in order to sustain technological development in the longer-term. However, Type A firms tend to be crisis driven and constantly engaged in 'fire-fighting'. Under these conditions there is little scope for learning either by managers or technical staff. Type A firms tend to repeat mistakes and fail to gain the productivity advantages of systematic learning in, for example, engineering or production.

5.16 Type A firms may benefit from assistance in developing a 'continuous improvement' learning capability, aided by measurement frameworks, interchanges with other more successful firms, training and advice. Learning depends upon reflection, review and planning within a strategic framework, and managers can be trained to introduce these skills into a company. Experience-sharing and learning are provided, for example, by the UK Industry Forum 'Masterclass'.

9. Linkages

5.17 Firms in the Type A category tend to be inward-looking and have limited access to players in the wider environment. Many lack the resources to make the necessary connections with the technological infrastructure and a demand-led process of improvement is unlikely to occur. Under these circumstances, the benefits of access to external resources (e.g. via networks or innovation consultants) need to be communicated clearly and simply, probably as 'bottom line' profit advantages. In order to develop demand, actors on the 'supply side' of the NSI may need to be pro-active and seek out Type A firms.

5.2 Type B firms: Problems and policy responses

5.18 Reactive firms also need to develop a framework or strategy for technological improvement to address key weaknesses and build on strengths. These firms may require outside support to search for technological solutions to problems, to explore new technologies and to acquire and implement new process and product capabilities. In the longer-term, reactive firms could be expected to develop an internal techno-managerial capability for upgrading and therefore require less and less support over time.

5.19 In manufacturing, these firms may already have progressed beyond assembly and have technician and engineering capabilities upon which to build. The next stage of development for this group of firms could well be to develop the capabilities to innovate with process technology.

1. Awareness

5.20 Type B firms are generally aware of the need to improve but are unclear how to proceed, cannot identify priorities and probably confuse urgent with non-urgent problems. These firms need strategic support to develop a framework (e.g. for manufacturing improvement) and assistance in following this through. Such assistance might include outreach services where trained consultants help firms recognize their difficulties and identify priority needs for change. Benchmarking techniques may also enable the targeting of manufacturing improvements (e.g. IRAP or TEKES) as in the case of Type A firms.

2. Search

5.21 Effective technology searching requires proper exploration of the range of technological solutions available and the ability to select among options. There may be competing machines, technologies, suppliers and so on. Type B Firms are aware of the need to address technology challenges but often search within familiar territory and suppliers. These firms need support in expanding the range of technology options and in ensuring there is a good strategic 'fit' between planned changes and the core objectives of the business.

5.22 Another challenge facing Type B firms is how to build up a network of technology supply sources. Because awareness of what is available is often rudimentary, they need to access additional sources of technological knowledge and support. 'Technology signposting' can provide access to technology where problems are clearly articulated. Agents and consultants offer various technology brokerage arrangements, in order to target enquiries (e.g. the TEKES Networks Program in Finland). These programmes provide access to networks to help firms extend their range of search options.

3. Build competence

5.23 Type B firms usually understand that their particular activities need to be focused around some form of distinctive competence. However, they may lack the guidance needed or framework for planning a series of next steps. There is perhaps a need to understand 'order winning' *vs* 'order qualifying' criteria, and how to move towards a more defensible competitive position using technology (e.g. by moving from a low cost supplier strategy to a more flexible or higher quality supplier).

5.24 Type B firms require support in identifying which competencies are needed, and in building these up in order to improve market success. Government and private sector consultants can provide strategic development support to enable firms to create a systematic framework within which improvement paths can be located in relation to business goals (e.g. the UK programs on 'Competitive manufacturing' and 'Making IT pay').

4. Technology strategy

5.25 Firms in category B recognize that technology strategy can be central to competitiveness, but they need a framework to gauge their existing position to plan an improvement program, including key priorities. Benchmarking and other measurement/comparison tools can enable progress and provide useful measurements for management. An example of the provision of these strategic development services is the UK's 'Competitive Manufacturing' initiative, which promotes the adoption of best practices in product development.

5. Assess and select

5.26 Firms in category B usually understand the need for a specific type of solution but do not appreciate the alternative routes available. They may be locked into patterns of behavior driven by prior experience rather than strategic planning and there is a risk that sub-optimal solutions are adopted because of an absence of selection skills. 'Technology signposting' can help where problems are clearly articulated, as can access to demonstration projects. For example, the 'Inside UK Enterprise' scheme, which has been replicated in several European countries, provides a wide range of opportunities for firms to explore technology solutions with successful users, rather than to try and evaluate concepts or sales proposals in isolation. Assistance with feasibility studies and evaluation can also be provided (e.g. the German Manufacturing Technologies Support

Program offered firms public funding support for developing, with an expert consultant, a detailed feasibility study and implementation plan).

6. Acquisition

5.27 Type B firms are often disadvantaged by a lack of skills and experience in acquiring technology in the form of knowledge, physical systems, skilled people, and/or software and IT. They are often weak at negotiating with suppliers or potential partners because of their lack of experience. As a result, they find it difficult to absorb and make effective use of the technology being acquired. Under these conditions government may wish to provide partial assistance with finding and funding relevant technology and, at the same time, ensure expert involvement in the transfer process either through demonstration programs or access to experienced consultants. Several schemes and programs which offer this kind of assistance are highlighted in Figure 5.1.

7. Implementation

5.28 The task of implementing technology often requires adaptation of both the technology in question (e.g. a business information system) and the organization to ensure a 'workable fit'. Type B firms frequently lack the basic organizational and managerial skills needed for effective project planning and management. As with Type A companies, there is a high risk of both cost overruns and a failure to meet business objectives. During the implementation process, firms may need to quickly resolve new difficulties and may need to access further specialized equipment and skilled people. Various options for support are available, including funding for long-term technology transfer or capability building (e.g. the Teaching Company Scheme in the UK), support in project planning and management, and assistance with training internal staff.

8. Learning

5.29 Much can be gained by systematic learning during technology acquisition, both in terms of productivity gains and in developing the internal capabilities needed to sustain further improvements in the future. Although firms in category B tend to be reacting to crisis and other circumstances, they have some experience upon which to build. However, they need to develop a long term plan to go beyond the 'fire-fighting' mode of operation. To do this they need to create space for learning activities in both management and technological spheres.

5.30 Long-term support in reviewing and in developing continuous learning capabilities can be made available, for example, through the use of measurement frameworks, facilitating interchanges with other firms, and *via* methods for reflection, analysis, training and human resource development. To ensure learning is sustained in the long term, Type B firms need to carry out learning within a strategic development framework. Programs which support learning include those provided by the HKPC in Hong Kong and IRAP in Canada.

9. Linkages

5.31 Typically, firms in this category, as with Type A firms, tend to be inward-looking, having limited awareness of policy organizations, consultancy firms, universities or other players in technology system. Whilst there is a recognition of the need for change, Type B firms lack strong connection to the NSI and beyond. The need here is for network-building to establish new connections. Facilitated access to resources *via* networks or innovation consultants acting as intermediaries, can often assist.

5. 2 KOREA'S POLICY SUPPORT SYSTEM

5.2.1 The Range of Policies

5.32 As the environment and capabilities of industry's technology development activity change, Korea's technology policies have also changed. Until the early 1980s when R&D investment from private enterprises was negligible, government policies put most emphasis on inducing private R&D investment by establishing incentive measures such as tax exemption and financial subsidy for private enterprises' technological activities. When, afterwards, R&D investment from private sector increased and exceeded that from public sector, and private sector's technological capabilities grew, government policy changed to strengthen such infra-structural measures as training technical personnel, linking industry to academia and government-funded research institutes (GRIs), and enhancing technology transfer.

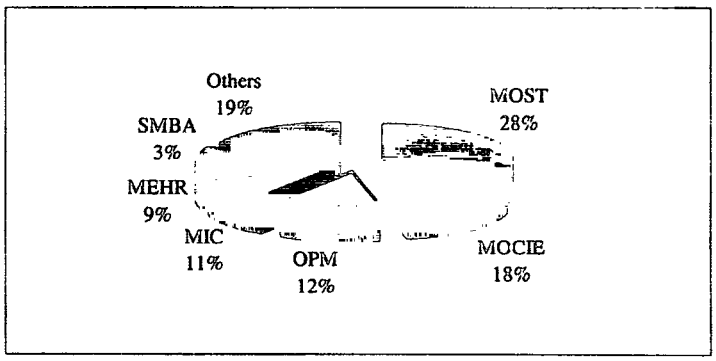
5.33 The underlying principle for infra-structural technology policy is to promote private enterprises' autonomous technology development activities by the government with necessary supportive measures. Currently, Korea's industrial technology policy is changing to enhance the effectiveness of policy measures with a special focus on nurturing venture business or new-technology-based firms (NTBF). The list of recent policies includes the following. 1) Assisting venture business; 2) refining tax incentive schemes; 3) solving SME-specific problems, particularly focusing on inducing more SME into technology development; 4) refining technical personnel training program; and 5) releasing regulatory measures in foreign direct investment in a way to activate R&D and technology transfer.

5.34 Government's technology policy can be reviewed from two perspectives: 'direct' technology development programs, or National Research and Development Programs (NRDP), and 'supportive' measures to induce more innovative activities from national innovation actors such as private enterprises, universities and GRIs.

5.35 NRDP is structured in a decentralized manner: ministries have their own programs needed for, or related to, ministry-specific missions. The National Science and Technology Council (NSTC), chaired by the President and composed of all ministers that have technology development programs, is the highest governmental body that evaluates and coordinates various NRDP at the program level. As of 2000, the Ministry of Science and Technology (MOST) took the largest share of NRDP, 28%. This was followed by Ministry of Commerce, Industry and Energy (MOCIE), 18%; Office of Prime Ministry

(OPM), 12%; Ministry of Information and Communications (MIC), 11%; Ministry of Education and Human Resources (MEHR), 9 %; and Small and Medium Business Administration (SMBA), 3%. OPM's budget mostly flew directly into R&D programs of GRI.

Figure 5.1: The Share of NRDP by Ministries, 2000



Source: data from NSTC (2001).

5.36 While NRDP are directly targeted for scientific research and technological development, supportive measures try to create conditions conducive to enhance innovative performances of various innovation actors; and most of these measures presume private enterprises as the main focal points. Such measures can be broadly grouped into 6 categories. 1) Tax incentives; 2) financial support; 3) information provision; 3) technical personnel training; 4) cooperative R&D promotion; 4) specific measures targeting SME; and 6) others such as procurement assistance, standardization, merit awards for excellent technology, and the promotion of industrial research laboratories. Below are brief descriptions on some of these measures. The list of reviewed measures is selective and , as mentioned in the introduction, the effectiveness of these measures is an important subject for further study.

5.2.2. Specific Measures for Strengthening Firms' Technological Capabilities

SBC's Technical Information Provision Service (TIPS)

5.37 SBC publishes two monthly periodicals: *Gi-up-na-ra*, or 'business country', and *TECH TIMES*. The former covers broad management issues common to SMEs, and the latter focuses on industrial technological issues such as technology trends, introducing new products and success cases in innovation. In addition to these periodicals, SBC publishes occasional reports relating to SME management and technology. Some examples on technology reports are the following: *Manual for CNC Program, Introduction to cost-effective production system, Preventing failure in factory automation*, and so on. Subscription of the magazines is effective through annual fees, and the number of subscription is about 12,000.

Technology Foresight (TF)

5.38 Korea has exercised Technology Foresight two times: the first one was completed in 1994, and the second result was published in 1999 as *Korea's Future Technologies: The Second Technology Foresight, 2000 ~ 2025*. The second exercise was based on Delphi survey on the future development prospective in the 15 science and technology areas, where about 1,800 Korean scientists and engineers participated. Technology Foresight exercises in general try to envision the long-term development paths of various scientific and technological fields; but, in addition, Korean exercise puts a specific emphasis on articulating the gap between advanced countries and Korea. This has helped establish national strategies to catch up with forerunners. The results of technology foresight are used as a guiding-post both for policy makers and business strategists. In particular, private companies are invited to establish their own technology strategies in line with government's long-term policy goals.

Technical Information Provision Service (TIPS) by KISTI

5.39 Korea Institute of Science and Technology Information (KISTI), a key institution of national knowledge information infrastructure, was established in January 2001 by merging KINITI (Korea Institute of Industry and Technology Information) and KORDIC (Korea Research and Development Information Center). KREONET (Korea Research Environment Open Network), with its 15 regional network centers, is one of the nation's core computer networks, and it provides information infrastructure to researchers who are working for about 300 GRIs, universities and industrial R&D centers. The list of KISTI's services provided to private company users includes industrial and technology information analysis, technology transfer and evaluation and intellectual property analysis. KISTI these years tries to use more information technologies in their consulting activities. For an example, KISTI established an on-line consulting portal system for technology and management.

Techno-Net http://techno.smba.go.kr

5.40 Techno-Net is a comprehensive on-line information source for Korean SMEs. Using Techno-Net, run by Small and Medium Business Administration (SMBA), Korean SMEs are offered basic information on technology-related issues such as where to find the needed technologies, how technologies to be transferred from public research organizations and where to find assistance for technological development. In addition to all the available information on SMBA's program for assisting SME's technological efforts, Techno-Net also provide useful information on the sources of technology development fund, human resources, and tax assistance offered by other government ministries and agencies.

TBI

5.41 Korea's Technology Business Incubator (TBI) program aims to nurture new-technology-based start-up companies. TBI program focuses on pre and initial stages of

commercialization of new technologies. Government, with the funds for facilities and equipment, designated about 40 universities and GRIs as TBI Centers. The TBI fund is financed jointly with central government, local governments and hosting universities or GRIs. TBI Centers are roughly evenly distributed across regions. Most of users of TBI programs are those who have new ideas or technologies flowing from research activities at universities or government-funded research institutes. Therefore, 'residents' at TBI Centers need practical guidance on how to commercialize. TBI Centers provide offices and facilities, and consult on technical and business matters. TBI centers test these ideas or technologies into the initial stage of commercialization. If they pass the test, TBI centers help to attract investment fund for commercialization. For those who successfully graduate from the incubation stage, TBI Centers can then help to start the business.

Special Researcher Program (SRP) & In-Company Technical College (ICTC) program

5.42 Among various Training and Providing Research Personnel (TPRP) programs in Korea, two are directly related to the needs of firms. Special Researcher Program (SRP) aims to supply researchers to private companies and research institutes. Private companies that employ at least five (two for SMEs) researchers with a masters degree in science and engineering qualify for using this program. With the approval of the Military Manpower Administration, young scientists and engineers with a masters degree or above are hired as special researchers and they are exempt from three-year army service for five-year employment. Special researchers are treated as the same as other employees. SRP is very useful, particularly for SMEs, for securing capable researchers.

5.43 In-Company Technical College (ICTC) program aims to link the specific needs of firms to the formal education system. Some companies feel the necessity to upgrade the technical capabilities of their workers and engage in the retraining of workers.. The main tool for assisting ICTC is to allow tax-exemption on retraining costs. Five percent (15% for SMES) of income and corporate taxes are exempted, and 90% of custom tax are exempted for educational equipment imports. The workers who graduate from ICTC are awarded BA or MA degrees which are accredited as normal university degrees.

UNITEF (University Industrial Technology Force) http://plaza.snu.ac.kr/~unitef

5.44 UNITEF is an association composed of about 1,800 professors from 105 engineering colleges. Established in 1996, UNITEF aims to link professors to SME technology development activities. UNITEF receives SME requests on bottleneck technologies and arranges a research team led by the university professor. UNITEF's technical fields are divided into ICT, machinery, chemical, medical engineering and industrial engineering. UNITEF conducts contract research for commercialization and is remunerated only after successful implementation and commercialization. UNITEF's research is targeted at problem-solving and in-site technical assistance for SMEs. Regarding coverage, UNTEF has 7 regional branches and 105 university offices across the nation. Although UNITEF's activities are centered around technological assistance; it

also helps its members to raise funds for commercialization and assists its member professors and enterprises to manage intellectual property rights.

KITECH (Korea Institute of Industrial Technology) www.kitech.re.kr

5.45 KITECH was established in 1989 with a specific mission of supporting SME's technological needs. Many of KITECH's laboratories are open for SMEs as 'Rental Labs', where SMEs can use R&D facilities and equipment for a small fee. Among the other activities of KITECH, the following are worth noting. The Production Technology Research Program (PTRP) focuses on developing capital goods related technologies. For those SMEs with no capacity for R&D investment, the costs for joining PTRP are waived. In other cases, 50% of total costs of R&D is subsidized. The Technology Realtor Program is a technology business incubator for start-up companies. Also, the Technology Helper Program dispatches KITECH engineers to resolve on-site problems faced by SMEs.

Small Business Corporation (SBC) www.sbc.or.kr

5.46 The Small Business Corporation (SBC) was established in 1979, based on Small and Medium Enterprises Promotion Act. As a non-profit government agency, SBC's mission is to foster small and medium-sized businesses by providing support in such areas as financial assistance, technical consulting, training and international industrial cooperation. SBC analyses the management and technology problems faced by SMEs, and can dispatch domestic or foreign consultants to companies. SBC's consulting services cover the following areas: 1) managerial consulting; 2) technical consulting in assembly technology, automation design, information system diagnosis, product design, and other R&D matters; 3) certification consulting in equipment requirements, factory refurbishing/retooling and ISO certification. The New Product Development Assistance Program provides special assistance for the development of new and high value-added products. The program offers various services ranging from the design of products to the setting up of development systems for new products.

5.47 Within the SBC, the Small & Medium Industry Technology Transfer Center (SMITTC) supports technology transactions between technology suppliers (mainly research institutes, companies, universities and personal inventors) and 'demanders' of technology (mainly SMEs, entrepreneurs and venture capitalists).

5.48 BC founded the Small Business Training Institute (SBTI) in 1982 to help SMEs cope with world's rapidly changing industrial environment and to train managerial and technical workers to achieve higher productivity and international competitiveness. Specialist Training Program is 2-year specialist cultivation course for enhance technological skills. The program aims to assure a stable supply of technically trained workforce for SMEs. The program emphasizes the practical applicability of theory in realistic settings. In addition, there are various kind of short-term training programs for the needs of SME in technology, quality and administrative management.

5.49 Also within the SBC, the Small and Medium Industry Certification Center provides guidance to firms seeking international quality assurance standards (ISO 9000). SBC evaluates companies that have developed quality assurance systems using ISO guidelines. After an internationally accepted quality assurance certificate is issued, periodic reevaluation is carried out every 6 months.

5.50 Finally, the Korea Technology Transfer Center (KTTC) and Technomart also function within SBC www.kttc.or.kr. Based on the *Technology Transfer Promotion Act*, KTTC was established in March 2000 with joint contributions from government, financial institutions and venture business organizations. As a public organization, KTTC aims to facilitate the industrial and commercial use of technology by playing a leading role in technology transfer, brokering and assessment. SBC is also providing similar services to SMEs by arranging and brokering technology transfer. *Technomart,* annually organized by SBC, functions as a market where prospective technologies are to be displayed and transacted.

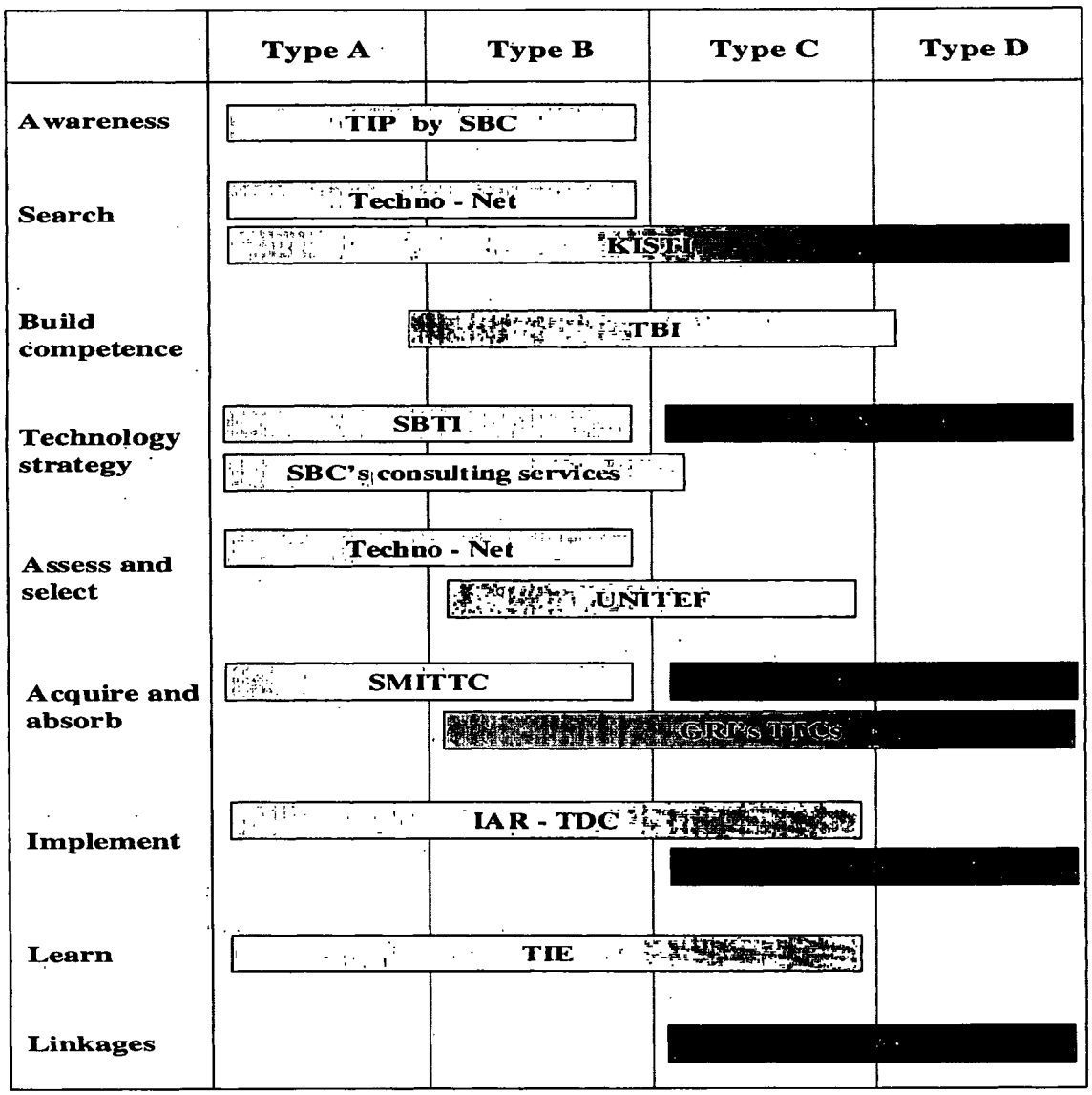
Industry-Academia-Research Institute Technology Development Consortium (IAR-TDC)

5.51 SMBA's IAR-TDC program allows SMEs utilize R&D facilities and human resources at universities or public research institutes and, thereby, resolve on-site technical problems. The program also promotes cooperative research networks among innovation actors. The budget is shared by central government (50%), local governments (25%), and participating companies (25%). A consortium is usually initiated by universities or research institutes; but it is required to include at least 7 SMEs . The consortium is managed autonomously according to contracts among the partners, but participating companies are entitled to have exclusive right to use consortia R&D results for five years. The number of consortia and participating companies are rapidly growing. When the program started in 1993 the numbers of consortia and participating companies were 19 and 328, respectively; in 2000, the figures were up to 146 and 1,870. The number of patent registered by the consortia is also rapidly growing: from 23 in 1993 to 654 in 2000.

Industrial Technology Research Association (ITRA)

5.52 ITRA is a non-profit organization for cooperative industrial technology development. An ITRA can be organized with an initiation of at least three qualified private companies. When accredited by the government, ITRA member companies can apply for tax-exemption, financial assistance and favorable procurement treatment for their R&D activities. At the end of 2000, there were 62 ITRAs, with on average 26 companies per ITRA as members. The main activities of ITRA are to participate in the government's National R&D Programs (NRDP) and to carry out independent R&D projects suggested by member companies. ITRA also assists member companies in various technology-related management issues such as commercialization of R&D results, technical guidance and training, and the pooling of R&D equipment and facilities for common use. For some member companies, ITRA is also an important forum for information exchange and learning.

Figure 5.2: Policies and Programs



Inter-Business Exchange (IBE) Program

5.53 IBE programs aim at developing new products by fusing different technologies and/or know-how of different businesses, but the activities of IBE groups are mostly centered at sharing business information. Drawing from Japan's experience, the Korean government in 1990 initiated IBE as one of key policy tools for nurturing SME. As IBE became active among SMEs , members opted for establishing an independent organization, the Korean Federation of Inter-Business Groups, in 1995. As of 2001, there were twelve regional IBE Associations, composed of 417 groups with 6,455 members who pay membership fees. Most of IBE members are from SMEs, but some of them are professors and professionals such as lawyers and tax accountants. IBE groups mostly

function as a forum for mutual learning and information sharing, but some groups share managerial resources and develop new products. The Annual Plaza for Technological Exchange is IBEs biggest event. The Korea Federation of IBE groups maintains sister relationships with counterparts in Japan, Taiwan and Singapore. International IBE Symposium is one of cooperative activities jointly organized by the four institutions.

5.2.3 The Scope and Effectiveness of Current Policies

5.54 It is quite clear even from the above, selected examples of policies and programs, that Korea already has in place an extensive range of technology support mechanisms. Figure 5.2 maps existing policy institutions and programs against the framework developed in Chapter 2. As the figure shows, most of the nine technology areas are covered, and most types of firms, in one way or another.

5.55 However, what is less clear from the above examples and existing policy studies, is the *effectiveness* of current policies and programs. It is not yet possible to say whether the programs target priority areas or whether or not they are successful in achieving their firm upgrading goals. Nor is it possible to impute 'strategic coherence' to the range of policies. Indeed, it could be that they have emerged historically in response to different issues, rather than having an overall 'strategic architecture' or design by which Korean industry is supposed to progress to higher stages of development. It is not clear, for example, whether there is unnecessary overlap or duplication of programs. Also important are questions concerning value for money and efficiency, not covered in this document. Above all, it is desirable to know whether the current polices are 'demand-driven' (i.e. capable of meeting the real needs of industry in an efficient way), rather than 'supply push' (ie. policies initiated, for example by ministries, in response to perceived needs and which may or may not be capable of fulfilling real industrial demands.

5.56 Therefore, it would be very useful (a) to examine the effectiveness of current policies and (b) to use the capability audit tool presented in Chapter 2 to analyze the real demands of SMEs and other lagging sectors of industry in order to match these demands against the current policy structure. With this micro level data on technology demands, it should then be possible to develop new policy initiatives for upgrading SMEs and other Type A and B firms in Korea.

6. POLICES FOR UPGRADING TYPE C FIRMS

6.1 INNOVATION CHALLENGES FACING TYPE C FIRMS

6.1 Within the Type C band various categories of firms at significantly different levels of technological competence were identified during the audit (Hobday et al, 2001). The categories included large electronics and automobile exporters, small capital goods and machinery suppliers, food processing companies, and chemical and pharmaceutical producers.

6.2 Regarding innovation problems, the small capital goods and machinery producers (in the lower band of group 'C') generally supplied large manufacturers within Korea. In the past these firms had successfully copied and improved on imported products. Their next stage was to create new, more technology-intensive products and systems and thereby move towards the upper levels of Type C and eventually on to Type D by creating radical new products. These firms needed stronger R&D facilities, as well as substantially improved financial and human resources. These firms found universities and Korean Government funded institutes (GFIs) largely disconnected from their needs, although some did have joint projects with GFIs and universities.

6.3 By contrast, the large electronics and automobile companies were generally in the upper band of Type C 'strategic', incorporating large R&D facilities and having mastered incremental new product development. They too needed to move to more original and radical product design in order to become world leaders in hardware production. For this, they needed to secure improved access to capital goods supplies and technology within Korea. Most had reached the stage where they were sourcing capital goods globally from some of the most advanced suppliers worldwide with whom they worked closely on new generations of capital equipment.

6.4 In order to move beyond Type C 'doing things better' to Type D 'doing new things' these firms needed to overcome the legacy of the past, especially the highly successful catch up formulas in the mass production of hardware. In moving on to create new markets, their core mass production competencies had become core 'rigidities'. Other detailed research also shows that, when confronting new uncertain markets where flexibility, experimentation with users and creative technology collaborations are

required, the *chaebol* performed poorly because their distinctive skills and structures were based on the needs of high volume hardware production (Hwang, 1998)[34].

6.5 Other Type C firms, such as food producers and pharmaceutical processors also needed to interact more with leading foreign technology partners and suppliers in the US, Europe and Japan to move up the Type C band and to have any prospect of attaining Type D status. Type C firms also needed to learn new marketing skills in order to capture post-production value added associated with marketing, distribution and brand development.

6.6 Type C firms which hoped to become more creative, confronted several difficulties within Korea:

- first, the shortage of world class engineering, scientific and managerial staff. In fact, one of the two creative Korean firms mentioned above had suffered a transfer of engineers from the company to the academic sector as individuals sought a less pressurized working environment and the prestige of being a professor at a top Korean university.

- second, a key feature of many Type D firms is the lack of hierarchy which favors organizational flexibility and the rapid implementation of creative ideas for new product markets and technologies. However, within Korea many firms operate within traditional hierarchical structures based on seniority, age and qualifications, rather than innovative capability. These ways of working often stifle creativity. This problem, to some extent, reflects Korean culture and history. There are relatively few industrial leaders and manager with experience in fast moving, agile companies. This contextual and resource problem faces both existing Type D firms and Type C firms hoping to become more creative in products, technologies, markets and organization.

- third, the historically successful strategies of Type C firms, based on incremental improvements to large scale manufacturing operations ('doing things better'), runs counter the needs of Type D firms ('doing new things') based on experimentation, and creative combinations of different technologies within and across firms and sectors (Hamel, 1999)[35]. Under these conditions, it is very hard for Korean firms to replicate or even compete with, for example, the innovative experimentation which occurs naturally in Silicon Valley, or the creative outsourcing of new product development and R&D as practiced by Cisco Systems or Dell (examples of US category D firms) (Hamel, 2000)[36]. Korean companies are limited in their exploitation of virtual R&D networks, (Gassman and Zedwitz 1999). They also find it difficult to move 'downstream' into high value added services from hardware and

[34] Hwang, H. R. (1998): Organizational Capabilities and Organizational Rigidities of Korean chaebol: Case studies of Semiconductor (DRAM) and Personal Computer (PC) Products, unpublished D.Phil thesis, SPRU, University of Sussex, England.
[35] Hamel, G. (1999): 'Bringing Silicon Valley Inside', Harvard Business Review, Sept. to Oct., pp71-84.
[36] Hamel, G. (2000): Leading the Revolution, Harvard Business School Press, Boston, Mass.

systems, as carried out by IBM and other US and European leaders (Wise and Baumgartner, 1999)[37].

- fourth, the university-industry links, often important for the creation of radical new products and industries (e.g. information technology and bio-technology) are particularly weak in Korea due to a catch up model based on the importation and improvement of foreign technology and the traditional values of Korean universities which, in the past, worked against involvement in industry and technology.

6.2: POLICY CAVEATS IN THE KOREAN CONTEXT

6.7 At the present time, most policy instruments and objectives in Korea are not conducive to the emergence and promotion of Type D firms. The latter require a great deal of operational freedom.

6.8 By contrast, one of the key aims of policy is to curb the freedom (and perceived excesses) of major privately-owned companies, especially the *chaebol*, which have sometimes been accused of lacking in good standards of corporate governance, profiting from monopoly and cross-subsidizing weaker operations from more profitable ones. Under these circumstances, a central and proper aim of policy, especially since the crisis of 1997, has been to ensure greater corporate transparency and, in particular, the reduction in the heavy debt of the *chaebol*. This, in turn, requires greater transparency between financial institutions and the *chaebol*. Understandably, this has been the focus on much recent competition policy and financial regulation (World Bank, 2000).

6.9 By contrast, Type D firms require a policy environment where they are free to experiment within a highly de-regulated policy context, where regulation is either self-imposed or imposed 'lightly' by regulatory bodies. Only in exceptional cases of alleged abuse of competitive position or standards (e.g. the current Microsoft anti-trust law suit, or the US Department of Justice anti-trust suit IBM of 1969 against IBM, which was eventually withdrawn in 1982), does government become involved in scrutinizing the operations or strategy of firms. In Korea, however, government is heavily involved in ensuring competition, improving standards of corporate governance, and preventing the abuse of monopoly power in the domestic market, rather than allowing more freedom to firms within the economy.

6.3: THE PROBLEMS POLICIES NEED TO ADDRESS

6.10 The technology audit showed that most leading Korean firms were not yet capable of contributing to the world technology frontier through basic research or the generation of new high value products. It also identified several major challenges confronting Korean firms wishing to move from the Type C 'strategic' to the Type D 'creative', knowledge-intensive category. Key problems included:

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[37] Wise, R. and Baumgartner, P. (1999): 'Go Downstream: the New Profit Imperative in Manufacturing, Harvard Business Review, September-October, pp133-141

1. the risks and costs of faster moves towards product creation;
2. the impact of the financial crisis, causing a retreat from basic to near-term applied research;
3. a shortage of world class engineering, scientific and managerial talent;
4. the need to develop more flexible organizational structures and become less hierarchical;
5. weaknesses in the supply and integration of capital goods within Korea.

The audit also demonstrated new opportunities, including:
1. crisis-induced, successful technological partnering between Korean and foreign firms;
2. organizational restructuring leading to improved service capabilities (e.g. in digital telecom);
3. a rapid growth in high technology SMEs in Korea.

6.11 Furthermore, the audit revealed at least two significant problems with current public sector support for Type C firms. First, although major firms collaborated extensively with universities and government-funded research institutes, most felt that publicly-funded research was overly disconnected from the needs of industry. Some argued that the policy emphasis on basic research in universities was misplaced, being poorly defined and not justified by local needs. There was a similar sense of 'disconnection' with government-funded research laboratories.

6.12 Second, most firms in the sample believed that government technology policies were formed without sufficient consultation and input from major industrial actors.[38] Not surprisingly, when asked, firms argued that government should provide more direct support for their activities by aligning public sector research investments more closely with their needs and, in effect, 'back up' corporate R&D. Suggestions included subsidized, shared research infrastructure, sponsored research consortia and an improved supply of human resources (see below for details). Firms also pointed to S&T policies in OECD countries, asking for similar types of support as received in the US (e.g. Sematech in semiconductors) and Europe (e.g. research consortia such as ESPRIT) and Japan (e.g. subsidized major collaborative research programs).

6.4: Five Policy Suggestions

6.13 Even if policies were successful in achieving the corporate reform objectives described in Section 6.2, Korea's leading firms would still confront the cultural and historical problems described, as well as the short supply of world class scientists and engineers, and the difficulties of creatively combining deep competencies across organizational and technological boundaries.

6.14 As and when the Korean Government becomes less concerned with corporate governance, at least four policy measures for promoting creativity suggest themselves, based on the experience of OECD countries.

[38] This is surprising given the various consultative exercises conducted (e.g. by MOCIE).

Policy Recommendation 1 - large firm research consortia

6.15 Potentially, subsidized large firm research consortia could address: (a) the need for more experimental and basic research; (b) some of the risk and high cost of faster moves to upstream R&D activities; and (c) the need to increase the supply of world class R&D talent.

6.16 During interviews, several Korean firms expressed interest in government support for setting up advanced research consortia (e.g. in the area of nano-technology) with shared technical facilities. Such consortia have been widely promoted by governments in Europe (e.g. ESPIRIT, JESSI and Eureka), in the U.S. (Sematech) and in Japan in earlier phases of development (e.g. the VLSI program for DRAMs, and the ICOT 5th Generation Computing Program). These programs seek to combine the capabilities of member corporations to develop future technologies. In the case of Korea, the government may wish to design programs which include leading foreign corporations, given that many Korean firms could learn from the most advanced foreign companies. Foreign firms could be attracted by the local market or the advanced process technologies of the *Chaebol.*

6.17 Government, however, would need to be convinced that the potential benefits (or 'positive externalities') likely to emerge from such consortia could justify any financial subsidies. The government would also need to be satisfied that: (a) it had the competence to monitor and evaluate such programs; (b) potential problems of abuse could be prevented or penalized; (c) any consortia did not undermine policies to promote more transparency and competition. Furthermore, Korean policy makers might also wish to look critically at the benefits *vs* the costs of consortia type programs in other countries, as these initiatives have not always led to unqualified improvements to innovative or competitive performance (Hobday, 1997)[39].

Policy Recommendation 2 - promoting inbound FDI

6.18 As the audit showed, foreign direct investment (FDI) can provide considerable partnering benefits and a 'pacing horse' (i.e. demonstrator) effect for local competitors. Foreign TNCs can inject new resources and capabilities into the technological infrastructure and potentially play a more important role in stimulating innovation in Korea, as it has done in many other countries. By deliberately targeting certain kinds of FDI, local Type C firms could be encouraged to climb the innovation 'staircase' described earlier. For example, in the R&D consortia suggested above, the government may wish to involve specific foreign participants with strong, complementary capabilities. This kind of policy has worked well in Singapore. By contrast, several early European programmes which excluded FDI could well have benefited from non-European foreign collaborations (Hobday, 1997).

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[39] Hobday, M. (1997): 'The Technological Competence of European Semiconductor Producers', International Journal of Technology Management, Volume 14, Numbers 2/3/4, 1997, pp401-414

6.19 In Singapore, Scotland and Ireland, governments have encouraged TNC subsidiaries to go beyond current production and set up advanced process and product research. Foreign firms in some countries (e.g. Singapore) have also begun to set up R&D facilities naturally as a consequence of their upgrading over the years and their appreciation of the high quality of the infrastructure (Wong, 1995)[40].

6.20 Unfortunately, until very recently Korea has been viewed as 'closed to FDI' and this perception has been confirmed by the very low levels of FDI until 1998 (Woo and Sul, 2000; Choi and Kang, 2000). A process of FDI-driven technology upgrading may therefore take several years to take root and a concerted effort to overcome the perceptions of foreign governments and businesses would be needed. Active government promotion of FDI, along the lines of other countries (e.g. Scottish Enterprise) could perhaps overcome initial hesitancies in developing Korean-based partnerships between foreign investors and Korean firms.

Policy Recommendation 3 - promoting overseas S&T networks

6.21 Problems identified during the audit included a disconnection between the needs of firms and the public sector S&T system and an insufficient supply of world class talent. As well as reforming current public sector research activities (as described in World Bank, 2000), the government may also wish to consider a new type of policy designed to promote overseas technology networks for Type C firms. In order to overcome limitations of domestic universities, the government could encourage the *Chaebol* to invest more intensively in foreign universities and other overseas public sector S&T groups. Through its embassies overseas, the government has contacts with and knowledge of key S&T resources and might be able to facilitate access to these, helping Korean firms move further away from the current centralized R&D model, towards a more collaborative internationally networked approach, more typical of large Type D firms. This new class of policy to support outward bound foreign technology investments could complement the inward bound foreign technology investments into Korea.

Policy Recommendation 4 - improving the supply of foreign capital goods

6.22 To compensate for weaknesses in domestic capital goods, the government may wish to encourage more FDI within the capital goods sector to meet the needs of the large exporting *chaebol*. An increased local presence of leading capital goods suppliers would assist Type C firms to raise the level of their joint work with foreign firms on the design of equipment needed for new product creation, and help local firms master the use of advanced capital goods. If successful, this would also lower the high import bill for capital equipment and services.

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[40] Wong, P.K., (1995): Technology Transfer and Development Inducement by Foreign MNCs: the Experience of Singapore, paper presented at the International Conference on Industrial Strategy for Global Competitiveness of Korean Firms, Seoul Korea, 10 January.

6.23 While foreign investment in capital goods already occurs to a limited extent (e.g. with the location of companies such as Bosch and Siemens), it might be accelerated by the targeting of capable foreign suppliers and the provision of the kinds of incentives to locate often found in other countries (e.g. the UK, Ireland, Malaysia and Singapore). For this policy to succeed, the image of the past ('closed to FDI') would need to be dispelled by the Korean Government in collaboration with business leaders. Such policies would need to go beyond passive acceptance or toleration of FDI, towards a pro-active targeting of specific firms, supported by political groups, trade associations and regional governments, as occurs widely in the UK (e.g. *via* Scottish Enterprise and the DTI's Invest in Britain Bureau). Such strategic targeting would probably exceed the current mandate of organizations such as KISC (the Korean Investment Services Corporation) which was recently set up within KOTRA (Korean Trade Promotion Corporation).

Policy Recommendation 5 - support for clusters of local capital goods producers

6.24 Several weaknesses were identified among locally-owned capital goods' suppliers including the need to upgrade product development skills and the lack of support received from the public sector S&T base. These smaller Type C firms also complained of difficulties in accessing marketing and technological information. In response, the government might consider supporting networks or regional 'clusters' of machinery firms by part subsidizing technology networks, consultancy services and improvement 'clubs' of various kinds (as provided by the U.K. Department of Trade and Industry). Consultancy services could be provided by private companies, competent government research institutes and/or talented university groups. 'Benchmarking clubs' could be set up to assess various new product development processes, compare relevant new technologies, and evaluate alternative overseas marketing strategies. However, as stressed above, the government may first wish to undertake a critical assessment of current support mechanisms within Korea, and gain information on the effectiveness and value for money of overseas programs of this kind, prior to introducing any new policy.

PART B: THE ROLE OF NETWORK-ENABLED INFORMATION SERVICES

1. THE ROLE OF NETWORK-ENABLED INFORMATION SERVICES

OVERVIEW

1.1 Network-enabled services are electronic information services that can be provided remotely using the Internet and other communications networks. As a recent World Bank-OECD report on Korea notes—

1.2 The knowledge-based economy is highly dependent on a competitive services sector. The more inter-linked the provision of goods and services, the more technologically advanced the products and the greater the capacity to satisfy increasingly sophisticated consumer demand. Furthermore, as incomes rise, the demand for services tends to increase faster than the demand for goods. The production of services is less standardized and less capital-intensive (but typically not less knowledge-intensive) than the production of goods.[1]

1.3 Korea is already a global e-leader. Its high level of Internet penetration is a strong foundation in a global economy dependent on networked services. But other emerging economies, favored with lower labor costs and other advantages, are moving fast to capitalize on their comparative advantages. India and Ireland are often cited as the most successful examples of the use of network-enabled services to transform a nation's economy. By satisfying the needs of major global corporations to outsource call centers, back office operations, and medical transcription services, and by taking steps to develop vibrant software industries, these two countries have raised employment and boosted exports.

> *It is the core recommendation of this report that the e-Transformation of business in Korea should be led by two leading-edge network-enabled services: Market Information and Promoting Creativity.*

1.4 Other emerging economies are also developing strategies to deliver e-business services with the goal of stimulating their national economies. Hong Kong aims to be the Asian e-trading hub. Jordan and Egypt are striving to develop strong software industries. However, as noted in a recent report on emerging economies in the networked world, "emerging economies and their business partners that want to take advantage of the

[1] *Korea and the Knowledge-based Economy, Making the Transition*, World Bank and Organization for Economic Co-Operation and Development, 2000.

opening created by the economic slowdown must move with uncharacteristic speed toward a more open environment. Only a few will be successful in this attempt."[2]

1.5 Without action, Korea will squander its lead. Effective action has two characteristics. First, it must be fast—at Internet speed. Second, it must be focused, building specifically on Korea's strengths and eliminating principal obstacles. Results, not activity, must be the measure of success.

The Export Trap

1.6 Many emerging economy governments focus on identifying, developing, and promoting network-enabled services for export. India's aggressive stance in aligning with the global marketplace for network-enabled services is expected to give it an increasing portion of a $150 billion market by 2008.[3]

1.7 In actuality, network-enabled services can contribute to economic development in two ways: by increasing exports and by improving efficiency and equity in the domestic economy, particularly in core industries such as heavy manufacturing. The benefits of such internal, domestic use of network-enabled services are three-fold—

- The development of indigenous domestic capacity creates a cadre of skilled information society professionals, an essential complement to the physical and policy infrastructure.
- Service-generated increases in productivity can decrease the costs of production for all goods, including exported goods, thus contributing indirectly to export growth.
- Focused delivery of network-enabled services can provide direct benefits to poor and underserved populations, consistent with the World Bank's mission. It can increase these populations' ability to participate as producers and consumers in the digital economy.[4]

The general hypothesis of this study is that network-enabled services can benefit Korea both domestically and via increased exports, but that domestic benefits will yield greater advantage in the near term. Promoting domestic e-services should be the principal focus of the Korean government.

[2] *Ready? Net. Go! Partnerships Leading the Global Economy*, p23. The report can be viewed at http://www.mcconnellinternational.com/ereadiness/default.cfm.
[3] Study performed for the National Association of Software and Service Companies (NASSCOM) in India.
[4] For example, a farmer can create or visit a virtual marketplace to learn current price information or to buy or sell goods directly. This can increase his profits by saving travel time and improving his negotiating position over the middlemen who normally operate on the basis of superior information.

1.8 This approach is in contrast with countries that have focused primarily on export-led services. An effort by the Korean government to replicate these countries' export-led successes would be short-sighted. As described in detail in the appendices, a variety of factors have led different countries to adopt appropriately different strategies to network-enabled services. India and Ireland, for example, share three important qualities that favor an export-led strategy—

- A population with strong English skills that have permitted them to serve the U.S. market.
- Low labor costs.
- A weak internal market for network-enabled services that limits the benefits to domestic productivity and equity.

1.9 In many ways, Korea's situation is more like that of the U.S. Korea has a strong potential internal market by virtue of its high connectivity and its net-savvy population. Its relatively high labor costs mean that it can export only high value-added services. Therefore, with the exception of a few leading companies, Korea should successfully establish domestic service offerings before engaging in a campaign to market them to the rest of the world.

The Current Situation

1.10 Korean businesses, government, and society are moving rapidly into the networked century across a broad front. The principal obstacles that many developing countries face in introducing information and communications technology (ICT) have been largely overcome. Twenty-one million Koreans, about 45 percent of the population, have access to computers and use the Internet, placing Korea among the world's leaders.

1.11 Korea's ICT sector has grown swiftly. A large part of the growth has come from the hardware side of the ICT sector and from a dramatic increase in the mobile telecommunications market. Korean companies are market leaders in many segments of the hardware and telecom equipment markets.

1.12 Korea also has begun to develop its own software programming capacity, in part by liberalizing immigration policies easing the entry of skilled Indian and other foreign programmers. The Korean software industry grew from $380 million in 1996 to $740 million in 1999. This growth is promising because the future challenges and opportunities for economic growth lie primarily in the service side of the ICT sector.

1.13 These major accomplishments are not yet widely recognized nor appreciated elsewhere in the world. Korea is underestimated in the world economy as a knowledge provider and participant in the global knowledge-based economy. Being underrated has both positive and negative implications. On one hand, it provides an opportunity for continued progress without excessive scrutiny. On the other hand, companies seeking to outsource the provision of network-enabled services may overlook Korea.

1.14 Korea aspires to be a knowledge-based nation powered by creativity and innovation. In early 2000, the government of Korea prepared a blueprint for creating an information society — *Cyber Korea 21*. In December 2000, it issued *White Paper 2000, The Informatization Vision for Constructing a Creative, Knowledge-Based Society.* To further the goals set out in those documents, the government has followed with a series of implementation strategies. The most relevant to the current analysis is the April 2001 *e-Business Initiative in Korea,* which lays out an ambitious and comprehensive action program to support the "e-Transformation" of Korean businesses, including specific target dates for achievable goals. The initiative recognizes that the next step to build on Korea's strong infrastructure is to deepen the connection between Korean businesses and the Internet. Since network-enabled services are essentially business services, this initiative serves as a useful benchmark for evaluating Korea's current strategy.

1.15 Current government plans and a high level of Internet access are not sufficient to transform Korea into an information services-based economy. While the average Korean citizen is highly educated about the availability of information technology and aware of the potential of the networked world, there remains a low level of integration of network-enabled services into daily business activities, particularly in SME's. As noted in the April 2001 report, for example, although the majority of Korean SMEs are already connected to the Internet, they do not yet use the computer to manage their business or manufacturing processes. Firms in key competitors such as Japan, Germany, Italy, and the U.S., on the other hand, are experiencing higher adoption rates. A survey conducted by the Korean government in early 2001 concluded that "the extent of the informatization of Korean SM[B]s was evaluated as only 47.8 out of 100 points."[5] In its preliminary survey of the informatization of 25 SMEs conducted in July 2001, the KDI found that only 5 firms offered order placement and modification through their company web sites, and only one firm's site facilitated order tracking and the exchange of delivery and payment data (see Annex B3). Eighteen firms were found not to engage in e-commerce sales at all, citing lack of integration between network access arrangements and internal information technology systems.[6] Thus, the government's real challenge lies in pinpointing the obstacles that are causing the slower than desired adoption of network-enabled services.

Moving Forward

1.16 Many countries are trying to increase their participation in the networked economy. In some countries, the rapid pace of technology change and the continuing addition of new players both inside and outside government lead the national e-society team to confusion, resulting in multiple, uncoordinated initiatives.

1.17 The experience of the most successful e-society to date, the United States, is instructive in this regard. While the private sector and market forces have been the principal drivers in U.S. e-society development, the government has played an important role as a facilitator and catalyst. The most organized initiative began under President

[5] Annex B3.
[6] See Annex B3, table B3.4.

Clinton. In 1993, he designated the Secretary of Commerce as the chairman of the Information Infrastructure Task Force (IITF), a coordinating group that brought together all relevant government departments and agencies. The IITF's goal was to articulate and implement the Administration's vision for a national information infrastructure. As discussed in Chapter 4, the IITF was very successful in some areas, and less successful in others. Based on the direct experience of this consultant, the degree of success in each area related directly to the ability to set priorities and focus actions.

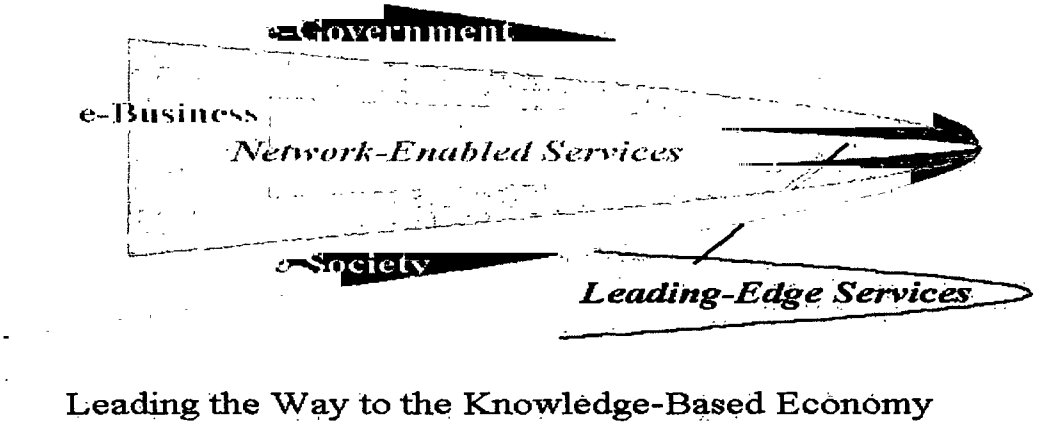
1.18 Numerous areas of action have also been identified by the Korean government. However, unless further steps are taken to prioritize actions for implementation, the objectives of the program will be at risk. The Government of Korea should manage that risk by deciding which areas are the most important to address first. A clear process is needed to assure that financial resources are allocated and that clear timetables are set, and met. An aggressive global branding campaign to raise awareness of Korea's capabilities will be needed in parallel with domestic promotion of the knowledge-based economy.

1.19 Korea must take stock of its strengths and base its course of action upon them. With respect to network-enabled services, Figure 11.1 depicts the desired relationship among the government's many initiatives to promote a knowledge-based economy. Korea is pursuing action in three areas, e-government, e-society, and e-business. Network-enabled services are a critical component of e-business and "e-transformation." While action is needed across a broad front, including development of the legal and regulatory infrastructure, market and financial openness and reform, human capital development, etc, it is the core recommendation of this report that *the e-transformation of business in Korea should be led by two specific leading-edge network-enabled services.*

1.20 There are a great number of network-enabled services from which to choose. To select among these, decision criteria are needed. As discussed in detail in Chapter 4, the recommended leading edge services to be promoted by the Korean government satisfy the following criteria—

- Build on Korea's core strengths.
- Address the principal obstacles facing Korea in its advance toward the knowledge-based economy.
- Involve key segments of Korean society who will help lead the rest of society.
- Can be implemented relatively quickly because there will be a positive appetite for these services among the participants.

Figure 1.1: Initiatives to Promote the Knowledge-Based Economy



1.21 The two specific recommendations that emerge from this analysis, Business Information and Domestic Logistics, are stated in terms of what the Korean government should do. This approach reflects that the government of Korea is the client for this report and has requested specific action recommendations. However, the primary engine of change must be the private sector. Government's role is to facilitate and encourage action by the private sector, not to supplant it.

1.22 **Recommendation - Market Information:** The Government of Korea through the Ministry of Commerce, Industry, and Energy and the Small and Medium Business Administration should benchmark the business information services needs of Small and Medium-sized Businesses (SMEs), identify SMEs that have successfully utilized ICTs to grow, and encourage the development of business information services portals to propagate these successes across Korean SMEs. Within this context, encouraging the creation and promotion of domestic logistics information services portals should be the first priority.

Organization

1.23 This report contains five chapters and four accompanying annexes contained in Part C of this report.

1.24 Chapter 2 describes the global marketplace for network-enabled services and the competencies needed to provide them competitively. Chapter 3 discusses Korea's position and capacity in the network-enabled services environment. Chapter 4 recommends a strategy for using network-enabled services to lead Korea into the knowledge-based economy, and explains the costs and benefits of the recommended

approach. Chapter 5 outlines the implications of Korea's situation for other emerging economies.

1.25 Annex B1 gives details about the marketplace for network-enabled services, and discusses the prospects for Korean providers. Annex B2 describes the status of a selected countries' provision of network-enabled services, and assesses the impact of each on Korea. Annex B3 presents the results of a small survey of Korean firms inquiring about the level of integration of NES into daily operations and constraints faced in doing so. Annex B4 includes an approach for surveying Korean SMBs to determine their business information needs and to identify best practices for promotion.

2. NETWORK-ENABLED SERVICES: FUTURE OF E-BUSINESS

NETWORK-ENABLED SERVICES

2.1 Network-enabled services are business functions and services that can be performed remotely and delivered electronically using telecommunications and computer networks. They vary from simple data entry to complex customer interaction, covering a range of labor-intensive and knowledge-intensive activities. Network-enabled services are the most important emerging market in the global ICT industry.

2.2 Examples of network-enabled services include call centers, medical transcription, animation and online games, distance education, telemedicine, and back office operations. Internet sites, such as web portals, which offer a broad array of resources and facilitate the provision of businesses services, are an emerging example. Each service requires a different mix of capabilities in firms desiring to provide the services commercially, and different kinds of national infrastructure to support those firms.

2.3 Simplified versions of many of these services are delivered today using voice telephone or fax alone. This report focuses on services that require Internet connectivity in addition to basic voice and fax service. The Internet provides unprecedented cost savings and improved efficiency. At the retail level, it permits a customer service representative anywhere in the world to have access to a customer's records, and can empower the customer to work along with the service representative. For business-to-business communications and transactions, the Internet provides a ready-made environment where multiple players can participate at various levels of openness and control.

Network-Enabled Service Marketplace

2.4 Businesses use network-enabled services for a variety of reasons. The use of such services is a primary avenue of "outsourcing" parts of a firm's operations. Decisions to outsource a particular business function are usually made on the basis of three criteria—

- Will outsourcing reduce costs or increase productivity?
- Will outsourcing increase predictability or reduce risk?
- Will outsourcing enable greater focus on the firm's core business and enhance the firm's comparative advantage in the marketplace?

2.5 As globalization and improved market information increases competition in one industry sector after another, firms turn to outsourcing first to reduce costs and increase productivity. The emergence of low cost, high quality software engineering firms in India exemplifies the market's response to the need for major U.S. software companies to become more efficient. Indian firms write large portions of the computer code that is then incorporated into U.S. commercial and custom software products.

2.6 Firms increasingly use network-enabled services to cope with fluctuations in demand. For example, locating customer service call centers in multiple jurisdictions permits load balancing when a particular region generates unusually high demand. Calls are automatically routed to an alternative site that shares full access to corporate customer databases.

2.7 Many firms are finding that the sheer complexity of modern business dictates shedding operations, such as payroll processing or printing, that are not central to the firm's comparative advantage, enabling focus to be on the core business. Ultimately this trend can lead to a new kind of organization, one which "will appear almost edgeless, with permeable and continuously changing interfaces between company, supplier, and customers," with some suppliers and customers spending "more time in the company than some of the firm's own workers."[7]

2.8 Multiple scenarios all suggest that the prevalence of network-enabled services will continue to increase. As the digital economy demands higher and higher levels of efficiency and cost-effectiveness, the necessity of delegating business activities only peripherally related to a company's core competencies will grow. Quality of service must increase and costs must be reduced. Successful companies will come to depend increasingly upon the high-skilled, quality workmanship available globally to support their key functions.

2.9 Today, however, the global marketplace in network-enabled services is in its infancy. Although reliable data are therefore in short supply, data from South Africa, for example, indicate that telecommunications, financial, and information services exports have grown at an annual average rate of 29 percent since 1994, almost 15 percent faster than exports of goods over this period.[8] The most current available global data on numerous types of network-enabled services comes from a study conducted in India (Table 2.1). These forecasts support the projection that network-enabled services will proliferate.

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[7] William Davidow and Michael Malone, *The Virtual Corporation*, Harper Business, 1992.
[8] *Union Budget 2000-2001*, Government of South Africa.

Table 2.1: The Global Network-Enabled Services Marketplace

Service	1998 Revenues ($ billions)	2008 Revenues ($ billions)	Cumulative Annual Growth Rate (%)
Call Centers	6.5	33.0	18
Finance and Accounting Services	1.5	15.0	26
Animation	1.3	2.0	4
Engineering and Design	0.4	5.0	21
Transcription, Translation, and Localization	0.3	1.2	29
Human Resources Services	0.2	44.0	71
Data Search, Integration and Management	-	18.0	-
Remote Education	-	15.0	-
Network Consulting and Management	-	5.0	-
Website Services	-	3.0	-
Market Research	-	1.0	-
TOTAL	**10**	**142**	**30**

Adapted from: *The Indian IT Strategy,* NASSCOM-McKinsey, 1999, page 4.5.

2.10 From Table 2.1 it is apparent that significant growth is expected in network enabled services. Human resources (i.e., payroll and personnel management) and finance and accounting services represent the largest growth area with revenue projection for 2008 of about $59 billion. Today these services tend be performed within organizations, as sensitive data and unique procedures are still closely held by companies. The market for these services will open up as companies (and their employees) have greater trust in the Internet and take advantage of the cost savings of having specialized firms in distant countries perform these services. Other sizeable markets include call centers (projected at $33 billion dollars in 2008), data search, integration and management (including geographic information services), and distance education. As the chart shows, these markets are expected to have cumulative annual growth rates of nearly 20 percent or more. Lastly, although animation, transcription, consulting, web services, and market research are the markets with least projected market growth, there is still a viable market for these services. With projected revenues in the billions, early movers into these areas can establish themselves as innovative leaders and may be able to secure the majority of these revenues. These services are discussed in more detail in Annex B1. Web portals,

which consolidate a variety of processes and resources, are the most important emerging method of delivering network-enabled services. Many of the services in Figure 2-1 and Appendix A will be delivered or supported by Internet portals.

2.11 Korean firms are already offering many of these services domestically and for export. Appendix B provides examples from other market leaders, including India, Ireland, Japan, Jordan, Malaysia, the Philippines, Singapore, and the United States.

National Capabilities Needed to Deliver Network-Enabled Services

2.12 While individual firms deliver network-enabled services, they can only do so successfully from within a national business and technical environment that makes it possible to deliver those services efficiently and profitably. A nation's "E-Readiness" is the baseline from which firms launch their quest to be competitive in delivering network-enabled services. By measuring E-Readiness at the national level, governments can take the steps necessary to support firms in the global network-enabled services marketplace.

2.13 At the national level, there are five key E-Readiness attributes—

- Connectivity: Are networks (including transportation networks) easy and affordable to access and use?
- E-Leadership: Is E-Readiness a national priority?
- Information Security: Can the processing and storage of networked information be trusted?
- Human Capital: Are the right people available to support e-business and to build a knowledge-based society?
- E-Business Climate: How easy is it to do e-business today?

2.14 These attributes are described in more detail in Figure 2.2. Evaluating these attributes helps measure a nation's overall capacity to participate in the networked economy. Appendix B provides a rating of the E-Readiness of selected countries with respect to these attributes. The E-Readiness ratings combine a dynamic evaluation of the relevance and accuracy of quantitative data with an understanding of myriad cultural, institutional, and historical factors relevant to the actual situation in each country.

Figure 2.2: Summary of E-Readiness Attributes

Connectivity – *Are networks easy and affordable to access and to use?*

- Availability of wireline and wireless communication services, community access centers (free and paid), and networked computers in businesses and homes.
- Affordability and reliability of network access, including the cost of service, downtime, and the prevalence of sharing access among individuals.
- Reliability of electrical supply for business-critical computer operations; and the ease of importing and exporting goods and of transporting them within a country.

E-Leadership – *Is E-Readiness a national priority?*

- Priority given by government to promoting the development of an e-society on a national level.
- Extent of demonstrated progress on e-government, including efforts to automate governmental processes, offer services to business and citizens electronically, and create national portals.
- Quality of partnerships between industry leaders and government to improve E-Readiness.
- Level of effort to promote access for all citizens.

Information Security – *Can the processing and storage of networked information be trusted?*

- Strength of legal protections and progress in protecting intellectual property rights, especially for software.
- Extent of efforts to protect electronic privacy.
- Strength and effectiveness of the legal framework to address and prosecute computer crimes, authorize digital signatures, and enable public key infrastructures.

Human Capital – *Are the right people available to support e-business and to build a knowledge-based society?*

- Quality of and participation levels in the education system, with an emphasis on efforts to create and support a knowledge-based society.
- Penetration of ICT in schools and ability of educators to use and teach in accordance with the technologies.
- Culture of local creativity and information sharing within the society.
- Skills and efficiency of the workforce, and strength of efforts to retain skilled managers and technologists.

E-Business Climate – *How easy is it to do e-business today?*

- Existence of effective competition among communication and information services providers.
- Transparency and predictability of regulatory implementation, openness of government, rule of law, and general business risk (e.g., political stability, financial soundness).
- Openness to financial and personal participation by foreign investors in ICT businesses.
- Ability of the financial system to support electronic transactions.
- Sponsorship of science and technology parks as hubs of innovation and support for new enterprises.

Source: Ready? Net. Go! Partnerships Leading the Global Economy, *McConnell International LLC, May 2001.*

Contingent E-Readiness Attributes

2.15 E-Readiness analysis can be "tuned" to shed particular light on the competencies and infrastructure required to enable the provision of specific network-enabled services. While all five attributes are important to the delivery of these services, for the purposes of this analysis they are grouped into two categories: contingent attributes and independent attributes (see Table 2.2). The degree of E-Readiness required in the contingent attributes varies depending on the specific service that is to be offered. In contrast, the independent attributes cut across all network-enabled services and are gauges of the general environment, both present and potential, for the conduct of e-business. That is, the degree of E-Readiness required in these attributes is, in general, independent of the type of network-enabled services offered.

Table 2.2: Contingent and Independent Attributes

Contingent	Connectivity, Information Security, Human Capital
Independent	E-Leadership, E-Business Climate

2.16 For example, in the Human Capital dimension, firms offering distance learning need skilled subject matter experts to provide content and supervise courses, while firms providing claims processing services need less skilled employees. On the other hand, strong E-Leadership and a favorable E-Business Climate are necessary for the successful provision of any of the network-enabled services described.[9]

2.17 This section analyzes the contingent attributes. It begins by discussing Connectivity, Human Capital, and Information Security, and then displays the capacity necessary for successful provision of typical network-enabled services.

Connectivity

2.18 Network-enabled services depend on the same Connectivity that is needed for e-business in general. A basic level of reliable bandwidth is common to all services, and many countries in the world do not have even this basic level. However this report focuses on the variation required among services that require more than the basic level of Connectivity. For these purposes, we have established three levels of Connectivity.[10] Table 2.3 displays the three levels.

[9] Specific legal aspects of the e-business climate can, of course, make a difference. For example, if the legality of providing medical advice across jurisdictional boundaries is unclear, as is the case among the various states in the United States, then telemedicine services will be slow to develop. A specific analysis of the legal requirements for offering the various network-enabled services is beyond the scope of this study.

[10] This taxonomy is adapted from the Oregon (U.S.) "OTFC Toolkit" developed by the Oregon Telecommunications Forum Council. The toolkit was designed to assist Oregon communities in using networks to enhance the delivery of education, health care, government services, and the development of business.

Table 2.3: Connectivity Levels for E-Businesses

Level	Available Telecommunications Services	Examples of Network-Enabled Services Supported
I	Reliable basic phone service Single party calling Touch tone dialing Call waiting. Call forwarding Multi-line access Three way calling Voice mail Local call internet access	Small office/home office operations Various professional services Computer consultants Small marketing consultants Graphic designers Writers
II	**Level I +** ISDN (voice and data) 56 K/T1 Frame relay Local points of presence for facilities-based long distance carriers Guaranteed service reliability	Software and multimedia developers Value-added internet service providers Light manufacturing Telemarketing operations
III	**Level II +** Optical carrier tariffed service Fiber optic route diversity Disaster recovery Service available from at least two local access providers Local points of presence available from at least two facilities-based long distance	Back office operations and call centers (credit card processing, technical support, telemarketing) Disaster recovery/data archiving Online media development including audio and video streaming Large Internet service providers Digital image processing Health care and health maintenance

Information Security

2.19 Information Security comprises three elements: intellectual property rights (IPR) protection, privacy protection, and systems security. Systems security includes reliability, availability, protection of confidentiality and the infrastructure for digital signatures and prosecution of computer crimes. Each network-enabled service requires different levels of E-Readiness in each element. For example, call centers, which are not very vulnerable to attack by hackers, require only routine levels of authentication, but must be operational around-the-clock. They therefore require a low-to-medium level of systems security. Telemedicine, on the other hand, deals with highly sensitive personal information that must be transmitted reliably at all times, and thus requires a high level of systems security.

Human Capital

2.20 As noted earlier, Human Capital requirements for delivery depend significantly on the type of service. In general, all services require a computer literate, cost-effective workforce. Cost-effectiveness is particularly critical for countries interested in competing in the global network-enabled services marketplace, since they will be competing against established, low-cost players such as India. A variety of specific Human Capital competencies are required for each service, as shown in Table 2.4.

Requisite Levels of Contingent Attributes

2.21 The Connectivity, Information Security, and Human Capital requirements for network-enabled services are summarized in Table 2.4.

Table 2.4: Levels of Contingent Attributes, by Service

Service	Connectivity	Information Security	Human Capita
Call Centers	Level I-II	IPR: Low Privacy: Low-Medium Systems: Low-Medium	Fluency in language of target customers Customer-oriented attitude Excellent hearing and listening skills
Medical Transcription	Level I-II	IPR: Low Privacy: High Systems: Medium	Fluency in language of target customers Excellent hearing and listening skills Knowledge of medical terminology
Animation	Level II-III	IPR: Medium Privacy: Low Systems: Medium	Programming skills Creativity and design skill
Geographic Information Systems (GIS)	Level I-III	IPR: Low-Medium Privacy: Low Systems: Low	Programming skills
Back Office Operations	Level II-III	IPR: Medium Privacy: Medium Systems: Medium-High	Some fluency in language of target customers Knowledge of customer's business practices Programming skills
Distance Education	Level II-III	IPR: Medium Privacy: Medium Systems: Medium	Academic background

Service	Connectivity	Information Security	Human Capita
Telemedicine	Level II-III	IPR: Medium Privacy: High Systems: High	Medical training
Tele-Engineering	Level III	IPR: High Privacy: Low Systems: High	Engineering training

3. KOREA'S CAPACITY AND PROGRESS

3.1 This section begins by describing the status and progress of Korea's journey to become a networked economy, using an E-Readiness framework. It then focuses on the current provision of network-enabled services in Korea. Finally, it evaluates Korea's capacity to provide network-enabled services.

3.2 Korea has made remarkable progress in laying a foundation for a knowledge-based economy. Korea's ICT sector has grown rapidly, rising from roughly five percent of GDP in 1992 to 11 percent in 1999. Its contribution to GDP growth is substantial, growing over the same period from 4.5 to 38 percent of GDP growth in 1999.[11] The primary reasons for this growth are--

> Leadership. Korea's leadership has supported this growth through heavy investment in infrastructure and by providing vision from the top.
>
> Affordable Infrastructure. Korean firms are cost-effective providers of telecommunications services and information technology hardware, making these core building blocks affordable and available within Korea.
>
> Population Density. Korea is a densely populated country of 47 million people. Its population density, and in particular the fact that increasing numbers of Koreans live in apartments, have made it relatively inexpensive to provide large numbers of Koreans with high-speed connections to the Internet.

E-Readiness: Korea's Capacity to Participate in the Networked World

3.3 Korea's E-Readiness is among the highest of emerging economies. Although challenges remain, high Connectivity requirements are generally not a major barrier to Korean network-enabled services providers, and E-Leadership is strong. However, in the areas of Human Capital, Information Security, and E-Business Climate, challenges are more evident.

Connectivity

3.4 Korea has very high electronic connectivity. That 45 percent of Koreans are connected to the Internet is but one indicator. Fifty-five percent of Koreans have cellular

[11] "Information Technology Overview of Korea: Statistical Profiles," Ministry of Information and Communication, January 2001.

phones. Five million households now have high-speed network access. Twenty thousand "PC Parlors" around the country enable almost anyone to enter cyberspace. Internet access costs are comparatively reasonable, from $12-30 per month.[12] Korean Internet users spend more time online than users in most other countries, and 50 percent of stock trades are conducted on the Web. Moreover, the installation of the EAC undersea cable is providing Korea with a 2,500-gigabit per second connection to its principal trading partners. Korea was the only emerging economy given a top rating in connectivity in the E-Readiness report. Two areas critical to future growth deserve attention, however: SMEs' internal integration of ICTs and the transportation and logistics infrastructure.

3.5 Small and medium businesses constitute the vast number of companies in Korea and are an important source of job creation. Korean businesses already have an excellent start on connectivity. According to a survey conducted by the National Computerization Agency in July 2000, 85 percent of firms with five to nine employees have Internet access. For larger firms the figure is 91 percent. Although government-led campaigns have been successful in promoting Internet usage, much progress is needed in integrating network activities such as online transactions into the mainstream. Most of these firms have not yet taken the next step to integrate technology into their internal business processes. They will not be ready for e-commerce until they do.

3.6 Strong electronic network connectivity is not enough for e-commerce to grow. Physical goods, as well as electronic goods, must move quickly and efficiently. Korea's transportation and logistics industry is dominated by thousands of unconnected small businesses that move goods from farm and town to city and port. This process is fragmented and slow, driving up shipping costs and causing delays. The broad benefits of e-business will not be available without substantial investment in transportation infrastructure. Left unaddressed, Korea's logistical inconvenience will likely hinder the growth available from network-enabled services.

E-Leadership

3.7 Leadership is another area of national strength. The government's efforts to promote a knowledge-based economy are among the most comprehensive in the world. President Kim Dae-Jung has advanced a vision of a knowledge-based society that has been elaborated on by the public and private sectors. Few governments can claim to have such broad and serious programs in this area.

3.8 Strong policy and programmatic leadership comes from the Ministry of Commerce, Industry and Energy, the Ministry of Information and Communications, and their supporting institutes. Other ministries have specific programs to support their industries, ranging from the two-floor Internet game production center built by the Ministry of Culture and Tourism at a cost of $10 million, to an electronic marketplace for farm products operated by the Ministry of Agriculture. However, additional concrete action, and a more coordinated approach among ministries, will be needed for Korea's

[12] All figures are in U.S. dollars unless otherwise noted.

progress to continue. Chapter 4 suggests certain areas for coordination among ministries and setting of priorities to further strengthen this ongoing effort.

Information Security

3.9 Strong information security is essential to nurture the development of knowledge-based industries, the engines of future economic growth. As stated in Chapter 2, information security comprises three aspects: the protection of intellectual property, the protection of data about individuals (privacy), and the protection of information systems. Korea is becoming a global leader in the last of these. Its planned public key infrastructure (PKI) is one of the most advanced and ambitious in the world, and, properly implemented, can be an important aid to advancing e-commerce in Korea. With respect to privacy, strong laws are in place prohibiting the transfer of personal data without consent. Some enforcement efforts are underway—the Ministry of Information and Communications ordered 500 companies to revise their privacy policies last year and fines have been levied for violations.

3.10 Intellectual property protection—the first aspect of information security—is more complicated. As is the case in many Asian countries, Korea has historically exhibited minimal enforcement of laws protecting intellectual property rights. Paradoxically, intangible cultural assets, such as traditional song, dance, and culinary customs and rituals, have been afforded a high level of respect, designated by law as national cultural assets. If this tradition of respect is not translated into adequate legal protection for intangible goods associated with the high-tech industry, Korea may continue to experience less than optimal levels of domestic innovation, foreign investment in the technology sector, and technology transfer allowing Koreans access to the latest advances in global technology. Without a guarantee that illegal reproductions of creative works will not be reproduced without consequence, creators may experience decreased incentives to produce or engage in entrepreneurial activities. While skeptics continue to question that these benefits arise from legal protection being assured for intellectual property, experiences from other nations have shown that the creation of legal frameworks protecting intangible assets associated with technological innovation is a key stage in economic growth. Switzerland, for example, did not have a patent system until late in the 19th century, when the onset of industrialization created a domestic industry with innovations worth protecting.

3.11 The Korean government has had underway for several years a campaign to reduce the rate of piracy for copyrighted software. According to the Business Software Alliance, the percentage of pirated software in Korean firms has dropped from 75 percent in 1994 to 50 percent in 1999, but increased in 2000 to 56 percent.[13] These figures place Korea on a much more successful plane than countries like China, Vietnam, and Indonesia, where piracy levels are at or above 90 percent. Korea's progress is similar to that of Taiwan, which decreased piracy rates from 70 percent in 1995 to 53 percent in 2000.

[13] The comparable U.S. figure is 24 percent. See, *Sixth Annual BSA Global Software Piracy Study*, Business Software Alliance and Software and Information Industry Association, May 2001; http://www.bsa.org.

More success in lowering piracy has been exhibited in Japan, however, where piracy has fallen from 55 percent in 1995 to 37 percent in 2000. Korea's overall reduction lays a promising foundation for the more difficult effort that will be necessary to make services a valued commodity in the minds of Korean businesses. However, changing a culture that has historically undervalued intangible assets will require leadership and time.

3.12 While the Korean government's anti-piracy campaign will help to instill the notion of concrete consequences for the illegal use of pirated software, it should be considered as simply one aspect of a multi-faceted program to boost the incentives for creativity, including reform of the traditional rote learning educational system, and the provision of additional funding for creative pursuits. Much more effort is needed before copyrighted materials and digitalized information will enjoy a level of protection that will encourage e-business to flourish.

Human Capital

3.13 The quality of its people is another of Korea's strengths. A 98 percent literacy rate forms a solid foundation. The strong industrial base of computer hardware manufacturing and assembly, and the surge in 1999-2000 of new Internet companies (many affected by the subsequent global "dot.crash") has created a market for technical skills. The Net is being used as a tool to expand these skills via distance education.

3.14 Two important shortfalls are holding Korea back, however: the shortage of skilled, creative software programmers, and the still inadequate command of English among Korean Internet business people. Despite English language instruction beginning in primary school, Koreans do not enjoy the same level of English competency as other network-enabled services powerhouses, such as India, Ireland, and the Philippines.

3.15 Creativity is of particular interest. The knowledge-based economy requires the synthesis of new approaches from among the old, taking into account a rapidly changing environment. Traditional Korean education, however, tends to focus on repetition and rote learning over originality. This area will become increasingly important as Korea moves forward.

E-Business Climate

3.16 With respect to the E-Business Climate, Korea has begun to open up its economy and make the business environment more transparent and predictable. Regarding deregulation, the privatization of Korea Telecom, the dominant, state-controlled communications services provider, is in process, and Korea is strengthening the role and independence of the regulator, the Korea Communications Commission, in order to assure fair competition. Wireless markets are relatively open.

3.17 Policies to promote foreign investment and foreign entrants into ICT markets are also progressing. A ceiling of 49 percent remains on foreign ownership of facilities-based communications service providers, but there is no ceiling on value-added service providers. A more open environment for foreign investment, enabling investment and

participation from foreign firms interested in forming strong local partnerships would maximize competition and increase consumer welfare.

3.18 Transparency in business procedures and regulatory decisions remains a rather new concept, and the legal infrastructure needed to create certainty in the validity and legal effect of electronic transactions is still under construction. Although Korea enjoys a relatively high country credit rating, ranking number 33 out of 145 countries in a recent survey conducted by Institutional Investor magazine,[14] many executives who conduct business in Korea still perceive the business environment to suffer from high level of opaqueness in both regulation and practice.

3.19 Ranking number 42 in Transparency International's recent poll of the degree of openness in business and government activities, as perceived by business leaders, risk analysts, and members of the general public in 91 countries,[15] Korea must continue to promote transparency in business and government transactions.

3.20 The application of law to electronic transactions is generally murky throughout the world. Questions about jurisdiction (i.e., which court can adjudicate a claim regarding an action that occurred in cyberspace), about the ability to authenticate the identity of a message sender, and about the ownership and legal validity of electronic documents are vexing lawyers everywhere. Increasingly businesses find that the uncertain legality of electronic transactions delays their implementation and keeps costs high. In the first stage of e-business, during which firms are transforming their internal operations, such issues are more easily dealt with because the parties to transactions are all employees of the firm. In the second stage, where suppliers become involved in transactions, many issues can be dealt with by private contracts between parties. Such arrangements are relatively easy to negotiate because there is already an underlying trust relationship based on prior business dealings. In the third stage, domestic arms-length transactions, and particularly in the fourth stage, international transactions, the transaction costs of arranging bilateral agreements become prohibitive. Thus, law is required, and clear law—creating predictable outcomes in electronic business processes.

3.21 As in other areas, Korea has a strong foundation, having passed several electronic commerce laws in recent years.[16] The lengthy list of work areas mentioned the April 2001 *e- Business Initiative in Korea* shows an understanding of the broad impact of moving business online. Particularly as more Korean firms emerge as offerors of network-enabled services, they will need the protection provided by clear laws affecting all areas of business practice.

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[14] Survey available at: http://www.iimagazine.com/premium/rr/countrycredit/ccr/2001.htm.

[15] Poll results available at: http://www.gwdg.de/~uwvw/icr.htm.

[16] Examples include: Framework Act on Telecommunications; Enforcement Decree of the Framework Act on Telecommunications; Telecommunications Business Act; Enforcement Decree of the Telecommunications Business Act; Framework Act on Information Promotion; Enforcement Decree of the Framework; Act on Informatization Promotion; Act on Expansion of Dissemination and Promotion of Utilization of Information System; Radio Waves Act; Digital Signature Act.

3.22 Encouraging the widespread use of online transactions will be a major stepping-stone in addressing this issue. The process of revising Korea's commercial laws to take into account the complexities of e-commerce has not yet been completed. This creates uncertainty in the e-business environment. As illustrated in several examples below, a variety of other challenges will inhibit the spread of network-enabled services if action is not taken. A lack of product quality standards makes online buying and selling difficult. Without clear service and product quality standards, domestic consumers will remain hesitant to purchase goods online and damage may occur in Korea's branding as a high-quality network-enabled service provider. For some goods, entrenched consumer buying habits, and a lack of public confidence in a new system, also delay uptake.

Korea's Status in Network-Enabled Services

3.23 Network-enabled services are included in Korean statistics in a category called "software and computer-related services." As Table 3.1 shows, compared with telecommunications services and information technology manufacturing, this industry is currently relatively small, amounting to less than five percent of the ICT industry total output. This figure is considerably lower than in the U.S., where in 2000, the percentage of the ICT industry comprised of software and related services topped 30 percent.[17]

Table 3.1: Korean ICT Industry Revenues

ICT Industry Sector	1999 Revenues ($ billions)	Percentage of Total Revenue	CAGR[18] (%)
Telecommunications Services	14.9	19.9	13.6
IT Technology Manufacturing	57.4	76.5	24.3
Software and Computer-related Services	2.7	3.6	25.0

Source: Ministry of Information and Communication, Government of Korea.

3.24 It is likely that the contribution of network-enabled services is greater than these figures suggest.[19] There are already significant providers of various services in Korea, and examples of leaders that are extending their benefits to small and medium businesses. Below, four case studies explore some of the leading network-enabled services currently being provided in Korea. The following examples were selected for their innovative means of attracting new users, such as fishers, farmers, and artisans, to the information economy. The first two examples highlight basic business information services that are being offered in the context of e-marketplaces while the third case study discusses more

[17] Statistical Abstract of the United States, U.S. Census Bureau; 2000, p.565.
[18] Cumulative Annual Growth Rate.
[19] In every country, statistics for emerging industries tend to lag reality by several years, both because of outdated statistical categories and difficulty in collecting results from new companies.

advanced logistical solutions involving ICT. Each provides a glimpse of the types of services that should be expanded and encouraged by the Korean government, with consideration given to Korea's current level of national E-Readiness. The examples are followed by a summary assessment of Korea's network-enabled services potential in each of the five E-Readiness components.

Farmers Join the Information Society

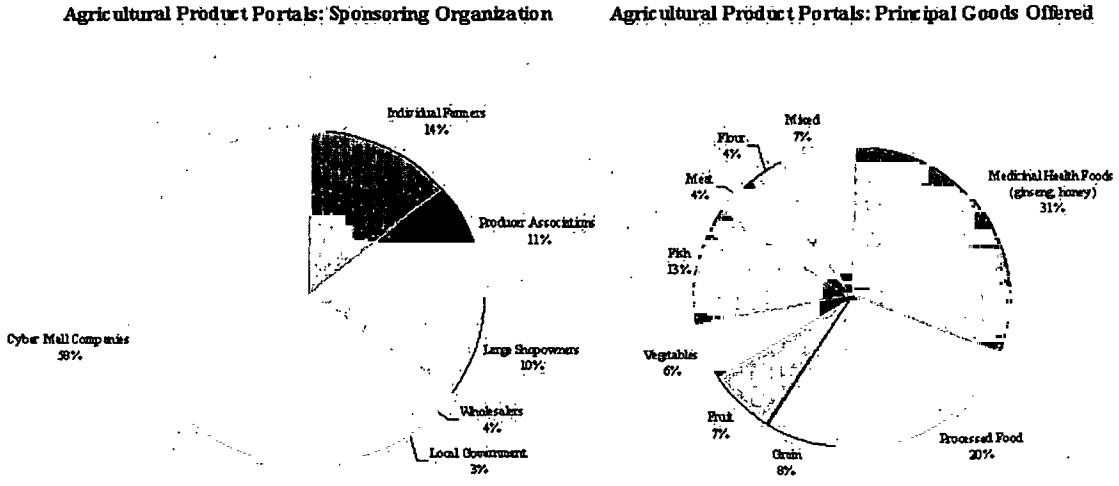
3.25 The Ministry of Agriculture's Korea Information Center for Agriculture, Forestry, and Fisheries (KICA) is conducting a project to provide network-enabled services to small farmers in order to raise productivity and increase profitability. The project, which operates two websites and delivers information via wireless networks, is an important extension of KICA's longstanding mission to provide information to Korean farmers.

3.26 The AFFIS site, www.affis.net, provides farmers with real time wholesale prices at central markets nationwide. Such price information increases farmers' leverage with the middlemen who buy and move produce from the farms to the central market. Weather forecasts, agricultural news, and advice are also provided. Price information is also available via telephone (including mobile phone), using menu-driven access to voice recordings. At this point, 111,000 farmers (out of 4 million) are now using these services.

3.27 A more ambitious effort involves the creation of an electronic marketplace that permits farmers to sell agricultural products directly to consumers. The site, www.a-peace.com, offers both processed and unprocessed goods for sale. Consumers can compare prices and quality before making their selections. The site opened late last year and is in its early stages. As of May 2001, some 500 producers were participating in the project. The results are promising, however, as participating farmers are receiving 20 percent higher prices for their products, and consumers are paying 10 percent less than normal retail prices. The program's goal is to have 4000 farmers participating by 2004.

3.28 KICA's initiative takes place in the context of a growing presence of agricultural websites in Korea. A recent survey of 150 agricultural websites showed that the majority of sites belonged to "cyber-mall" companies and included processed agricultural products among their wares. As shown in Figures 2.3 and 2.4, the sites carry a wide variety of goods.

Figures 3.1 and 3.2: Agricultural Product Portals



3.29 The KICA-sponsored websites provide a successful example of citizens' need for business information being met. Government support for additional market information websites, catering to small and medium-sized businesses in other sectors, such as manufacturing, traditionally neglected by information technology advances could augment Korea's current strengths in Connectivity and E-Business Climate.

Traditional Marketplaces Open Their Eyes to E-Commerce

3.30 Two of Seoul's largest traditional wholesale and retail markets are creating electronic marketplaces where their members can sell products both locally and globally, expanding sales and reducing costs.

3.31 Namdaemun Market, founded in 1414, is the oldest traditional wholesale and retail marketplace in central Seoul. Ten thousand small shops sell textiles, clothing, crafts, leather goods, kitchenware, appliances, etc. Many of the merchants also own small workshops where they produce some of the goods they sell. Namdaemun Market's management has installed high-speed (ADSL) lines throughout the seven-hectare maze of shops and stalls. Shop owners are taking advantage of this high quality connection. They are using the Net to check the prices of wholesalers and web retailers, enabling them to immediately offer their customers competitive prices.

3.32 In addition, through its e-business agent the market has created a retail e-marketplace for member merchants. For about $35 per month, a merchant can list up to 10 products in an electronic catalog. Some 200 merchants now sell directly to consumers

using this service. A business-to-business service for wholesalers is planned, with a goal of 500 users by next year.

3.33 Across Seoul is the Dongdaemun Market, one of the largest wholesale markets in the global fashion industry with annual turnover of $11.7 billion. Founded originally in 1905, this market is also entering the digital age. One supply chain management company has created an electronic marketplace where 27 of the market's 27,000 merchants are advertising and selling their wholesale fashion wares. It charges merchants a five percent transaction fee to handle all aspects of the electronic transactions.

3.34 In developing countries, many e-markets are limited in their growth by low acceptance of credit cards by merchants and online buyers. Both of Seoul's e-markets are partnering with an electronic service company, which facilitates payments for buyers and sellers who choose not to use credit cards. Dealing directly with the buyer's bank, the company guarantees payment to sellers, enabling electronic purchases to proceed smoothly and quickly. Its one percent transaction fee is lower than the three-to-four percent credit card companies charge, and payment is guaranteed.

3.35 Although this service removes a substantial obstacle to e-commerce, other challenges remain. The legal infrastructure to support e-markets is still under development, creating uncertainty and risk. And, the Korean logistics infrastructure remains fragmented and slow, thus driving up shipping costs.

3.36 These challenges notwithstanding, the e-markets of Seoul are creating substantial opportunities for small businesses to reduce costs and increase profitability. By providing better price information and creating access to new customers, they are increasing the likelihood that Korea's trading industry will stay abreast of the changes in the digital age. The growing success of Korea's new electronic marketplaces provide yet another example of the latent demand for online business information services. These services should be encouraged and promoted by the Government of Korea.

E-Business Portals

3.37 E-Business portals are electronic marketplaces where buyers and sellers meet to conduct business. Cyber marketplaces create a meeting place for buyers and sellers, and enable buyers to buy directly from the sellers, eliminating the middleman, the chain store, and the re-seller. Some are like village markets, where transactions are negotiated and secured among participants, person-to-person. Others have more structured and formal prices and processes.

3.38 One major Korean corporation has created a set of these portals, often in cooperation with other industry participants. Table 3.2 describes three of these.

Table 3.2: Electronic Marketplaces

Industry	Service Description
Seafood	Enables buyers and sellers to search, communicate, offer, trade, manage, and participate in auctions in the seafood industry.
Chemicals	Connects global buyers and sellers to a portfolio of strategic business-related services that specifically address chemical industry needs.
Steel	Serves registered buyers and sellers of steel and offers an open and competitive negotiation process. Provides users greater control over the costs associated with international steel trading.

Example: Seafood Industry

3.39 One prominent example of a business portal designed for a leading company in Korea's seafood industry was developed with participants from around the globe and relies upon network-enabled services to manage a chain of delivery that spans several continents. Fish that are caught in the northern Asian seas off the Russian coast are processed in Chinese factories before being shipped to and consumed in Asian, Western European, and U.S. markets. By placing digital cameras in factories, allowing complete start to finish processing visibility, the portal enables customers at each stage of the value chain a high level of quality assurance. Information on the primary sellers' plants and raw materials are provided to buyers in advance of auctions, and secondary producers are able to monitor the activities effecting the processing of their orders. Even cargo tracking and shipping management services are available. Minimal fees based on a percentage of the value of the transaction, 0.5 percent for buyers and 1.0 percent for sellers, are charged for the service. Overall, the company's one-stop service offering makes it easier and more convenient for buyers and sellers to engage in transactions and reduces costs.

3.40 The dynamic e-marketplace is enabled using three different types of auction platforms: standard, sealed-bid, and auto-creasing. Standard auctions allow buyers to view previous bids and to place multiple bids, ensuring that the highest bidder receives the products. While buyers may make multiple bids in a sealed-bidding process as well, using this auction format, participants may not view one another's bids. The highest bid is then selected by the auction creator. In an auto-crease auction, product pricing is set in motion by the auction creator and is either raised or lowered depending upon the actions of buying and selling parties. This unique process creates a progression through which neither buyers nor sellers are affected by adverse bidding.

3.41 To facilitate payment for goods that are transferred via its network, the company has begun to add financial services such as an escrow service that guarantees transactions for buyers and sellers who lack a history of mutual trust. Other financial services planned

for the future include credit at competitive interest rates and insurance offerings. Letters of credit are not yet planned as no international standard for handling these electronically has yet emerged. Finally, another service offering enables its members to coordinate cost effective and timely transportation of products. Booking status and documents also can be accessed and checked online.

3.42 Logistics information portals, such as the seafood industry example, are an attractive method of integrating additional SMEs at various stages of firm-level E-Readiness along numerous links of products' supply chains. The importance of government efforts to ensure that more widespread logistical information services are delivered online is explored more fully in the next chapter.

Korea's Capacity to Deliver Network-Enabled Services

3.43 Table 3.3 summarizes Korean firms' current capacity as network-enabled service providers. Existing advantages and challenges are highlighted.

Table 3.3: Korea's Advantages and Challenges in Network-Enabled Services

Attribute	Advantages	Challenges
Connectivity	Broadband communications infrastructure widely available	Integrating SMEs Transportation and logistics infrastructure
E-Leadership	Strong top-level leadership	Coordination among ministries Need for focus
Information Security	Public key infrastructure Systems security policies Privacy policy	Valuation of intangible assets
Human Capital	Well-educated population Customer-service attitude	English language skills Software programming skills Fostering creativity
E-Business Climate	Strong entrepreneurial spirit Emerging competition in communications and Internet services	Transparency in business and regulatory transactions Market openness Legal infrastructure still unclear Lack of product quality standards

3.44 Table 3.4 summarizes the potential of Korea to provide network-enabled services listed in Table 3.1. Additional detail is provided in Appendix A. An analysis of leading nations providing these services and their positioning relative to Korea's is provided in Appendix B.

Table 3.4: Summary of Korean Market Potential

Network-Enabled Service	English Language Necessity	Competitive Labor Costs	Potential for Korean Businesses
Call Centers	High	Low	Domestic uses.
Medical Transcription	High	Low	Low market potential.
Animation	Low	Low	Decreasing market share due to high cost labor.
Geographic Information Services	Low	Low	Low market potential.
Back Office Operations	None – High	Medium	Opportunity to promote domestically. Website content development and hosting could be promoted internationally.
Distance Education	None – High	High	Domestic uses.
Telemedicine	Medium	High	Domestic uses.
Tele-Engineering	None - Medium	High	Opportunity to promote domestically and to export to Korean's living overseas. Long-term international market potential.

3.45 Because several of Korea's competitors, offering lower labor costs and other advantages such as strong English language skills, are better positioned to export many of these key network-enabled services, it is essential that Korea focus instead on building domestic capacity. Encouraging an environment in which Korean firms readily recognize the benefits of interacting electronically should be a primary goal of the Korean government.

3.46 Korea's high connectivity and net-savvy population indicate that strong potential exists for domestic consumption of network-enabled services. By focusing on encouraging Korean firms to increase domestic service offerings before engaging in a campaign to market them to the rest of the world, the Korean government will solidify the foundation necessary for sustained growth in the global knowledge economy.

4. KOREA'S STRATEGY – LEADING FROM STRENGTH

4.1 Korea has identified the promotion of e-business as the next stage of becoming a knowledge-based economy. As discussed earlier, network-enabled services are the most important area of e-business growth. This chapter examines Korea's strategy to encourage the use of network-enabled services by Korean firms and makes recommendations, intended as a starting point for debate and consultation with the private sector. Government's principal role is to create an environment that encourages private sector use of network-enabled services, while protecting and empowering consumers. As explained in Chapter 1, a domestic rather than export-led focus is more likely to produce near-term results for Korea.

E-Business: The Next Frontier

4.2 E-Business—at all levels—will be the driver for emerging economies' entrance into the networked century. The need for the promotion of e-business was recognized in the Ministry of Information and Communication's December 2000 White Paper, which envisioned support for the informatization of critical industries and of small and medium sized businesses as a key component of the development of Korea's knowledge-based society. This emphasis is correct for three reasons.

4.3 First, sustainable progress toward a knowledge-based society requires the financial incentives that only business can provide. Only the private sector can make the investments to improve the capabilities of networks and of people who will sustain such a society. Bringing the network into the mainstream of business life will create strong pressures among Korean suppliers of ICT services to reduce costs. The ensuing price reductions will benefit all Korean Internet users.

4.4 Second, Korea's core industries are at a critical stage. They must keep up with the B2B process improvements that their competitors in China, Germany, Japan, and the U.S. have made and are making, or they will lose their position in the global manufacturing economy. Businesses must now take on the process of "e-transformation." Information and communications technologies must be looked at as tools that enable a business not merely to automate its procedures, but to change the very ways it operates. The electronic marketplaces discussed earlier, where suppliers and buyers get together directly, eliminating many parties and their associated transaction costs, are one example. Old lines of communication via captive supply chains give way to open markets. To flourish in this new environment, companies must move to just-in-time inventory management, share information across company divisions, and otherwise break down old practices. This e-transformation can be painful, but it is essential.

4.5 Third, to ensure inclusion of all parts of Korean society in the knowledge-based economy, small and medium businesses are critical partners. SMEs are at the core of the

Korean economy in terms of job creation and as suppliers to large firms. These businesses, which constitute over 99 percent of all Korean firms and employ the majority of the Korean workforce, must become involved in the B2B e-transformation if the initiative is to create a sustainable knowledge-based economy. In this regard, two elements are critical—better integrating the Net into SME activities, and improving the knowledge and skills of small business employees and owners so they can benefit from B2B services.

A Strategy of Strength that Recognizes Challenges

4.6 In April 2001, the Korean Government released *e-Business Initiative in Korea,* the results of the Sixth Information Strategy Meeting of some 16 government organizations, including the Ministry of Commerce, Industry, and Energy, the Ministry of Information and Communication, the Ministry of Finance and Economy, the Ministry of Construction and Transportation, and the Ministry of Planning and Budget. The report argues correctly that the last ten years have laid a foundation for Korean e-Business by creating an underlying infrastructure, promoting the ICT industry, and beginning to optimize manufacturing through the use of digitally controlled manufacturing technologies. This report followed on the heels of the December 2000 White Paper, which had included many provisions to improve Korea's E-Business Climate. For example, the Commerce at Light Speed (CALS) pilot project was highlighted as a means of "connecting the information network between large companies and small and medium subcontracting companies in each business sector."[20] While the December 2000 White Paper included relatively fewer target dates for its proposed accomplishments, the April 2001 strategy sets clear, measurable goals, including specific time frames for the completion of initiatives, in many areas. Figure 2.8, taken from the report, summarizes the situation.

Table 4.1: Past and Future Goals for Korean E-Business Progress

	Past 10 Years	Next 10 Years
Core Strategy	Building IT infrastructure	E-transformation of industries
Way To Proceed	Separate development of off-line and on-line industries	E-transformation of traditional industries
Main Task	Improving business processes at individual firm level	Improving business processes at intra- and inter- firm levels
Expected Effects	Cost savings	Higher value added

4.7 The report points out that, in order to move to the next stage, all industries must transform the way they work, and that the boundaries between traditional and ICT industries must be removed, thus permitting more efficient logistics management and

[20] White Paper 2000, Ministry of Information and Communication, p34.

increased value from network-enabled services. It lays out five areas of work for stimulating these changes:

- Increasing security and reliability by reforming the legal and policy infrastructure.
- Improving e-business communications networks, technology, and human capital.
- Promoting the computerization of the public sector (e-government).
- Promoting business-to-business (B2B) services, especially among small and medium businesses and in technology parks.
- Promoting the electronic trading of imports and exports.

4.8 The report underscores the urgency of the problem, raising the fear that without significant progress by 2003 Korea will lose its global competitiveness. To oversee implementation of the work, a committee of ministries will continue to meet. In addition, an e-Business Roundtable, chaired by the head of the Federation of Korean Industries, will work with the government, drawing on the examples of Japan and Canada.

4.9 The report identifies four principal challenges in promoting e-business—

- Lack of a cooperative culture among firms.
- Lack of confidence in e-business and low investment capacity among SMEs.
- Slow progress in management innovation and in increasing transparency of business practices.
- Need for more progress on standardization, human resource development, and electronic payment systems.

4.10 The report envisions Korea as an "e-Hub" for Asia, and sets numerical goals for the integration of ICTs into Korea's core manufacturing industries—electronics, automobile, shipbuilding, steel, machinery, and textiles. With respect to SMEs in these sectors, it acknowledges that, although already connected to the Internet, they do not yet use the computer to manage their business or manufacturing processes. A pilot program will begin to address this issue by assisting 30,000 SMEs through 2003 to improve their Internet connections and integrate computing into their business practices. The report acknowledges that this is a small proportion of the 2.8 million SMEs in Korea, and calls on larger firms to push their suppliers to modernize and to create electronic supply networks. The example of Covisint (www.covisint.com), the electronic network created by GM, Ford, and Daimler-Chrysler for their suppliers is noted. This "e-logistics" focus will be given particular attention in Korean industrial parks, in addition to providing electronic business services, management advice, and upgrading the currently inadequate connectivity in those locations, building towards the creation of a "e-Industry Complex Network."

4.11 For industries such as agriculture, fishing, health care, and construction, that are not as far along as manufacturing, the report proposes creating electronic marketplaces to reduce transportation and middlemen costs, automating the medical claims and interconnecting health care providers, and sharing construction documents electronically particularly for government construction projects.

4.12 The electronic government proposal echoes the highly successful "Works Better, Costs Less" motto of the U.S. Clinton-Gore electronic government initiative, beginning specifically on electronic procurement for government contracts. It also proposes that government attempt to use the market power of its procurement to promote the adoption of standards by Korean businesses.[21] Attention is also given to human capital, including—

- Expanded deferments from military service for technical personnel.
- National certification for e-business training institutes.
- Further lowering entry barriers for Indian and other foreign software engineers.

4.13 The strategy proposes continuing work to create new laws covering electronic commerce and information security, with emphasis on extending existing laws in detail into the e-business space, so as to clarify their applicability and reduce uncertainty. Areas mentioned include foreign trade, government contracting, intellectual property rights, privacy, and consumer protection. Particular attention is given to establishing a system to handle payments for low value B2C (business-to-consumer) transactions, and creating an e-business scorecard for each industry and selected countries as reference service for firms.

4.14 To promote exports, electronic export marketplaces, such as Silkroad 21 (www.silkroad21.co.kr, or www.silkroad21.com), will be expanded to cover 20,000 SMEs and 100,000 products by 2002. Participation in global organizations, and bilateral and regional cooperation, particularly with China, Japan, Taiwan, Hong Kong, and Singapore, are also emphasized.

Many Challenges, But Is the Focus Right?

4.15 The Korean government's ambitious strategy misses none of the major areas that need to be addressed. All aspects of E-Readiness are treated, and the emphasis on e-business is appropriate. The April 2001 strategy succeeds in setting clear, measurable target dates for the completion of goals in many areas. Yet the strategy's breadth and, paradoxically, its business focus, are also two sources of weakness. First, an even clearer focus and set of priorities would be helpful if the intended results are to be achieved in a timely manner. Second, a more inclusive view of the affected population is critical to support the overall leap into the knowledge-based economy.

4.16 With respect to focus and priorities, one is reminded of the adage, "less is more." This consultancy's direct experience with information society initiatives in other countries, as summarized in Box 4.1, teaches that any broad, comprehensive program has three major drawbacks.

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[21] It should be noted that this approach was attempted by the U.S. and European governments in the 1980s and 1990s respectively, failing spectacularly. For example, the U.S. attempted to promote the so-called Open Systems Interconnection standards for computer communications, and X12 standards for Electronic Data Interchange transactions. These efforts led to delay in government computerization and a lack of interoperability, as the market went to TCP/IP and EDIFACT standards, respectively, ignoring the government's policies.

- Breadth can mean that there is too much to monitor. In some cases the committee that oversees the effort is burdened with complex tracking systems that require and deliver more information than can be digested. In other cases the coordinators receive only anecdotes from projects with strong promoters. Drift sets in, and the integrated and systemic vision is lost, replaced by an uneven mix of accomplishments and failures.
- When the task list is long, often the easier or more glamorous projects are given undue attention, regardless of stated priorities and real needs.
- Breadth creates high expectations among constituents. Because some goals will not be met, important stakeholders could become disappointed and disenfranchised. It is prudent to manage expectations early in the process.

Box 4.1: Priorities and Focus in Developing an Information Society – the U.S. Experience

While the private sector and market forces have been the principal drivers in U.S. e-society development, the government has played an important role as a facilitator and catalyst. The most organized e-society initiative began in 1993 when President Clinton created the Information Infrastructure Task Force (IITF), and designated Secretary of Commerce Ron Brown as its chairman. The IITF brought together all the agencies that play a major role in the development and application of information and telecommunications technologies to articulate and implement the Administration's vision for a national information infrastructure. (The conclusions herein derive from direct participation in the Task Force's work.)

The IITF was organized into three principal sub-groups:

- The Telecommunications Policy Committee led the Administration's effort to enact telecommunications reform legislation.
- The Information Policy Committee developed policy in the areas of electronic privacy (data protection), intellectual property protection, and government information.
- The Committee on Applications and Technology coordinated Federal efforts to promote applications of information technology in manufacturing, education, health care, government services, libraries, environmental monitoring, and electronic commerce.

The IITF was very successful in some areas, and less successful in others. The degree of success related directly to the ability to set priorities and focus actions. For example, the telecommunications policy committee was highly successful in working with Congress and enacting the Telecommunications Reform Act of 1996. This occurred because of unusually strong White House leadership that brought the various agencies together and assured that this task was of the highest priority. The information policy committee had a more mixed success. In the intellectual property area, clear tasks and timetables were set out to analyze copyright laws and suggest revisions. This was accomplished in less than 18 months. In the data protection (privacy) area, however, no clear tasks were set out nor responsibilities assigned, resulting in long debates. After three years, only a set of principles had been produced. A similar result occurred in the applications area. Although many interesting public-private discussions took place, the lack of a clear focus and priorities, coupled with no connection to the budgetary and funding process, meant that the committee had little actual effect on the development of Internet applications.[22]

4.17 With respect to inclusion, the strategy makes a brief mention of the "digital divide" that affects small businesses, but does not give strong emphasis to involving

[22] More about the IITF can be found at http://www.iitf.nist.gov/committee.html. This consultant served as principal White House staff liaison to the IITF Information Policy Committee.

underserved populations. The strategy's business emphasis, while it is absolutely essential, should perhaps be tempered with a vision that reaches more broadly and deeply into Korean society.

4.18 These shortcomings can be overcome by giving strong emphasis to a few key areas. Once those areas are selected, setting out a clear sequence of actions, and establishing sound processes to accomplish them, will greatly increase the likelihood of successful outcomes. Industry and government must look for new ways to forge relationships that are mutually beneficial and that promote sustained e-business growth. This chapter provides recommendations for the Korean government to stimulate private sector activity in this regard.

Leading Edge Services

4.19 In order to promote e-business and the growth of a knowledge-based economy in Korea, two NES need focus. The two services are Business Information and Domestic Logistics services. As explained below, these priorities are based on Korea's current strengths and were pinpointed because they address specific obstacles to continued e-business growth that were brought to this consultancy's attention during its mission in Korea. They may serve to boost productivity and overall participation in the knowledge-based economy. These services are discussed below, along with the leading participant groups for each. Further rationale for choosing these particular services is discussed under "Strengths and Challenges" at the end of this chapter. Ultimately, however, these services are presented as examples of actions that could be encouraged, subject to further discussion and dialogue among stakeholders inside and outside the government. Figure 4-3 summarizes the recommendations.

Table 4.2: Summary of Priority Network-Enabled Services

Service	Leading Providers	Leading Users
Market Information: a) Business Information Services b) Domestic Logistics	Private firms with government encouragement	a) SME suppliers to core manufacturing industries b) SMEs in trucking and warehousing industries

Market Information

4.20 Both the United States and Korea understand the importance of promoting ICTs in business and in using ICTs to improve their competitiveness. For example, KTNet (www.ktnet.com) was set up by the Korean government as a trade facilitation initiative in 1991. KTNet's online service enables businesses to handle import and export transactions electronically without additional investment in software, and provides import/export statistics upon demand.

4.21 The Korean government's commitment to helping SMEs in particular is evident through its outreach via such portals as Inno-NET (www.innonet.net), which is jointly managed and operated by the Small and Medium Business Administration (SMBA), The Korean Institute of Science, Technology, and Information, and the Ministry of Commerce, Industry, and Energy. In addition, the SMBA and its related institutes and public corporations operate numerous information services for SMEs, including Venture Net, Techno Net, Start-up Net, Small Business Net, Consulting Net, Export Support Net, Foreign Exchange Net, and Regional Specialization Net.

4.22 The U.S. government has also demonstrated a strong commitment to assisting SMEs; its unique "one-stop-shopping" business advisory portal www.business.gov. allows SME's to gain access to a variety of market information. Figure 2.5 details some of the services available to American SMEs.

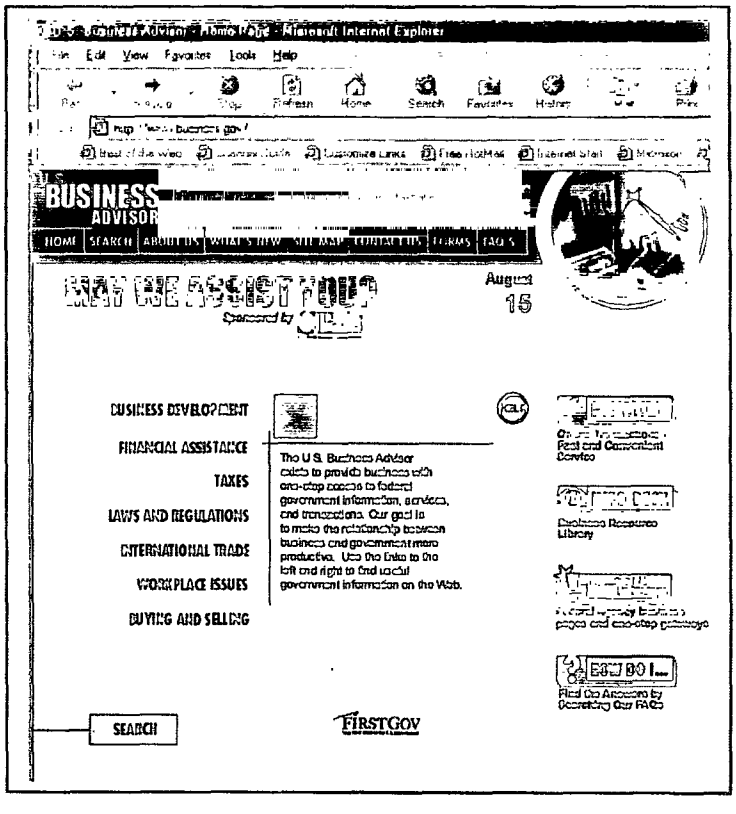


Figure 4.1:
U.S. Business Advisor

4.23 Under the E-Services link of the U.S. Business Advisor, visitors are presented with a host of business information services options designed to assist an SME in its e-agenda. For example, links are provided to articles, research databases, and organizations dedicated to assisting SMEs with integrating technology into the workplace; online counseling is offered through a network of retired executive volunteers; and governmental forms and information on laws and regulations governing SMEs are available.

4.24 Most small Korean firms, however, remain unaware of constantly changing market information, are dependent on large suppliers of raw materials, and are engaged in passive relationships with their large customers. For example, a small manufacturing company that supplies disc brake components to an automobile manufacturer has relatively few supply sources for the materials (steel, asbestos, fasteners) that go into the parts, and even fewer customers for its specialized products. While these arrangements

served adequately in an earlier era, they are no longer suitable. The situation is critical. As one well-informed researcher notes—

4.25 Most Korean SMEs are in great peril indeed. Their ultimate competitiveness bases—sheltered markets, subcontracts with leading domestic companies, and low-cost production—will erode fast, facing a set of adverse forces such as market liberalization, globalization of parent companies, and relentless catching-up of the newly-industrialized economies, especially China. Surely, there are some favorable changes for SMEs such as increased demand for differentiated products and availability of new low-cost information technologies. But most Korean SMEs simply lack the abilities to capitalize on them.[23]

Recommendation: *The Government of Korea through the Ministry of Commerce, Industry, and Energy and the Small and Medium Business Administration should benchmark the business information services needs of Small and Medium-sized Businesses (SMEs), identify SMEs that have successfully utilized ICTs to grow, and encourage the development of business information services portals to propagate these successes across Korean SMEs. Within this context, encouraging the creation and promotion of domestic logistics information services portals should be the first priority.*

4.26 This recommendation has two parts, business information services and domestic logistics portals.

Business Information Services

4.27 Easy access to market information is essential for businesses to make sound investment, production, pricing, and other business decisions, and to participate in an increasingly competitive marketplace within Korea and in global markets. As mentioned above, current, objective market information is available in Korea through a variety of media. Nonetheless, perhaps due to the myriad of channels of information distribution, SMEs generally suffer from limited uptake of such market information. An exception is information about agricultural commodities, where, like many national governments, Korea provides free wholesale pricing and sales information, which is widely used by farmers.

4.28 Thus far, government-initiated campaigns to raise SME awareness of the benefits of the Internet have been successful to a degree. As noted above, over 85 percent of

[23] Cheonsik Woo, "Innovation Challenges to SMEs in Korea." Paper delivered at the Policy Seminar on Technology Readiness and Innovation, the 3rd Asian Development Forum, June 2001. The paper notes further that SMBs are falling further behind. In the machinery and equipment sector, total share of value-added increased between 1985 and 1995 from 30.6 percent to 45 percent, while among SMBs, the share went from 25.4 to 35.7 percent.

Korean SMEs have an online presence. However, what is still lacking is an integration of networks into daily business activities beyond basic functions such as email and file-sharing. For instance, as noted above, only 10% of SMEs surveyed by the KDI conducted higher-level functions such as processing orders and conducting e-commerce on their websites.

4.29 Small business owners cite insufficient in-house expertise in terms of technology and skills as barriers to greater integration. Also since SMEs cannot conduct all activities in-house and consequently outsource, issues relating to information security and intellectual property rights regime also affect NES deployment (see Annex B3 for SME survey details).

4.30 Perhaps it is simply not enough to encourage citizens, particularly business owners, to go online and to assume that they will navigate for themselves among the wealth of informational sites available to help them improve their businesses. Without concrete examples of what they stand to gain, busy small business owners will not take the time to truly embrace the Internet. A promotional campaign centered on testimonials from SMEs regarding the benefits they have accrued from integrating the Internet into their daily business practices could help pinpoint concrete measures to improve the take-up of internet-related services.

Strategy

4.31 The Ministry of Commerce, Industry, and Energy (MOCIE) should lead this initiative, in cooperation with the Korean Development Institute (KDI) and the SMBA. It can bolster its current campaign to raise awareness of the benefits of ICTs and promote business information services portals for SMEs by:

- Benchmarking the current E-Readiness of Korean SMEs by expanding the recent work done by the KDI[24]. Recent work by KDI could be expanded to include a much larger, cross-sectoral sample of SMEs[25]. The survey will serve a dual purpose—
- To pinpoint key market information services that are needed and could be consumed online by SMEs.
- To identify success stories and acquire testimonials of SMEs that have experienced growth due to the use of online business information services.
- Encouraging the growth of portals, targeted to SMEs, offering priority business information services, as determined by the results of the survey.
- Publicizing these SME success stories as best practices and lessons-learned for less network-integrated SMEs.

4.32 It is important that government involvement be held to a minimum. The government's "market-making" activity should be designed to remove structural barriers

[24] A summary of which is found in Annex B3.

[25] Including more participants in the survey would simultaneously serve two purposes. First, it would facilitate the identification of SMEs needs according to industry. Second, it would assist in locating best practices that can, in turn, be used in a new marketing campaign aimed at demonstrating to others through the use of example, how and why ICTs should be integrated in daily business activities.

and inefficiencies as opposed to displacing activity more appropriately conducted by the private sector. For this strategy to be successful, the government needs to take action on multiple fronts simultaneously, incorporate evaluation sessions into each phase, and re-focus efforts based on uptake as it proceeds. By engaging the private sector, and demonstrating that the needs of multiple stakeholders are addressed, the government of Korea will foster a sense of ownership of market information portals among firms, thus leading to greater sustainability and improved E-Readiness.

Phase 1: Select priority market segments (one month)

4.33 In order to quickly implement this strategy, an initial focus on a particular market segment is needed to keep the scope manageable and to demonstrate and build on successes. Consistent with the government's priorities, the initial focus should be placed on the provision of online market information for the electronics, automobile, shipbuilding, steel, machinery, and textiles industries. These firms are selected for two reasons.

4.34 First, these firms are critical to Korea's global competitiveness.[26] The market information will enable these key SMEs to increase the number of firms from which they buy and sell, causing positive reverberations throughout the economy. This will be particularly true if the market information is—

- Pertinent for greater leverage in interactions with large firms.
- Creatable and deployable quickly with a limited investment in software and hardware.
- Easy to use and not requiring an extensive security infrastructure.

4.35 Second, the major manufacturers have already begun to require their suppliers to come online. It is likely that the large firms will provide assistance to their suppliers in this area, because they expect to benefit from the SMEs increased productivity and from the reduced costs of transactions. Indeed, the large firms recognize that they cannot succeed alone in e-transformation; they need their suppliers to be active participants. Because larger firms have already initiated the process by which SMEs will be encouraged to engage in additional network-related activities, further encouragement from the government in promoting market information services will serve to supplement the message of the SMEs' most important customers. Promotion of market data to those SMEs will assist them in becoming "smart partners" of the large firms they supply.

[26] According to the Small and Medium Business Administration, SMEs in seven main manufacturing sectors – machinery and equipment, fabricated metal products, textiles, apparel and wool products, food and beverage, and rubber and plastic goods – represent 55.7% of all manufacturing firms in Korea and are responsible for nearly 43% of Korea's total exports. "Of total SME exports, electronic and electric products account for 27.1%, textiles 23.5%, machinery and transportation equipment 17.0%, plastic, rubber, and leather goods 6.5%, iron, steel and metal products 6.6%, and others 19.3%. http://www1.smba.go.kr/human/english/korea_smes1.htm

Phase 2: Benchmark information needs (three months)

4.36 A survey is the best means to benchmark the current information needs of SMEs in order to pinpoint strengths of existing providers, identify gaps, and determine bottlenecks. Gathered survey responses should be validated through interviews with respondents, supplier businesses, and government officials who work with these industries. It is important to have independent, substantiated results in order to base decisions on the data. This extra step will also build buy-in for the results and for the on-going promotional program.

4.37 Moreover, validating responses will help to evaluate and shape the direction of this initiative. Face-to-face interaction with these firms will allow MOCIE to determine the level of enthusiasm compared to anxiety and risk aversion each business has for using and exploring ICTs. If interest levels are high, then the government can encourage its private sector partners to proceed with greater haste. If interest is moderate or low, the government would need to proceed more cautiously, putting greater emphasis on the marketing phase.

4.38 Examples of the types of business information services that address the SMEs' needs and could be consolidated for provision via portals include--

- Business Development
- Financial Assistance
- Legal and Regulatory Information
- Diagnostic Services
- Networking Services
- Consulting and Technical Support
- Continuing Education
- International Outreach

4.39 The exact length of this phase will depend on the number of industries surveyed, the fieldworkers available to validate answers, and the response rates of the businesses. It is the recommendation of this paper that sufficient staff be available to answer any questions posed by the surveyed businesses and to ensure complete, accurate and verified response.

Phase 3: Identify providers and promoters of key business information services via portals (one month)

4.40 Following the SMEs' needs assessment, MOCIE should explore the capabilities of information services providers to design or expand business information portals. It is important that MOCIE's role be as a facilitator, to engage members of the private sector to establish new or consolidate existing portals that provide core industry market information services into a "one-stop-shopping" model.

Phase 4: Piloting of business information services portals (three to six months)

4.41 The plan for rolling out these services needs to be considered carefully. A select group of businesses, e.g., those that responded enthusiastically during the survey, should be identified as a test market to pilot any new or restructured business information services. It is important that these pilot users have a clear mechanism to give feedback. If the reaction of leading SMEs to the new information services portal and promotional campaign is favorable, the government can proceed to announce and implement the portal's launch according to schedule. If the reaction of leading SMEs and the information services industry is unfavorable, however, adjustments will be necessary to ensure that needs are met.

Phase 5: Promote SME successes using ICT-related testimonials (ongoing)

4.42 Before the launch of the enhanced business information services portals, the Korean government should design a campaign to educate SMEs on the successes demonstrated by their peers. As discussed above, part of the benchmarking survey should be designed to collect success stories of businesses that have prospered as a result of their utilization of online informational resources. These SMEs can be publicized in a promotional campaign focused on learning by example, as they will be the best "sellers" of the new technology.

4.43 Without an awareness of the concrete types of benefits --time saved, efficiency improved, profits increased-- that can be gained from utilizing ICTs, Korean SMEs will continue to disregard the wealth of information at their fingertips once the enhanced portal is launched. Therefore, this campaign must be thorough and well targeted. It will take at least six months for a promotional strategy to be effective.

Domestic Logistics

4.44 The creation of a domestic logistics information services portal is the second part of the Market Information recommendation. Currently, a large impediment to cost-effective e-commerce in Korea is the slow and expensive domestic logistics[27] system.

4.45 Much of Korea's situation has been caused by rapid urbanization. As the Fourth Comprehensive National Territorial Plan 2000-2020 notes, the population share along the Seoul-Busan axis has grown from 44 percent in 1960 to 74 percent in 1995. Manufacturing firms have seen parallel urbanization, with the percentage of companies located in the same region rising from 56 percent in 1960 to 80 percent in 1995. The Korean government has already recognized that "distribution systems are inadequate ... [as] is the linkage among transportation networks." In addition, the report estimates that the cost incurred by traffic congestion has already topped 18 trillion won (4.4 percent of GDP) with expected growth of as much as 22.4 percent per year. According to the report, "The shortage of transportation facilities not only makes the daily life of citizens inconvenient but also hinders the nation's economic progress by causing staggering

[27] Here logistics refers to the domestic cargo transportation infrastructure (primarily trucking), and the institutions and information systems that support that infrastructure.

socio-economic costs.... All this points to a greater need to create conditions on the nation's territory that could accommodate future growth industries in the 21st century." [28] Creating such conditions presents a challenge, as Korea's transportation sector is currently dominated by numerous independently-operated SME's. Figure 4.5 provides data on the fragmented transportation sector. [29]

Figure 4.5: Korean SMEs in the Transportation Industry

Industry	Total Number of Firms	Small Firms by the Number of Employees		Total Small Firms
		1-4 Employees	5-9 Employees	
Transportation	188,111	181,356	2,444	183,800

As shown above, over 96 percent of Korean transportation firms employ between one and four employees. A further one percent employ between five and nine employees. Overall, nearly 98 percent of the industry is comprised of SMEs.

4.46 Korea's logistics infrastructure situation is exemplified by the experiences of a popular Seoul department store during a recent lunar holiday. Because so many customers took advantage of new online purchasing service offerings, the store was inundated with orders requiring timely delivery. Due to lack of adequate delivery infrastructure, the store was forced to pull hundreds of employees from the store floors to hand deliver goods at the last moment. The resulting transportation costs negated any efficiency gains from e-commerce. This is just one example of how Korea's disaggregated logistics industry is negatively impacting future e-commerce growth. Numerous interviews conducted with both private and sector suggested that difficulty in getting goods to purchasers is one of the most significant barriers to successful implementation of e-commerce initiatives.

4.47 Other countries have similar problems. As one U.S. e-logistics provider notes, "E-commerce has changed the way companies do business. However, the cost savings and efficiencies promised by e-commerce often evaporate when it's time to deliver the goods."[30] Nevertheless, U.S. firms reduced logistics costs by 33 percent from 1983 to 1997, according to the U.S. Council of Logistics Management.

4.48 To stay competitive, Korea must make similar improvements. Currently, a number of Korea's large trucking and logistics companies offer information services to facilitate export and import transactions, yet few companies offer logistics information services over the Internet to assist domestic transactions. Where information services are offered to domestic shippers, they are generally limited to rate information. By contrast, larger firms, which dominate the U.S. market, offer online services such as order

[28] Fourth Comprehensive National Territorial Plan 2000-2020; p. 20, 23.
[29] Data extracted from "Statistics on Korean Firms", http://www1.smba.go.kr/human/english/introduction.htm.
[30] See http://www.nistevo.com.

placement and door-to-door tracking, and industry-wide portals have featured load matching and sharing.

4.49 While the Fourth National Territorial Plan acknowledges Korea's "weakening competitiveness due to inadequate infrastructure" and proposes numerous traditional measures to alleviate the problem, more emphasis could be placed on using technology to overcome structural obstacles. "Intensifying investment in facilities for high-efficiency transportation" has been identified as a goal, but without naming what form these facilities might take. Furthermore, "heighten[ing] the efficiency of logistics facilities through informatization and standardization" has been presented as an idea. The suggested method is to "build a database that includes electronic document exchange, facilities, and intermediary information plus a cargo transport information system to materialize vehicle tracking and remote control using wireless communication." This concept is an excellent idea and can be made accessible to the logistics community at large through the creation and promotion of a domestic logistics services portal.[31]

4.50 Such a portal should cater to SMEs from the trucking and warehousing industry. Delivering goods efficiently is particularly challenging in Korea because trucking is the most disaggregated industry in Korea, with, as noted above, 98 percent of firms having from 1-9 employees, and 96 percent from 1-4. (The U.S. numbers are 76 and 62 percent, respectively.) Increasing the efficiency of Korean trucking firms would be of major benefit to domestic e-business in Korea, particularly for other SMEs in the agriculture and garment sectors. Truckers would also become excellent ambassadors of B2B services throughout the Korean countryside.

4.51 In this arena, a number of useful lessons can be learned from the recent failures of several "dot.com" logistics portals in the U.S. While a full exposition of the lessons-learned from the U.S. experience is beyond the scope of this report, the situation can generally be characterized as follows.

4.52 In the late 1990s a number of ventures attempted to create automated scheduling systems across multiple trucking companies. Two niche approaches were of particular interest, exchanging loads and cooperative buying services. The theory behind the first approach was that, given the long distances in the U.S., a truck going from San Francisco to New York could meet a truck going from New York to San Francisco and exchange loads, sending the truckers back to their home territories and avoiding costly "dead-heading"—returning with an empty truck. These ventures generally failed for several reasons—

- Concern from cargo shippers about accountability for transport.
- Lack of interest from large carriers.
- No systems for sustaining price levels (small truckers bidding too low).
- Lack of established infrastructure for settling inter-company payments.

[31] Fourth Comprehensive National Territorial Plan 2000-2020; p.11, 113, 129-130.

4.53 With cooperative buying services, the business model attempted to aggregate loads and then find carriers to transport them. These generally failed to reach critical mass—too few shipments to interest large carriers, and too little capacity among participating small carriers to satisfy the demand that was generated.

4.54 In both cases these models were hampered by other important factors, including—

- Lack of time among small truckers to interact and manage within the system.
- Lack of IT penetration among small truckers.
- Great distances involved.
- Weak ability to communicate with trucks while they were en route.

4.55 An integrated model involving the sharing of shipment information among competitors, known variously as collaborative logistics or synchronized supply chains, is emerging based on lessons learned from these experiences. Under this model, companies collaborate with supply chain partners and synchronize operations. Both the technology and business models are moving very quickly in this area. Therefore, the solution will need to be flexible and the solution provider agile. This is a challenging task, and should involve the best Korean and international ICT companies. However, Korea cannot afford to wait until an inefficient logistics system renders it uncompetitive. In addition, Korea has certain advantages over the U.S. and its Asian competitors in moving forward in this area—

- Smaller distances and dense population create greater liquidity in logistics exchange markets.
- Robust wireless communications infrastructure makes real-time communications possible.
- Korea can benefit from the U.S. experiences.

Strategy

4.56 The government should follow a combined strategy of encouraging the commercial provision of the service and promoting the service to the trucking community with the goal of stimulating collective action among firms.

4.57 First, within three months, the government should specify the functionality for the service using a Request for Information (RFI) process to gauge industry interest. The RFI should—

- Specify that the service must provide an easy means for buyers, shippers, and truckers to collaborate on deliveries.
- Stipulate that the government will support the initiative by assisting the winning offeror in acquiring start-up capital, and by assisting in reaching out to the truckers (see below).

4.58 Based on the responses to the RFI, the government should craft a Request for Proposals (RFP) that requires responses in three areas—

- Technology and management plan describing the functionality and operation of the proposed solution and how the offeror will assure success.
- Deployment and marketing plan to connect with the communities of interest (buyers, shippers, and truckers).
- Business plan to make the operation economically viable within three years.

Selection of the service provider should be completed within nine months and should be based on a balanced evaluation of the three areas.

4.59 Second, the government should promote the project through the 50 SMBA support centers nationwide and MOCIE's Electronic Commerce Resource Centers. Outreach to Korean trucking associations will also be critical as will coordination with other, ongoing initiatives. This outreach should be coordinated with the publicity campaign recommended as part of the Business Information Services strategy.

4.60 As mentioned above, Korea stands to gain important lessons-learned from the failure of many U.S. logistics information services, as well as from the best practices of players who succeeded in maintaining their competitive edge. A useful avenue to gain key insights from the U.S. experience would be for Korean officials to visit American logistics enterprises, as well as major trucking companies, trucking and shipping associations, and universities such as the University of Maryland's Supply Chain Management Program offered through its business school, in order to formulate more concrete ideas of how the U.S. system could be best adapted to suit the Korean market. Although the domestic logistics information services recommended above cannot and should not be offered by the government, knowledgeable government representatives should act as catalysts.

Strengths and Challenges

4.61 Why choose these services as priority? Increasing access to market information and logistics satisfy the following criteria—

- They build on Korea's core strengths in Connectivity, E-Leadership, and Human Capital.
- They address the principal challenges facing Korea in its advance toward the knowledge-based economy.
- They involve a key segment of Korean society -- small businesses -- who will help lead the rest of the society forward.
- They can be implemented relatively quickly because there will be a positive appetite for and sense of ownership of these services among the private sector stakeholders.

4.62 This section discusses the first two criteria. The subsequent section, "Costs and Benefits" discusses the second two. A final section discusses process and coordination.

Building on Core Strengths

4.63 The E-Readiness analysis of Chapter 3 identified a variety of Korean strengths in its move towards a knowledge-based economy. These strengths include the broadband communications infrastructure, strong top-level leadership, high level of network awareness, and a strong entrepreneurial spirit.

4.64 The selected leading edge services build on all these strengths. In particular, they require the strong foundations of infrastructure, network awareness, and entrepreneurial spirit. They will increase the international competitiveness of Korea's manufacturing sector.

4.65 They will also depend heavily on continued high-level leadership. Because of its importance, this aspect is discussed separately in the "Process and Coordination" section at the end of this chapter.

Addressing the Principal Challenges

4.66 The selected services address, either directly or indirectly, the principal challenges that Korea faces in creating a knowledge-based economy. These challenges are of two kinds, those specific to e-business/e-transformation, and more general E-Readiness challenges. The relationship between the selected services and the challenges is summarized in Table 4.3.

4.67 While the selected services address each challenge in some way, they are not by themselves enough. Areas such as increasing market openness and clarifying the legal infrastructure are proceeding on separate tracks. Strong links between the people who direct this program and those with primary responsibility for other relevant areas are essential. The absence of such links could lead to duplication of effort or working at cross-purposes, detracting from the effectiveness of the focused approach. This issue is discussed further at the end of this chapter.

Table 4.3: How the Recommended Initiatives Address Recognized Challenges

Challenge	Market Information	
	Business Information Services	Domestic Logistics
E-Business Challenges (as listed in April 2000 initiative)		
- Need for cooperative culture among firms.	D	D
- Improving confidence in e-business and increasing low investment capacity among SMEs.	D	D
- Slow progress in management innovation and increasing transparency of business practices.	D	D
- Need for more progress on standardization, human resource development, and electronic payment systems.	D	D
E-Readiness Challenges (from figure 3.5)		
- Need to integrate network services into SME processes	D	D
- Transportation and logistics infrastructure	I	D
- Coordination among ministries	I	I
- Need for focused approach	D	D
- Valuation of intangible assets	D	I
- Transparency in business and regulatory transactions	D	D
- Market openness	I	
- Legal infrastructure unclear	I	I
- Need for product quality standards	I	D

Key: D = addresses the challenge directly. I = contributes indirectly to meeting the challenge.

Costs and Benefits

4.68 The services are also recommended because they will produce the maximum strategic benefit at the least cost. Least cost, however, does not mean no cost. In general, significant weight has been given to the strategic benefits of these initiatives as flagship examples. Table 4.4 and Table 4.5 provide an overview of the costs and benefits in the priority areas.

4.69 Costs may derive from a wide variety of sources, the most important being—

- Investment costs to improve E-Readiness at national and firm level.[32]
- Opportunity costs from delays in implementation.[33]
- Frictional costs of overcoming resistance to change.

Table 4.4: Costs in Priority Areas

Leading-Edge Service		Investment Costs (national and firm level)	Likely Opportunity Costs from Delay	Frictional Costs Not Directly Compensated for by Perceived Participant Benefits
Market Information	Business Info. Services (for Core Industry Suppliers)	Low. Korean national E-Readiness is adequate in all five areas. 85 percent of firms in the core industries already have Internet connections.[34]	Medium. Preparing and implementing a promotional campaign that publicizes best practices will require time for foresight and planning.	Low. Utilization of the survey method to assess and respond to SMEs' needs will create buy-in from SME stakeholders.
	Domestic Logistics (Domestic Trucking)	Medium. Connectivity remains a challenge in remote areas. Firm level Internet access is unknown, but our estimate is between 30 and 50 percent.[35]	Medium. Uptake will be slow and some considerable outreach and education will be required. See sequencing and process discussions below.	Medium. Substantial resistance to change is likely from existing middlemen. This must be countered with a strong public education campaign to the two most direct beneficiaries—primary producers and end consumers.

[32] One approach to firm-level cost, is analyzing the total cost of ownership (TCO) for firms not presently connected or not using the Internet fully. TCO is a calculation of the expense involved in deploying, maintaining and troubleshooting computer resources in the enterprise. In the words of Intel (Japan), "It's a slippery concept to define and estimates vary widely. But everyone agrees that, over its lifetime, a computer system will cost your company far more than you paid for it." Many reputable Korean and international consulting firms offer TCO analysis services.

[33] Delay is particularly costly when dealing with rapid technology changes and, in Bill Gates's words, "Business@ The Speed Of Thought."

[34] Firm connectivity information in Figure 4-5 comes from a June 2000 survey by the National Computerization Agency, contained in its Internet White Paper 2001.

[35] According to the NCA survey, only 30 percent of agricultural firms have Internet connectivity, and fewer than 70 percent of all very small firms (1-4 employees) have connections. The domestic trucking industry is comprised primarily of small firms.

4.70 Possible benefits may also come from several areas, the most important being—

- Higher domestic productivity in core industries served by market information services and benefiting from streamlined logistics services.

- Strategic leverage from increased participation in the knowledge-based economy by underserved portions of Korean society, and from creating strategic examples to inspire other participants.

Fully realizing these benefits depends on a host of other reforms and changes that will enable network-enabled services to make their full contribution to the Korean economy.

Table 4.5: Benefits in Priority Areas

Leading-Edge Service		Domestic Productivity Benefits	Export Benefits	Strategic Leverage from Increased Participation and Leadership by Example
Market Information	Business Info. Services (Core Industry Suppliers)	High, based on the experience in U.S. manufacturing industries.	Indirect, via increased productivity in leading export industries.	High. A large number of firms and individuals are affected at the core of the Korean traditional economy.
	Domestic Logistics (Domestic Trucking)	High, as this is will help clear a major production and economic bottleneck.	Indirect, via increased economic efficiency.	High. By reaching SMEs in remote and rural areas, the initiative will spread participation to currently unconnected populations.

4.71 It is worth noting the implications of these proposals for market structure in Korea. Notwithstanding the Framework Act on Small and Medium-Sized Enterprises, which limits the activities of large firms in order to protect SMEs, competition in domestic markets remains restricted.[36] Thus there is a strong possibility that the exercise of market power by large conglomerates could inhibit the development of a flourishing domestic network-enabled services sector. The Market Information services are designed to give immediate and direct support to SMEs in the most critical sectors. It is expected that this action would have a useful distributional effect as well. By attacking the "digital divide" at the small business level, it will stimulate new sources of wealth creation and improve living standards among underserved and rural populations.

[36] In the longer term, the Act may need to be amended to cover network-enabled services activities explicitly. However, that legislative effort is not recommended as a priority here for two reasons. First, efforts to legislate in the early stages of an emerging industry usually wind up creating unintended rigidities and can even distort the normal growth of the market. Second, such legislation would likely take several years to enact and longer to have its effects, considerably slower than the currently adopted time frame.

4.72 These objectives are key to stimulating increased participation in Korea's information society, an important means by which to fuel the domestic economy. The economy cannot rely upon the export of network-enabled services to predominantly English-speaking consumers, particularly when forced to compete with countries which have established a well-branded presence in the provision of low-cost services as a result of low labor costs. By focusing instead on its existing strengths, Korea will succeed in engaging an increasing number of national stakeholders.

Process and Coordination

4.73 As with any process of social change, creating a knowledge-based economy requires the buy-in of those who will be affected. The Korean government has strong relationships with the private sector. Recently the government moved to formalize and strengthen these relationships by establishing an e-Business Roundtable of Korean business leaders. Because the knowledge-based economy will create winners and losers, buy-in from opinion leaders in the affected economic sectors is essential. Without buy-in, there will be limited adoption of the technologies, and few benefits. A coordinated public information strategy to promote these initiatives will be essential to success. More critical will be the creation of partnerships with the private sector. It is for this reason that private sector participation and consultation is emphasized in the discussions of each of the leading edge services.

4.74 Collaboration among ministries will be an equally important part of this strategy. For example, a large number of programs already exist to assist SMEs. These programs need to be evaluated for their effectiveness and consolidated or eliminated where necessary. A streamlined program should be established that responds to market needs, targets specific industries, and creates synergies rather than wasteful duplication and overlap. The recent decision in June 2001 to clarify responsibilities among the various ministries working for the knowledge-based economy gives the lead for non-infrastructure matters to MOCIE. This clarification is a welcome development, which paves the way for focused initiatives in the area of network-enabled service.

5. IMPLICATIONS FOR OTHER DEVELOPING COUNTRIES IN THE REGION

5.1 Consistent with the spirit of the Knowledge Partnership between Korea and the World Bank, this report is designed to enable other Asian countries to build on the Korean experience. The example of Korea's strong position in many aspects of the knowledge economy, the prospective benefits of network-enabled services, and the analysis of the competencies required to provide them will offer a sound basis for evaluation, planning, and action by the governments of these countries.

Evaluation

5.2 Before a country can undertake any sort of transformation towards a knowledge-based economy, it is vital to first take stock of what progress has already been made in order to obtain a keen understanding of what the next logical step would be. Thus, countries need to assess their current position in terms of their "E-Readiness." All five attributes -- Connectivity, E-Leadership, Information Security, Human Capital, and E-Business Climate -- need to be explored to capture the broadest picture of a country's strengths, weaknesses, and gaps. E-Readiness as a whole should be evaluated first. Once a broad sense of a country's current state of progress has been gained, only then should the specific competencies needed for network-enable services be examined in further detail. A closer examination of individual E-Readiness components will enable specific target areas to be pinpointed, thereby prioritizing where action is to be taken. Korea's experience in this process is instructive.

Planning

5.3 Governments need a vision that aligns with their strengths and with global market needs. As mentioned earlier, Hong Kong wants to be an e-trading hub, Jordan a regional leader in software development, and India the home of outsourced services. Each of these countries has a plan to achieve their goal that examines their society from all aspects of E-Readiness, and then prioritizes actions to be taken and deadlines. As recommended for Korea, the more specific a country can be the better. For example, Latvia also wants to be a leader in software development, but is being crowded out by its Central European neighbors, such as the Czech Republic and Hungary. In response, Latvia has decided to focus on security software as its "niche" product and seeks to be a global leader in developing this service. Once established, Latvia can branch out and offer other types of software development. It is important when planning to choose one or a limited number of network-enabled services that are a natural match for the country's level of E-Readiness.

Action

5.4 As developed countries cope with a temporary economic slowdown, emerging economies' governments, and their private sector partners, now face a great opportunity to narrow the gap between themselves and the global leaders. It is a time for action to remove barriers and move forward, learning from the policy development experiences of developed countries, and standing on their shoulders to leapfrog the old technologies. Strong partnerships, led by the private sector, and enthusiastically supported by all levels of government and by non-governmental organizations, are the best way for countries to improve the business climate for entrepreneurs and make the difference in future global position.

5.5 Sharing information across borders enables neighbors to learn valuable lessons and avoid making costly mistakes. Focused, well-managed, and action-oriented public-private networks, regional collaboration, and global exchanges on the knowledge-based economy are the most effective means for valuable discourse and collaboration.

Promotion

5.6 Korea's successes should be promoted both nationally and across the globe. Promoting achievements realized from careful evaluation, planning, and action will help to spur additional action and will increase the level of understanding and acceptance among all people.

PART C: SKILLS THAT MATTER IN THE WORKPLACE

1. INTRODUCTION

1.1 Korea has attained remarkable achievements in education over the past three decades and the quality of its basic education has been internationally acclaimed. Total education expenditure has increased from 8.8% of GDP in 1966 to 13.3% in 1998, the highest share for any country at this level of development.

1.2 Illiteracy reached near zero in 1997, primary school enrollment has been 100%, and secondary school enrollment is almost universal. Drop-out rates from schools are also very low: 2.1% for high school, and 2.5% for higher education. At the same time, class sizes are smaller and while pupil teacher ratios in Korea remain higher than the OECD average of around 20 for secondary education, they have fallen from 40 in 1970 to around 25 in 1997.

1.3 At the tertiary level, Korea ranks third among OECD countries in the educational attainment of its population with 84% of its high school graduates entering a university or college in 1998. Although countries like the United States, Australia, and Finland are ahead of Korea in terms of enrollment rates, it is noteworthy that Korea has overtaken Japan and the UK. Female tertiary enrollment has also surpassed Japan and Singapore. Korea also boasts the highest growth rate in scientific publications among the OECD countries.

1.4 Student performance has consequently improved. According to the TIMSS study, Korean students at the 4th and 8th grades performed significantly better than the OECD average. In mathematics in particular, Korean students obtained the highest scores among all participating countries, followed by Japan. Results from the most recent OECD Program for International Student Assessment (PISA) also show that Korea's 15-year-olds have scored very high in scientific and mathematical literacy, followed by Japan among 32 participating countries [1].

1.5 There are however a few issues of concern. While public expenditure per student as a percentage of GNP per capita in Korea has increased for primary and secondary education it has been stagnant for tertiary education. It is only recently that the government has launched an ambitious project, known as Brain Korea 21, which provides competitive grants to tertiary institutions (WBI, the Korea Knowledge Report, 2001). Also, while total education expenditure has been increasing, only 4.4% of its share is publicly financed which is lower than the OECD average of 4.9% for 1995,

[1] Knowledge and Skills for Life: First Results from PISA 2000 (http://www.sourceoecd.com/data/cm/00003527/9601141e.pdf).

despite the government's proclaimed commitments to education and human resource development[2].

1.6 A number of factors have recently exacerbated these concerns. First, slower population growth rates have resulted in the population aged 15-24 years to decline forcing something to be done about the quality of labor. Second, following the economic crisis of 1997, the government urged corporations to liquidate unprofitable businesses and to proceed with mergers and acquisitions to accelerate corporate restructuring. As a result, many workers were laid off and Koreas long-practiced life-long employment customs came to an end. Since then, the economy has recovered quickly, and the employment rate which now stands at 3.6 percent (pre-IMF crisis level) has again been on the rise with ongoing restructuring. Currently, South Korea's labor market is relatively rich in human resources with a higher selection standard due to an economic recession and corporate restructuring. Finally, the demands of a knowledge-based economy have placed special emphasis on the ability of a nations workforce to bring about industrial and organizational innovation which are becoming the cornerstone of maintaining competitiveness.

1.7 Several industrializing and industrial countries share similar concerns. In fact, in the US there is growing recognition of the fact that the skills necessary in the current workplace -- which is increasingly characterized by continuous change in a global, competitive environment -- are drastically different from those taught in schools and colleges. Evidence from other countries also suggests that the new knowledge-based economy requires a different type of organization of production, which calls for changes in the relationship of worker to work, worker to worker, and worker to consumer, and seeks to stimulate continuous improvements made by workers. To maintain relevance, education and training institutions need to become more market-orientated; i.e., meeting the needs of employers and students alike. However, in reality, whereas the workplace has undergone exponential change, education systems are undergoing only incremental changes. This mismatch between the rates of change in industry and education has been attributed to a number of factors including lack of private industry's participation in shaping education reform.

1.8 Part A of this report has documented that Korean firms are still lacking both upstream and downstream capabilities and as such remain in a catch-up mode of development. To overcome these weaknesses would require, among other things, good quality scientists/engineers and better communications between academia, industry and policy groups. Part B goes on to strongly suggest promotion of creativity as a strategy to transform the Korean economy into a knowledge-based one. In essence, both chapters bring attention to education reform. The next logical step towards tailoring and speeding up education reform is to understand the direction and magnitude of change that has already taken place in the workplace. This study attempts to take this first step for Korea

[2] This year, the government has upgraded the Ministry of Education to be headed by a deputy prime minister and also changed the name of the Ministry from the MOE to the Ministry of Education and HRD. In addition, the government took several measures to increase education budget by for example earmarking 13% (formerly 11.8%) of the internal tax revenue for K-12 education.

by investigating the hiring, retention, training and reward practices of high performing firms. By doing so, this study corrects for the fact that the views of the private sector have been largely absent from past policy discussion and reform efforts at the secondary and tertiary levels.

1.9 The format of this paper is as follows: Section 2 identifies the major changes occurring in the workplace that have significant repercussions for workers and employers. Section 3 then identifies the skill requirements for both market entrants and existing workers. It also examines the relevance of school education for high performing firms. Section 4 discusses the implications of these changes for education reform policies for the government.

METHODOLOGY

1.10 The design of the work is to backward map from what employers say are important skills and attributes for workers across a variety of positions. The establishments in the sample come from the both the manufacturing and service sectors. While there continue to be many low skill, low wage jobs in the Korean economy, this study focuses on the frontier by selecting firms that are characterized by high performing work practices. For the purpose of this study, a firm is considered a high performing workplace if it is ISO certified or it can clearly articulate the process by which it selects workers using a formal test instrument, and continues to invest in worker development through formal training(in-house and outside); or it has a structured quality program and continues to invest in worker development through formal training(in-house and outside). It is expected that global pressure will require others to gradually emulate many of these practices[3].

1.11 The sample includes major establishments with more than 300 workers. Sectors represented include telecommunication, automotive, electronics, distribution, tourism, and banking. The instrument was designed to include both open-ended questions with follow-up probes as well as a number of more structured questions that required the respondent to rank their response to certain questions using a Likert scale ranging from a response of 1 (not important) to a response of 5 (very important). Interviews were held with the general manager, a supervisor, the director of human resources, and the training manager at relevant establishments. In some(smaller) firms, often the general manager and a supervisor responded to all questions as there was no formal head of human resources or training. Most questions focused on recruitment, selection, worker qualities and training. Employers were also asked to discuss the characteristics of outstanding workers.

1.12 In addition to conducting face to face interviews, company documents related to recruitment, selection, training and evaluation were collected and reviewed. For each establishment, a full narrative case study was developed.

[3] The firms were identified by peer referral to ensure a sample representative of leading human resource practices.

2. THE CHANGING WORKPLACE

ORGANIZATIONAL CHANGE WITHIN FIRMS

2.1 There is some evidence that high performing firms are rapidly changing the way they organize work, make decisions, carry out functions, and produce goods and services. To remain competitive, these firms are moving towards a decentralized flat organization, knowledge intensive production and quality management.

2.2 Less hierarchical, team work and quick decentralized decision making. Since the economic crisis of 1997, many Korean companies have been forced to change and restructure their business practices. In particular, the companies surveyed have systematized and restructured their internal organization in order to deal better with rapid changes in industries and new macroeconomic instabilities in the global economy. The organizational structure of high performing firms has become more horizontal than ever before through various efforts to simplify previously complicated decision making processes.

2.3 One common trend is that traditional hierarchy is being replaced by task/project teams through delegation of authorities and networking. In the past, Korean major companies were organized around a pyramid type of management structure with multi-level decision-making. Now, many companies have introduced the team system, eliminating many middle-management positions. Traditional divisions and departments still exist but they are renamed based on their jobs and duties. Smaller companies, service firms and newer companies are quicker to adopt new management structures. In the new system, reporting channels have been streamlined and simplified. For production workers, the pattern is: worker–technician–team leader–head–director. For clerical workers: worker–deputy manager–head–vice chief–chief–director–CEO. The current four to five layers replaces a previous system of eight to nine layers between worker and head of the organization.

2.4 Another important trend is that computerization has reduced the time gap between decision-making and implementation, and as a result new methods are quickly adopted to work sites. For instance, the adoption of on-line approval system at L Distribution, S Telecom, C Hotel and H Bank has eliminated all excess paperwork[4]. The work processes has been computerized to the extent that notices, communication between workers, complaints, suggestions and grievance procedures are processed on-line for horizontal information sharing. In addition, innovative activities along production lines, including 6 Sigma and FI-10 at L Electronics and Win21 and Line-Stop systems at H Automotive are examples of new effort to "flexibly control" the work

[4] Establishments have been coded for confidentiality reasons.

process. At L Distribution, a detailed manual has been instituted through MCS 2001 for customer satisfaction.

2.5 Knowledge-intensive production. Manufacturers are increasingly standardizing and automating production procedures and quality control methods for acquisition and maintenance of standard certifications set by international organizations. Thus, workers are required to understand and follow the new rules and regulations. Work process reports and errors are submitted on written forms to related teams or workers. For the service industry, workers are asked to attain comprehensive knowledge of their field, standardize and raise the quality of service, while following all regulations and improving their language skills. These work skills are constantly checked and evaluated.

2.6 In the case of H Automobiles, managers predict increased demand for knowledge in electronics and computer utilization skills as automation increases. Managers at L Electronics point out the increasing requirements for problem-solving, knowledge-acquiring skills, and IT skills with more adoption of new technologies. In C Hotel, service related professional knowledge and skills are stressed. In the case of H Bank, managers point out the reduced need of calculation and bookkeeping functions and services. Leadership skills and analytic ability are more emphasized for senior managers.

2.7 Increasingly workers are expected to have more comprehensive knowledge relevant to their job area. H Automotive, for example, expects its new workers to be familiar with electronics and computers as production lines are being automated, while L Electronics focuses on problem solving, academic and IT skills. H Bank notes that calculating and accounting skills are less important, and consulting skills and customer relations and service skills are more important. Survey results reporting skills used at work in order of importance are depicted in Figure 3.2.

2.8 Quality product/customer oriented management. South Korean companies in the past have found their niche in the international market with mass exports of low cost products. However, since the 1990s, domestic wage hikes and increasing competition with newly industrialized Asian economies, has forced companies to realize the importance of innovation and quality advancement to maintain competitiveness in a global market. As a result, Korean firms have in recent years paid more attention to producing higher quality goods with investment in infrastructure, technology and people.

2.9 Most companies surveyed are certified with ISO 9000 and 14000 from organizations abroad. An ISO certificate proves standardized service and quality, and is widely required by international consumers as verification means. It also contributes to improving productivity and quality while lowering manufacturing cost. Companies are enthusiastic about ISO certification programs and require that workers perform their work with a sense of duty and participate in the education programs that companies offer. At H Automobile, workers are given qualifications with training of skills required to perform tests and inspections required under ISO.

2.10 In addition, companies also set target production volumes and evaluate their goals with quality control teams. Quantitative goals for production volumes are agreed to and production line workers are required to sign off on each product produced to insure a sense of accountability. Quality is controlled and checked by accurate measuring equipment and also by customers' feedback. At L Electronics and H Automotive, it is mandatory to check work processes before and after work begins and ends, and to have outside suppliers subject to evaluations and provide skill guidance periodically. S Telecom carefully reviews customers' comments and complaints and deals with them in order of importance.

Changes in Human Resource Management

2.11 High performing firms are also moving away from year-old practices of human resource management. This emerging trend is seen at every stage of human resource management from recruitment to the rewarding system, the main focus being on reinforcing competence and performance.

2.12 Flexible and decentralized recruitment. The patterns of employment and recruitment have rapidly changed in major enterprises in Korea, since the economic crises of 1997. In the past, firms recruited a large number of workers through once-a-year regular employment season. The economic crisis has forced firms to turn to "quality approach" to human resource management. Efficient use of existing workforce is perceived to be more important than a large scale new recruitment, and firms tend to prefer to fill up vacancies whenever necessary, instead of fixed seasons as in the past. They also tend to prefer more experienced workers who are ready to be assigned to work immediately. In this regard, several trends are noteworthy.

2.13 The first trend is that companies hire workers based on occasional demands and vacancies. This has caused firms to do 'just-in-time' hiring – as and when a need arises rather than the old practice of hiring during fixed periods of the calendar. L Electronics and H Automobile fill vacancies seasonally, as these companies have large numbers of employees, while S Telecom, C Hotel, H Bank and C Distribution hire their employees whenever there is a need.

2.14 A second trend is that human resource management has moved towards shop/front-line managers and away from personnel department. While the personnel department is still responsible for overall recruitment process, the actual recruitment is determined by shop managers. These front line managers also decide the kind of skills or competence that candidates should possess and they actually conduct the interview. At L Electronics and H Automotive, production line workers that occupy 60-70 percent of the entire workforce are hired and managed by front line units or local offices.

2.15 A third trend is that the terms of employment are also changing and new entrants should increasingly expect to be offered contractual employment instead of tenure-track positions: a feature of post-economic crisis which placed emphasis on promoting flexible employment and lowering labor costs. Managers interviewed were mostly hesitant to reveal the level and proportion of such employees, only to say that they maintained at "a certain level."

2.16 **Upskilling, and pursuit of competences/worker attributes.** The survey finds that high performing firms with exception of production workers are no longer hiring high school graduates, and instead they prefer workers with college or above level education. S Telecom, H Bank, and C Hotel presently are not hiring any high school graduates. In the case of banking establishments, business high schools were frequently hired before. But, hiring of these graduates are "quite rare" these days, says one manager. The same is true with manufacturing companies which used to hire graduates of technical high schools. Automation and computerization appear to have eliminated comparative edge of VOTEC high school graduates.

2.17 Managers of high performing firms insist that education level and occupational skills were not viewed as the sole critical part of their recruitment decisions. Most firms are also concerned about other characteristics of workers. The company managers tend to demand greater attention for basic character education and etiquettes, no less weight on major/concentration of worker's education background. Many managers point out that while the younger generation of workers has exhibited improved proficiency and creativity, they seem to lack spirit of sacrifice and patience. Additionally, some workers seem to enter with excellent IT skills but lack practical language skills. Most notably, desirable competences and worker attributes are examined and assessed through in-depth interviews and aptitude tests.

2.18 In-depth interviews are more often employed to sort out the candidates because interview tools are thought to be better suited for assessing worker traits such as creativity, problem-solving and teamwork abilities. Interview panels are often composed of executives, personnel managers, and the relevant department manager. The sample survey results indicate that group interviews tend to be used for clerical positions and individual interviews for production workers. Interviewers ask questions about each candidate's special skills and personality while checking them against their application form. The typical checklists are: the prospective employee's communication skills and logical skills (L Electronics), attitude toward work place (S Telecom), and good manners and hospitality (C Hotel and L Distribution). As for H Bank, interviewers participate in a 2 day training camp and evaluate participants' social skills, creativity and cooperation through games, discussions and debates. Interviewee's personal opinion on the company and its corporate goals are also frequently asked. At L Electronics, for instance, they ask questions like "What would you do if your boss asks you to do something improper?" Clear and logical answers are likely to get more points.

2.19 Results of aptitude tests are widely used in place of language and basic knowledge tests. The test comes in a standardized questionnaire form and is designed to evaluate the prospective employee's intelligence, creativity, organizational suitability and so on. S Telecom conducts personality and aptitude tests with 345 and 150 questions, respectively.

2.20 **Less job rotation and better rewards for new ideas, training and performance.** Most companies surveyed do not enforce job rotation but place efforts to train and encourage workers to acquire core skills and competence. The survey confirms that companies normally do not conduct job rotations except for some particular cases. Instead, they attempt to equip workers with specified and yet multi-facet skills. At L

Electronics, job rotation rarely happens in order to provide employees with opportunities to specialize in their area of expertise and gain comprehensive knowledge. Even in the cases of some occasional relocations, OJT and training sessions are provided at all times to allow employees to adapt to new technologies and working environments.

2.21 A closely related trend is that the firms surveyed have a systematic way of rewarding new ideas. Worker Suggestion Programs (WSP) are widely practiced. Workers voluntarily participate in WSP at L Electronics, H Automotive, S Telecom and H Bank while it is obligatory at M Distribution and C Hotel. L Electronics, for example, has a WSP in which employee's ideas are solicited such that workers are encouraged to come up with new ideas on improvement of working condition, and neglected matters. The aim is to improve while motivating them to be creative and interested in their workplace. The companies are quick to take action on issues raised by workers' suggestions. Submitted ideas are reviewed and companies notify the workers of the results or actions taken. Good suggestions are monetarily rewarded and reflected into performance appraisal in companies such as S Telecom, H Bank and C Hotel.

2.22 In addition, training and the resulting increase in competence are well rewarded by the high performing firms. Most employees can expect to be continuously evaluated rather than the old practice of once a year evaluations. Employees are rewarded for undertaking proactive measures to improving their job skills. To that extent, workers are more tuned in to the advice and comments from co-workers as well as senior workers. At H Automotive and L Electronics, promotion tests and other special programs are undertaken during these courses. Companies commonly grant generous educational benefits for long-time serving employees. Sometimes, these employees become in-house trainers. In some companies, employee's course performance level is rigorously evaluated through tests and the course credits obtained are strictly managed. For instance, the 6 sigma program motivates workers by awarding them with different belts-- from green belt to black, master belt -- to those workers who are aware of the program and actively participate in it. Many of the workers themselves are also enthusiastic about improving their job skills. This is because employee's efforts are actively considered in performance ratings. Improving job skills is also a motivating factor which increases self-esteem. With the current atmosphere job insecurity, workers recognize the importance of promoting self-improvement, competency and the like.

2.23 Workers' compensation structure in Korean firms has been based on seniority payment system. Recently, companies have started to introduce annually-based compensation system based on employee's abilities and performance[5]. The companies in this survey adopted an annual salary system mostly for their managerial workers, but have plans to expand it to lower level worker groups. Some are also considering introducing production line workers based on their performance.

2.24 H Automobile runs an annual salary system for its managerial workers and time payment for production line workers. L Electronics does the same for managerial

[5] An 'annual salary system' is a performance-based compensation system where a line worker can be paid more than his immediate manager. The term 'annual salary system' is used because it is value-neutral.

workers but applies serial payment to its production line workers. H Bank compensates its managerial workers based on output payment, and pays other workers by the salary class system. At C Hotel, deputy managers or above receive an annual salary.

2.25 Workers on an annual salaries program get a 200-700 percent bonus depending on their performance and evaluation results while other workers receive a fixed amount for their regular bonus. In cases of an outstanding increase in profit, workers are additionally compensated at year's end. Individuals or groups also receive incentives upon the realization of significant performance. At L Electronics, workers are irregularly compensated in cases of outstanding performance while S Telecom disperses incentives individually. H Bank pays 20 percent of the worker's salary as a bonus, and H Automotive and C Hotel pay in groups or individually. These practices are intended to equitably compensate the workers in a manner commensurate to their performance.

2.26 **Increasing investment in OJT for competences.** For high performing firms, training cost has risen enormously compared to past standards. It had reached 8 billion Korean Won(KRW) for H Automotive (= 6 million USD), 16 billion KRW (=12 million USD) for L Electronics and 8.5 billion KRW (6.4 million USD) for S Telecom. These companies also provide specialized training programs to develop professional skills of workers.

2.27 Most companies surveyed have created, in addition to personnel departments, separate divisions and officers for education and training to develop a variety of training programs for their workers. Examples include: Learning Center of L Electronics, Human Resource Development Team of H Automobile, Human Resource Center of S Telecom, and Cyber Learning Center of L Distribution, H Bank and C Hotel. Companies with multiple business units and factories also have independent education programs on sites where the head office provides the guidelines for education and training, support them and, when necessary, delivers training programs directly.

2.28 OJT is provided to all employees: office workers, production and sales workers and executives and managers. In the past, managerial workers were excused from these sessions, but nowadays, they too are attending courses. Training programs for leadership skills, counseling skills, managerial skills and motivating skills are offered to managerial workers. L Electronics, H Automotive and S Telecom are all active in providing training to mid- to senior managers.

2.29 The skill areas covered by OJT for workers is very diverse: job and skill training, service skills training, language or IT training, attitude training and management training. There are also retraining and improvement training by various job areas. Job skills training is divided into office work, administration, sales and production line training. For instance, H Automotive offers leadership programs to office workers; service and sales skills to salespersons and telecommunication personnel; and automotive classes to production line workers. In addition, ICT, language and self-development programs are made available to all workers regardless of their duties or level of position.

2.30 OJT is delivered through various modalities including on-line lectures, traditional training programs and courses at external institutes. Occasional OJT sessions are also offered by senior workers and visiting instructors. Most importantly, however, firms have started to provide e-learning. High performing firms use internal intranets to deliver online lectures to employees of all ages(20 to 40) and even to production line workers. In the service-oriented companies surveyed, in-house instructors (senior managers or experienced trainers on the payroll of the firm) play an important role in the education department. In-house instructors have been proven to motivate workers and are able to effectively introduce new tactics and knowledge. C Hotel features instructors in 20 different fields including marketing, accounting, finance, management and hospitality and they are well received by trainees.

3. SKILLS AND ATTRIBUTES REQUIRED FOR HIGH PERFORMANCE

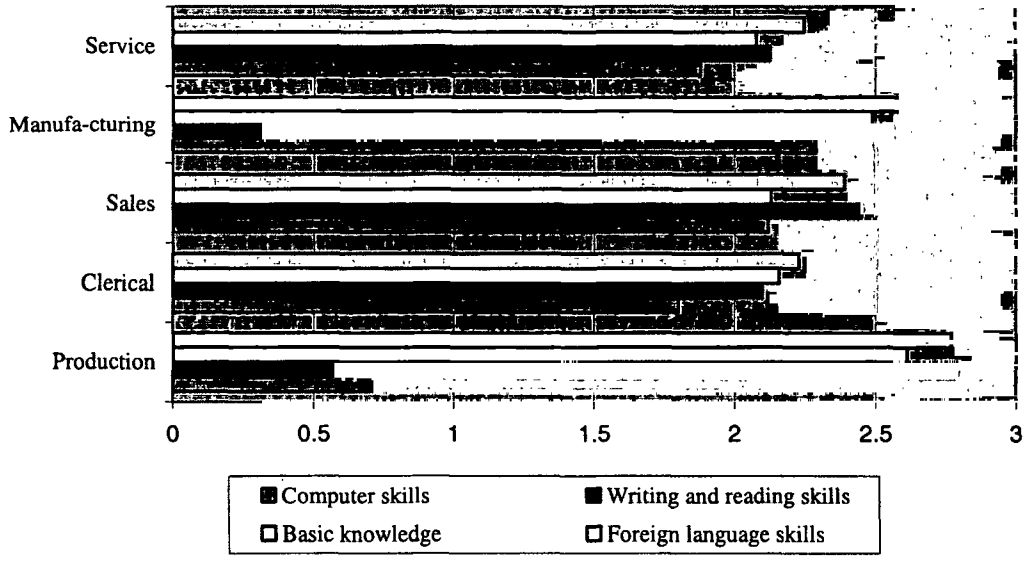
3.1 Changing workplaces have required a new set of skills for both market entrants and existing employees. The focus has been placed on learning new skills continuously. Relevance of school education is questioned.

SKILLS FOR ENTRY LEVEL WORKERS

3.2 For market entrants, it becomes increasingly important to possess foreign language and solid basic/generic skills or learn-to-learn skills. Also critical is to build good personal traits such as team work skills and communication skills.

3.3 Changes in workplaces have obviously created demand for a new set of skills for labor market entrants. Rapidly changing technologies require workers to possess strong work-related specialized knowledge and skills, noticeably with a higher component of IT related skills. However, it is nearly impossible for workers inherent skills to match up with the needs of the changing workplace, hence the trainability of workers by the firm has become an important factor. Managers define trainable workers as those that possess some "soft" skills such as foreign language or problem-solving skills.

Figure 3.1: Skills needed for entry level workers (1 to 5 scale)



3.4 Firms surveyed believe that much of what an employee applies towards a task is largely learnt on-the-job, hence are trying to gauge the level of 'trainability' of a prospective worker. Figure 3.1 above shows the order of important skills for the selected firms. Note that the scores for foreign langue skills and writing and reading skills are consistently high across all industries. The practice of using an aptitude test coincides well with the trend of skill requirements.

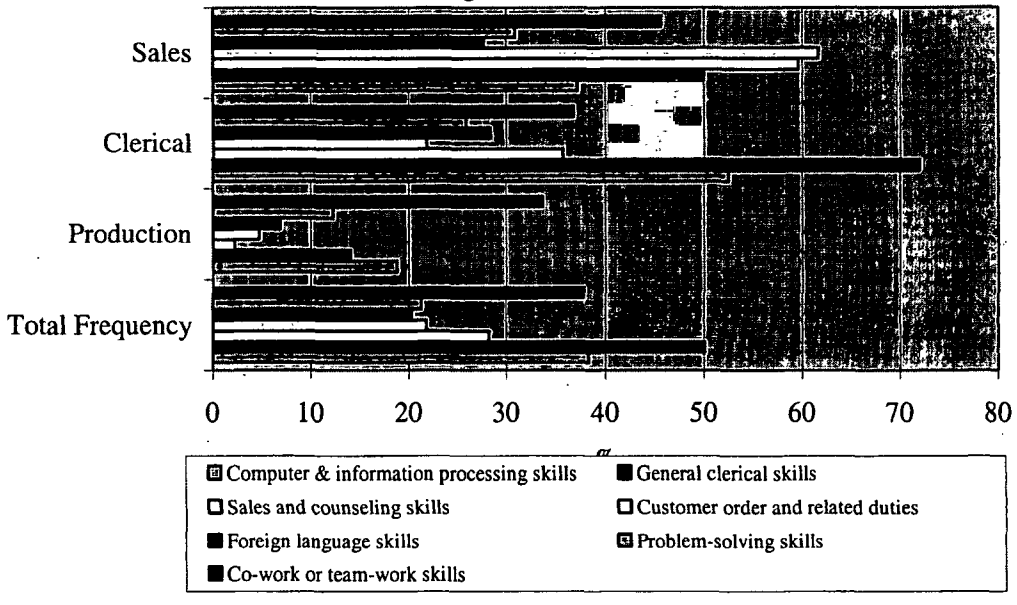
3.5 In order to foster an innovation-prone work environment, the ability of workers to get along, communicate with other team members, and cooperate in the face of radical organizational and technological changes is key. Managers of high performing firms tend to select workers with sound character because it translates into a good work attitude and performance. Managers assert that workers with good attitudes are more 'trainable' even when they lack professional skills.

Skills for Existing Workers

3.6 By the same token, existing employees are also seeing changes in the way their performance is measured and rewarded. This places an even greater emphasis than before on continuous upskilling or lifelong learning, and also on teamwork and the ability to coordinate minute processes among different members. Employees are encouraged to share knowledge and learn from each others mistakes.

3.7 When asked about skills and competence used at work, workers responded in the order of general clerical skills, computer/information processing skills, and teamwork skills. Figure 3.2 shows the importance of different skills across occupation type. General clerical skills, and computer and information processing skills are being widely recognized as a basic work skill for most workers. However, there are some variations in response by occupation type: production line, clerical, and sales workers. Problem-solving skills and academic skills are also considered important. The basic pattern is similar to market entrants since general clerical skills can be regarded as generic job skills. Compared to market entrants, computer skills are seen more important than foreign language skills for existing workers. Also notable is the importance of team-work skills.

Figure 3.2: Skills needed for existing workers (% of respondents)



3.8 The trend seems to be consistent with the new management practices which focuses on quality control, error detection and avoidance in manufacturing. This places new demands on employees. Whereas previously an employee did his/her job and passed it on to the worker at the next stage, now each frontline employee is expected to participate in the full process by learning the mechanics as well as the business consequences of manufacturing decisions.

RELEVANCE OF SKILLS ACQUIRED THROUGH SCHOOL EDUCATION

3.9 Regarding the usefulness of schooling, survey results indicate that many workers feel what they learned in schools is only partially utilized and hence not adequately useful in the workplace. Workers felt that computer and ICT skills were inadequately taught at school; English and foreign language at medium to low; basic knowledge and skills including mathematics, logical skills, composition and problem solving at medium to low. Interviewees said that they were not able to apply their knowledge of foreign language or mathematical skills, because they had inadequate training in these. Since problem-solving and teamwork skills are quite useful, more training in these fields in school is suggested by workers.

3.10 Managers also warn that while the demands for education become greater, the existing school curricular are becoming less relevant to the world of work. In a separate survey, managers and workers were asked to rank the level of mismatch of skills acquired in school and required in the workplace. Table 1 presents the results which point to a majority of workers and managers perceiving the discrepancy to be quite high.

Table 3.1: Managers and workers ranking of the difference between skills/ competences acquired in universities and those required at worksites (percent of respondents)
1 indicates no discrepancy, 5 indicates highest discrepancy

	No diff. (1)	2	3	4	Big diff.(5)	Total (# respondents)
Personnel managers	2.2	13.4	43.6	34.5	6.2	100 (417)
College graduated workers	1.6	9.5	23.5	53.4	12.0	100 (442)

Source: Korea Research Institute for Vocational Education and Training (KRIVET), 2000. A study on the business firms' satisfaction of university education (in Korean). p. 105.

4. CONCLUSIONS: IMPLICATIONS FOR EDUCATION REFORM

4.1 By listening to employers and workers in high performing firms, a number of issues become underlined for reform if Korea is to make the transition to a knowledge-based economy and compete globally. Some important trends have emerged from this survey of high performing firms:

- These firms are rapidly changing their organizational arrangements towards less hierarchical, more team work, quicker decentralized decision making, more knowledge-intense production and quality product oriented management;
- Human resource management is also moving towards 1) flexible and decentralized recruitment, 2) upskilling and pursuit of competences rather than mere academic credentials, 3) better rewards for ideas, training and performance, and 4) increasing investment in OJT for competences;
- Most needed skills and competencies are the general skills such as ICT skills, and ability/adaptability to work in a group and a changing work environment;
- Skills learned at school education are becoming less important or irrelevant while newly required skills are learned while on the job, especially through OJT.

4.2 **Reform is most needed in K-12 curriculum, pedagogy and assessment.** Workers report a mismatch between what they have learnt in school and what they need in the workplace (table 1). There is an urgent need to change curriculum content to reflect what is sought for at work. While basic conceptual and technical subjects need to form a cornerstone of any good education, Korean schools could benefit from shifting the focus away from the rediscovery of facts towards the application of analytical concepts and technical knowledge. For instance, national curriculum could focus on a few core subjects that deal with basic learn-to-learn skills and foreign language skills while providing local education authorities and schools with more discretion in terms of choosing other subject matters that lead to building characters and good attitudes. This would require a massive drive for deregulation and decentralization of curriculum policy.

4.3 Also required is the change in the practice of pedagogy and student assessment. To better perform in an ever changing knowledge-intensive environment, individuals need to possess problem-solving/team working skills as well as good personalities/behaviors. Desirable pedagogy would encourage a learner centered experimental learning, group learning and team work. Methods of student assessment also need revamping: moving away from examinations and measurement of student knowledge towards an ongoing evaluation of performance. Policies should attend to incentive mechanisms for teachers to boost the desirable practices in classrooms; and for students to build good/employable cognitive as well as behavioral skills. This would

entail an overhaul of teacher policies including teacher training and teacher incentives. Also important is college admission policy that has traditionally emphasized cognitive achievement over behavioral development.

4.4 **High school vocational and technical education need to be aligned with demand shifts.** The case of high performing firms indicates that most jobs are now filled with graduates from tertiary institutions and that production line is becoming more knowledge based. Managers are seeking workers who are more amenable to training and learning. Broad-based general knowledge appears to fare better in high paying professions. Policies are thus required to restructure upper secondary education to attune to the demand shifts. It may be time for traditional vocational high schools such as business and technical high schools to change their specialization into new skill areas including ICT and languages. On the policy side, more could be done to provide incentives to vocational schools for their transformation including teacher policies for retraining and redeployment.

4.5 **Public investment in higher education should increase to make it more affordable to both workers and employers.** The survey results show a strong demand for continuous learning by workers and for training by employers. It turns out that workers are willing to take further education and training as they are increasingly recruited and evaluated by competence and performance. The firms are augmenting their spending on retraining workers and changing their managerial practice to reward ideas, knowledge and training. Korea has been successful in privatizing higher education and as such spends relatively less on tertiary education than on lower level of education. While reversing this trend may not be feasible, alternative means of financing such as student loans could be considered to increase participation of adult population and workers in various learning opportunities offered by universities and colleges. To make the system more responsive to market, performance-based funding or/and competitive financing schemes could be considered. To induce spontaneity on the part of the tertiary institutions, deregulation process needs to be further expedited.

4.6 **The government needs to strengthen its role to build stakeholder partnership or a new social compact for lifelong learning.** New skills that matter at workplace would not be trained, acquired and utilized unless those who have important stakes are not working together to meet the challenges and opportunities set by a knowledge economy. Under the present scenario of rigid and largely irrelevant school curricula, Korean firms will need to undertake some training for their workers, almost on a continuous basis. This would entail a huge investment over and above formal schooling which will eventually erode firm's competitive edges. However, schools may not be attuned to teach all the specific skills needed by the firms but broader/generic skills. A balance needs to be worked out between general vs specific education/training in a formal education system. Role division and partnership is also critical to increase learning opportunities of all kinds including distance education and e-learning by deploying network enables services (NES). In order to build partnerships through stakeholder dialogue between teachers, trade unions, NGOs and business firms, the government should act as a convener or facilitator rather than a regulator of the education and learning system.

PART D: ANNEXES

Annex A1

USING MICRO-LEVEL DATA TO BUILD ON KOREAN POLICY AND SURVEY STUDIES

There are several recent surveys of industry and policy studies in Korea which this report builds upon by using micro-level data to explore, in more depth, firm-level reactions to policy and especially the impact of the recent crisis on firm technology operations. For example, the R&D surveys published by the Ministry of Science and Technology (MOST) in Korea show how the rate of growth of R&D spending overall fell immediately after the crisis from an average of 10% per annum in the period 1992-1997 to 5% in 1999 (MOST, 2000, p69). This survey also shows that R&D spending as a proportion of overall GDP fell from 2.55% in 1998 to 2.4% in 1999. The findings in the present study show how the general trend in R&D spending impacted severely on some leading firms' R&D strategies and reveal how these firms re-structured their R&D, focusing on short-term at the expenses of longer-term investment.

There are also important studies which examine the impact of policies on Korean firms. For example, Kim (1998) provides useful tools for analyzing Korean policies, deriving important lessons for other developing countries. The present study confirms Kim's argument that most Korean firms remain in a 'catch up', learning mode of development and shows how various categories of Korean firms differ in their ability and achievements in catching up with the world frontier. The present study also notes how recent joint ventures with foreign companies have rejuvenated the prospects facing some leading Korean exporters, but have threatened lagging firms in the capital goods sector.

Other studies analyze the overall 'architecture' of Korean industrial policy making, placing current policies within both an historical and international context, for example, comparing Korean policies and outcomes with those of OECD countries (e.g. Woo and Sul, 2000; World Bank 2000, Chapter 5). Woo and Sul show how closed Korea was to FDI prior to the crisis and illustrate how FDI began to increase rapidly following the crisis, partly due to new policy measures undertaken. The present study shows how important FDI has been to specific individual firms in the form of joint foreign ventures undertaken for the first time within Korea. It also shows the motivations of Korean firms in collaborating with foreign multinational investors and explains the difficulties confronted, as well as new Korean corporate strategies towards FDI.

The present study also draws upon major recent surveys of Korean firms. For example, Choi and Kang (2000), provide a survey-based analysis of the crisis, recovery and subsequent industrial restructuring. This study surveyed 850 firms over the period November 1998 to February 1999, focusing on output, employment, investment, FDI and profitability. Surveys also show the 'most important bottlenecks' confronting production and technological improvement facing firms across all sectors of the economy, ranking 'high interest rates', 'red tape/bureaucracy' and 'corruption' as the three most significant barriers to improvement (World Bank, 2000, p129). In addition, an innovation survey based on the European CIS-2 (Community Innovation Survey-2) was sent to 5,852 manufacturing firms (2339 replies) and 727 service

firms (192 replies) in 1998-1999 (English summary translation, provided in June workshop in KDI). This survey covered the main sources and types of innovation, showing that improving product quality was the main goal of technological investment. The present study also complements these surveys by examining the processes of technological change within firms, and the strategies adopted by firms to cope with crisis and exploit the recovery. It also 'benchmarks' individual firms against best practices at the international level.

AUDIT TOOL FOR MEASURING INNOVATION CAPABILITY

Using the framework presented in Part A (Chapter 2) we can generate a series of questions to ask of firms to help assess how well-developed is their technological capability. For example, a firm which makes no effort to scan its environment for signals about threats and opportunities is likely to be much weaker than one which has in place sophisticated mechanisms for spotting and evaluating g signals about relevant changes - such as the emergence of new technologies. We can apply this approach to the whole of the above process and, in response to the questions posed, put some kind of score against the firm in each of the dimensions of technological capability. Table A2.1 gives an overview of this approach.

Table A2.1: Overview of Assessment Approach

Stage	Score	Assessment of technological capability
1. Awareness		
2. Search		
3. Building core competence		
4. Technology strategy		
5. Assessing and selecting		
6. Acquiring technology		
7. Implementing		
8. Learning		
9. Linking to external sources		

We can use this score in each dimension to give an indication of where the firm has strengths and weaknesses in its technological capability and where further development is needed.

Using the assessment

This kind of assessment is useful to several groups:

- To the firm itself, as a simple form of feedback on how well it is doing and where it might usefully concentrate its development efforts

- To agencies concerned with providing various kinds of technological support, to help identify where and how the firm may have difficulties in accessing their services. For example, the firm may not be very strong in linking technology to its business strategy and so a technology support agency might be able to help with advice on business planning. Or the firm may have limited capability to scan the environment so the technology agency could look at different channels for communicating what they can offer.

- To policy-makers concerned with developing focused ways of linking supply of technological expertise with the demand side.

Developing suitable measuring instruments

In order to enable the assessment process we have developed three complementary 'tools' which can be used by the firms themselves, by technology support agencies, by policy-makers, by researchers, etc. These are outlined in Table A2.2.

Table A2.2: Tools for Exploring Technological Capability

Tool	Typical usage	Main characteristics
Simple survey tool	Quick assessment Self-assessment by the firm Postal or email survey	Uses a small number of questions and thus has advantage of speed. Main disadvantage is that it does not explore deeply and can only provide an overview assessment.
Interview tool	More detailed assessment, based on a schedule of questions which can guide an interview (1 hour) with senior and informed technical and strategic management	Provides opportunity to explore issues in greater depth and to follow-up on particular themes. Interview format allows for examples and other material to corroborate the answers to key questions. Depends on gaining access and on the skill and experience of the interviewer.
Case study	Very detailed assessment based on wide range of questions which explore aspects of the technological change process. Involves multiple interviews with managers across the organization	Provides in-depth review of technology management within the firm and allows for case examples to illustrate and clarify the assessment. Requires time and access and some measure of researcher/interviewer skills.

1. Simple survey tool

Company Name.....Date.....
Number of employees/turnover.....
Products/market.....

Technologies required.....
Name/s of interviewee/s.....

Please answer the following questions according to the scale presented – enter 1,2,3, or 4, for each question[1]

[1] Ideally, several people from different departments and the various levels of seniority should fill in the questionnaire to gain a representative view from inside the company. Sometimes, differences in perception between different groups within the firm can be very interesting and informative.

TECHNOLOGY ACTIVITY AREA	Key Questions	Strongly Disagree	Disagree Some-what	Agree Some-what	Strongly Agree	N/A
Assessment Score		*1*	*2*	*3*	*4*	
1 Technology plays an important part in my company's business strategy						
2 My company is well aware of the technologies most important to its business						
3 My firm is well equipped to assess technological opportunities						
4 My company can assess technology threats without difficulty						
5 My company has special technological strengths which it is able to exploit						
6 My company knows which technologies to outsource and which to develop internally						
7 Our management is skilled at formulating a technology strategy to meet business goals						
8 Our firm knows its main technology priorities						
9 Our firm has a well developed technology 'vision'						
10 Our firm knows how to select the technology needed for its business						
11 Our company knows which are the best sources of technology						
12 Our company is effective at acquiring technology from external sources						
13 Our company has good links with important external suppliers of technology						
14 Our technology activities (e.g. engineering and R&D) are organised effectively within our company						
15 We have clear processes for carrying out technology projects						
16 Our company has a good system for assessing technology projects.						
17 Our firm carries out post-project reviews						
18 We are able to learn from one technology project to another						
19 Government policies encourage us to invest in technology						
20 We use external organisations (e.g. consultancy firms) to assist us with technology assessment						
21 We use outside bodies to help us develop technology						
22 External organisations help us assess our technology performance						
23 We work with universities in key technology projects						
24 We work with government research institutes in important technology projects						

Assessing Your Company's Capability Level

From the above scores you can now (Step 1) calculate your company's current overall technology capability level and (Step 2) identify detailed strengths and weaknesses according to various important categories of technology activity.

Step 1: Calculating your company's overall capability level

Add up your total score (total possible score is 96) and enter in the table below, where your overall organisational capability level is described:

Capability Level (1-4)	Your Score	Total Possible Score	Overall Audit Result
1		24	Your company is weak and ill-prepared in all major areas of technology acquisition, use, development, strategy and so on; a major improvement program is urgently needed
2		25-48	Your company has poorly developed capabilities in most areas of technology strategy, search, acquisition and capability building. However, there are some strengths upon which to build
3		49-72	Your company has strong in-house capabilities and takes a strategic approach to technology. In some areas, the firm is behind the international technology frontier but has many important strengths upon which to build
4		73-96	Your company has a fully developed set of technological capabilities and is able to help define the international technology frontier. In many areas it takes a creative and pro-active approach to exploiting technology for competitive advantage.

Step 2: Assessing your particular strengths and weaknesses

Now enter the detailed scores from your questionnaire to arrive at your own profile of technological strengths and weaknesses. The questions you have completed relate to 9 main categories of technological capability described below:

1. *Awareness* - refers to the ability of senior management to recognize the role of technology in competitiveness and the dangers of 'standing still' in today's highly competitive environment.

Questions 1 and 2

A: Total possible score/ best practice	B: Your score	% (B/A)
8		

2. *Search* - is the ability of the company to scan or monitor external technology events and trends, which might affect the company or provide opportunities for growth or competitiveness. Large, advanced, companies often have a group of individuals permanently working on this task. In smaller companies, the managing director or a senior engineer may be responsible.

Questions 3 and 4

A: Total possible score/ best practice	*B: Your score*	% (B/A)
8		

3. ***Building a core technological competence*** - this category refers to the success of a company in defining its individual technological strengths and building up a unique advantage in specific areas. A company with a strong technological competence will understand how its distinctive technological strengths differ from its competitors and how to further develop its skills and knowledge to remain competitive. It will have well-developed methods for protecting and exploiting its intellectual property.

Questions 5 and 6

A: Total possible score/ best practice	B: Your score	% (B/A)
8		

4. ***Technology strategy*** – formulating a technology strategy is a key part of the overall business strategy of any leading firm. This is the process by which visions, objectives and priorities are set and communicated within the company. Even the best-resourced organization cannot do everything with respect to technology, so part of the strategic challenge lies in choosing which technology activities to conduct in house and which to outsource to technology partners.

Questions 7, 8 and 9

A: Total possible score/ best practice	B: Your score	% (B/A)
12		

5. ***Assessing and selecting technology*** - leading companies are able to gather information on the range of technological options available, chose quickly among competing solutions (e.g. different machines, approaches or suppliers) and identify the most appropriate source which 'fits' with their needs. A leading firm is able to make a comparison between (or 'benchmark') the various options available and can reliably select the most appropriate option, based upon this comparison.

Questions 10 and 11

A: Total possible score/ best practice	B: Your score	% (B/A)
8		

6. ***Technology acquisition*** – once a new technology option is decided upon, a firm needs to deploy the resources to exploit it (e.g. by creating technology *via* in-house R&D, or by acquiring it through a joint venture or technology licensing etc.). In some cases, this may be a simple matter of buying off-the-shelf, or it may involve exploiting the results of research already carried out. In other cases it might require extensive search and research to acquire the technology. Most leading firms have well-developed skills in negotiating for the transfer of technology from external sources and for developing technology in-house.

Questions 12 and 13

A: Total possible score/ best practice	B: Your score	% (B/A)
8		

7. *Implementing and absorbing technology* - having acquired technology, a firm needs to implement the technology within the organization, which may involve various stages of further development to final launch, as in the case of a new product or service in the external market place, or a new manufacturing process or method within the organization. This often involves further innovation as the technology is adapted and reconfigured. As well as in-house knowledge and skills, a leading firm will usually need well-developed project management capabilities to ensure implementation is effective and efficient.

Questions 14 and 15

A: Total possible score/ best practice	B: Your score	% (B/A)
8		

8. *Learning* – an important part of building technological competencies involves reflecting upon and reviewing technology projects and processes within the firm, in order to learn from both successes and failures. In leading firms this learning process can become conscious and formal, leading to continuous improvements in effectiveness, efficiency and strategy formulation. In order to learn how to manage the above technology processes better, a firm needs to systematically capture relevant knowledge from its own (and other firms') experience and act on this knowledge.

Questions 16, 17, 18

A: Total possible score/ best practice	*B: Your score*	% (B/A)
12		

9. *Exploiting external linkages and incentives* – in each of the 8 key technology activities above, firms can and, in some cases, should make use of external suppliers of technology and related services. These five questions (19-24) concern the different kinds of organisations which might supply your firm with services (e.g. consultancy companies, government research institutes or universities). As well as giving an indication as to the level of technological sophistication and openness of the firm, the answers can also give an indication of how well-developed is the external support system for technology development (sometimes called the 'national system of innovation').

Questions 19, 20, 21, 22, 23, and 24

A: Total possible score/ best practice	B: Your score	% (B/A)
24		

For each key area of capability, look at how well you compare with best practice (i.e. the total possible score). You may wish to identify the lowest three scores (technology weakness areas) and the top three scores (technology strengths). This information can help lead on to the development of an improvement programme (please turn over for a guide to improvement).

2. Interview tool

This is a more elaborate form of the previous tool and can be seen as a guide or schedule to help interviewers steer a discussion with the management of the firm around key issues in technological capability. There are nine sections, corresponding to the model in Figure 2, and the interviewer may find that some sections are more relevant than others. Within this format there are key and supplementary questions which can be used to elaborate on particular themes - some guidance on this is given in the tool below.

For each section there is a short summary score which indicates the extent to which the firm has developed capability in this area.

Section 1: Awareness - this refers to the ability of senior management to recognize the role of technology in competitiveness and the dangers of 'standing still' in today's highly competitive environment. Key questions here would be:

Question	*Underlying themes*	*How to interpret the response*
1. In what ways does technology affect the competitiveness of your business?	Technological change is constantly taking place and will affect competitiveness in terms of product (new or improved products coming on to the marketplace) and processes (new or improved ways of producing the products which may be lower cost, faster, higher quality, etc.)	If the firm has no clear idea of how technology affects their competitive position they are in a very weak position. You might wish to explore further the kinds of change which could have an effect on the firm and challenge them as to why they feel that technology is not an important factor. If they are aware of the potential role technology plays try and get a sharper focus on this - see question 2.
2. In what ways might technology affect the competitiveness of your products? ***And your processes?***	It is important to recognize that technology can affect both products and processes. Simply being able to match competitors on price, quality or speed (process characteristics) may not be sufficient if they come up with a new product design. Firms need to be aware of the challenge of change across a broad front.	If they are only focusing on product or process it may be useful to challenge their thinking and suggest the need for a broader view. If they are aware of the specific implications for products and processes, try and explore the extent to which the firm is aware of the 'technological frontier' - see question 3.
3. Where would you say the technological frontier is in your business - and how far away from it are you?	Technological development makes possible a range of new products and processes but these do not diffuse overnight. Firms need to be aware of where the 'frontier' is and how fast it is moving - and most important, where they stand in relation to it.	If they are not aware of the frontier they may need to extend their search behavior (see next section) to make sure they are not surprised by new developments. If they appear to be clear about where they stand and the major developments in technology they are probably in a reasonably strong position as far as awareness of the need and direction for change is concerned. Move on to next section.

Summary score:

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	1	2	3	4
Typical characteristics	[illegible] need to change or [illegible] in the outside world	Some limited awareness but confined to local issues and [illegible] the firm only [illegible] when it [illegible] to	[illegible] well-[illegible] awareness - the [illegible] it has to change and [illegible] looks for [illegible] the process	Well aware and ready to change - this firm makes [illegible] technology to set the pace of change for its competitors
Your assessment				

Section 2: Searching - the ability of the company to scan or monitor external technology events and trends, which might affect the company or provide opportunities for growth or competitiveness. Large, advanced, companies often have a group of individuals permanently working on this task. In smaller companies, the managing director or a senior engineer may be responsible.

Question	Underlying themes	How to interpret the response
1. What factors affect whether or not people buy from you?	Markets are increasingly demanding a range of price and non-price factors (like quality, design, customization, etc.) - and technology affects these.	If they don't know who their customers are or what they want they are in a very weak position. There is unlikely to be a clear strategic base for choosing or using technology to help them compete.
2. What are the key order winning and order qualifying factors in your business	Markets increasingly require some factors - low prices, reliable quality, etc. - as a qualifying condition. This does not mean that the firm will win orders, simply that it can play in the game. Technology plays an important part in enabling order-winning characteristics to be developed and competitive advantage to be obtained.	If the list has only one factor - price - this is often a high risk case Given the difficulties of sustaining competitive advantage in a world where price competition is increasing this can be a risky position. It suggests a limited view of how competitiveness is built up and probably means that their idea of technology - if they see this as useful at all - is confined to cost saving - often through simple replacement of machinery. Products/services are seen as simply cost-competing and there is no attention to adding other features If they have some sense of there being multiple factors affecting competitiveness - and if they have some sense of which are the most important they are in a much better strategic position to see how technology might help and to look for specific tools to help.
3. How do these vary across	Markets are increasingly segmented	If they do not understand the need for such

Question	*Underlying themes*	*How to interpret the response*
your different products and markets?	and the requirements for one may differ widely from another. Technology can help provide customized solutions to differing market requirements - but its effective use depends on understanding the marketplace.	separation they risk having an unfocused change strategy. A more sophisticated understanding would mean they recognize different customers/markets have different needs and technology needs to be linked to these.
4. How do you know what is going on in the field of technology development relevant to your industry? - ***in your country?*** - ***Internationally?***	Successful firms scan widely and deeply to ensure they are aware of developments which might have an impact on their business. They make use of multiple channels - for example, visits, exhibitions, conferences and seminars, the Internet, etc.	If the firm says that it is well aware it would be useful to get them to list the various mechanisms which they employ, and to explore where they see the gaps in their 'intelligence' network.

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no idea [illegible] or even of what the market [illegible]	The [illegible] based on simple notions of price	The firm [illegible] factors [illegible] and their relative importance but tends to assume that the same [illegible] across the business [illegible] these [illegible] businesses	The firm is well aware of its competitive drivers and can construct a [illegible] It actively seeks the information it needs to [illegible] these measures and to build a clear [illegible]

Section 3: Building a core technological competence - this category refers to the success of a company in defining its individual technological strengths and building up a unique advantage in specific areas. A company with a strong technological competence will understand how its distinctive technological strengths differ from its competitors and how to further develop its skills and knowledge to remain competitive. It will have well-developed methods for protecting and exploiting its intellectual property.

Question	Underlying issues	How to interpret the response
1. What is your particular and distinctive competitive edge?	Firms need to build and sustain some form of distinctive competitive advantage and technology provides a powerful resource for doing so. Being able to offer something no one else can or to offer something faster, cheaper, of higher quality, etc. are examples of distinctive competencies which derive from technology.	If they don't know they are in a very weak position. And at risk from competitors who may use technology to create more distinctive advantage. If they do, go on to question 2.
2. Which factors affect whether or not people buy from you?		If price is their only concern they are probably looking at technology - if at all - in terms of simplistic cost savings , often through investments in replacement machinery If the list has more than one factor and they seem to understand the need to develop a competitive edge which can be protected, go on to question 3. If they see competitiveness as being made up of more than price they are probably reasonably aware of at least how technology might help - though they may not know where or how to get it
3. What are you doing to sustain and protect this advantage?		If they are not actively aiming to protect their advantage, they risk someone else moving in and eroding it. Ways of protection include legal protection (patents, copyright, etc.) but also keeping the process of creating specialist knowledge (e.g. through R&D) going so as to stay one jump ahead of potential competitors.
4. What are you doing to create future advantage?		If they are not actively seeking new sources of advantage they risk others catching up with them, or the emergence of substitute products and processes which eliminate their advantage. If they are actively trying to create and sustain advantage they will probably be looking to use product and process technology to help. They should be able to give examples of where and how
5. How do you decide which technologies to develop/retain in - house and which to outsource?		

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no idea of how it competes, or what - if any - distinctive competitive advantage it can offer	The firm has limited understanding of how it competes - usually based on simple notions of price	The firm understands the range of factors - price and non-price which affect how it competes and its distinctive competitive advantage - core competence. However it is not actively seeking to maintain, protect or develop this.	The firm is well aware of its competitive drivers and is actively scanning for new [illegible] to develop its competencies and to develop and deploy these in new products and processes.
Your assessment				

Section 4: Technology strategy – formulating a technology strategy is a key part of the overall business strategy of any leading firm. This is the process by which visions, objectives and priorities are set and communicated within the company. Even the best-resourced organization cannot do everything with respect to technology, so part of the strategic challenge lies in choosing which technology activities to conduct in house and which to outsource to technology partners.

Question	*Underlying themes*	*How to interpret the response*
1. What are the key strategic targets for the business?	Firms need a clear business strategy to provide the framework within which decisions about technology can be located.	If they only see price as important then this is likely to skew their view of technology and what it can offer - at best this results in a limited approach. If they are able to explain their strategy and the particular ways in which they see themselves competing then go on to question 3.
2. What are the main technology priorities for the company?	Successful firms have a clear and shared understanding of the ways in which technology can provide strategic advantage - and the relative priorities associated with different options.	If they have no clear idea of priorities it may be that they are not thinking about technology in strategic fashion but rather as a reaction to what others in the market are doing. If they are they are probably aware of their distinctive (core) competence and how to develop this - see next question.
3. What are your core	Firms need to be aware	If they are not aware of their

Question	*Underlying themes*	*How to interpret the response*
competencies - and how are you using them to create strategic advantage	of the ways in which they can offer something distinctive in the market-place - products or processes which are better and which are in some way difficult for others to copy	competencies they risk either trying to compete on a 'me-too' basis (because they have no distinctive competitive edge) or missing out on market opportunities (because they don't exploit their strengths). If they do, go on to question 4.
4. How do you deploy your business strategy to provide a framework for change in your products and in the ways in which you make them?	Firms need a process for discussing and communicating technology strategy. Typically this begins with an overall set of business objectives and then involves a top-down/bottom up process of exploring the ways in which technology can help to fulfill these business objectives	If they do not understand the need for such specific strategic frameworks they risk having an overall sense of direction for the business but no way of connecting change programmes to it. If they do go on to question 5.f they can link their business objectives to targets for change in products and processes there is likely to be a coherent search for technology
5. What is the strategic vision for technology within your company?		

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no [illegible] strategy	The firm has a simple strategy but does not have a clear idea of how technology can help it create [illegible]	[illegible] what the market wants but also [illegible]	The firm has a [illegible] strategy [illegible] has deployed its [illegible] process [illegible]
Your assessment				

Section 5: Assessing and selecting technology - leading companies are able to gather information on the range of technological options available, choose quickly among competing solutions (e.g. different machines, approaches or suppliers) and identify the most appropriate source which 'fits' with their needs. A leading firm is able to make a comparison between (or 'benchmark') the various options available and can reliably select the most appropriate option, based upon this comparison.

Question	*Underlying themes*	*How to interpret the response*
How do you go about assessing technology?	Successful firms have a clear framework and criteria against which to assess technological options.	If the firm has no clear framework or is governed only by the cost and availability of the technology there is a risk that they will choose inappropriately.
How do you select from different technological options?	Successful firms consider a wide range of factors when assessing different technological options including the long-term costs of supporting and extending the technology, their ability to absorb and make effective use of it, etc. - in addition to short-term considerations like price and availability.	Firms with a high degree of technological capability will have a clear process for assessing and selecting technology and may make use of different formal techniques to help them in this.
How do you know you have selected the best sources of technology?		

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no clear process for assessing or selecting technologies	The firm has some framework for selecting between options but this is primarily concerned with price	The firm has a well-developed framework for assessing and selecting technologies which covers short term issues like price and availability and longer-term issues like support and service, and their ability to absorb and extend the use of the chosen technology.	The firm is experienced in looking for, assessing and selecting key strategic technologies..
Your assessment				

Section 6: Technology acquisition – once a new technology option is decided upon, a firm needs to deploy the resources to exploit it (e.g. by creating technology *via* in-house R&D, or by acquiring it through a joint venture or technology licensing etc.). In some cases, this may be a simple matter of buying off-the-shelf, or it may involve exploiting the results of research already carried out. In other cases it might require extensive search and research to acquire the technology. Most leading firms have well-developed skills in negotiating for the transfer of technology from external sources and for developing technology in-house.

Question	*Underlying themes*	*How to interpret the response*
How you manage the process of acquiring technology from outside	Successful firms recognize that they are likely to need to build technological strength through a combination of internal and external sources. They have developed skills in managing the acquisition process and have good absorptive capacity within the firm	If the firm has no clear process for acquisition it is likely to risk acquiring the wrong technology or else being unable to absorb and use technology transferred in.
What mechanisms do you use to bring in outside sources of knowledge?	**Successful firms recognise that there are multiple mechanisms for outsourcing technology (for example, joint R&D projects, licensing or direct purchase of equipment) and operate a portfolio approach to the problem.**	If the firm uses few mechanisms - for example, relying only on equipment purchases - it risks becoming dependent on outside sources without building internal capability. Successful firms develop skills in negotiation and the use of a portfolio approach to acquiring technology.

Question	*Underlying themes*	*How to interpret the response*
How do you ensure you capture knowledge form your externally acquired technology?	Outsourcing decisions are made not simply on the basis of price but in terms of other factors such as the degree to which there are learning opportunities.	If the firm emphasizes short-term acquisition only there is a risk that the development of technological competence will be constrained. Successful firms place emphasis on the ability and opportunity to capture knowledge and learning from technologies acquired from outside - for example, through negotiating conditions in licensing or in operating joint R&D ventures.
What proportion of your technology do you source from outside?		

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no clear process for acquiring or absorbing technology.	The firm has [illegible] in acquiring technology from outside but tends to rely on 'tied and true' approaches such as equipment purchase.	The firm makes use of multiple mechanisms for acquiring technology, both through in house development work and external acquisition.	The firm uses a wide [illegible] of sources of technology but ensures that learning and knowledge accumulation are given a high priority in each case.
Your assessment				

Section 7: Implementing and absorbing technology - having acquired technology, a firm needs to implement the technology within the organization, which may involve various stages of further development to final launch, as in the case of a new product or service in the external market place, or a new manufacturing process or method within the organization. This often involves further innovation as the technology is adapted and reconfigured. As well as in-house knowledge and skills, a leading firm will usually need well-developed project management capabilities to ensure implementation is effective and efficient.

Question	Underlying themes	How to interpret the response
How do you manage the process of implementing technology-based projects?	Successful firms have skills and experience in project management.	If the firm is inexperienced or incapable of project management there is a high risk that projects will run over time or budget.
How do you manage risk in development projects?	Successful firms operate some form of risk management - such as the use of a 'stage-gate' framework to guide product development.	Without a suitable risk management framework the firm may find itself unable to monitor progress or to stop projects which have run into difficulties or no longer fit the strategy.
How do you ensure co-operation and communication between different functions in the firm - R&D, engineering, production, marketing, etc.?	Successful firms are able to engage cross-functional expertise (e.g. marketing, production, quality) to create new products/processes.	If the firm is unable to bring different functions together during the project there is a risk of costs and time problems.

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	1	2	3	4
Typical characteristics	The firm has little project management experience or structure. Projects can easily drift out of control.	The firm has some project management expertise but has no framework for risk management or continuing assessment of project progress.	The firm makes use of a risk management framework and has project management skills.	The firm has a well-developed framework for risk management and is experienced in project management. It has structures and processes in place to enable cross-functional co-operation and early involvement.
Your assessment				

Section 8: Learning – an important part of building technological competencies involves reflecting upon and reviewing technology projects and processes within the firm, in order to learn from both successes and failures. In leading firms this learning process can become conscious and formal, leading to continuous improvements in effectiveness, efficiency and strategy formulation. In order to learn how to manage the above technology processes better, a

firm needs to systematically capture relevant knowledge from its own (and other firms') experience and act on this knowledge.

Question	*Underlying themes*	*How to interpret the response*
How do you know how well you are doing - with respect to competitors?	Successful firms make use of 'benchmarking' and other approaches to monitor their competitors and to search out opportunities for learning about products and processes.	If the firm does not monitor its performance against external standards it risks being isolated and unaware of the need or direction for change.
How do ensure you capture learning from projects and avoid 're-inventing the wheel' next time?	Successful firms take steps to ensure that learning is captured and shared across the organization, to build both technical and managerial competence.	Without an active approach to capturing learning there is a risk that firms will continue to repeat the same mistakes.
What mechanisms are in place to enable learning and continuous improvement within the firm?	Successful firms make strong efforts to build 'learning organisations' - through training, workforce involvement in 'kaizen' programmes, process mapping and codification, etc.	

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm has no [illegible] structure in place to enable learning between projects	The firm undertakes some basic reviews of completed [illegible] but these tend to be [illegible] and informal.	The firm regularly reviews its progress on projects and captures learning about what it can do better next time. technological lessons, etc.	The firm has a highly developed system for [illegible] at all levels across the organization. It operates [illegible] project reviews, continuous improvement programmes, etc. - and the learning [illegible] and shared across the organization.
Your assessment				

Section 9: Exploiting external linkages and incentives,_– in each of the 8 key technology activities above, firms can and, in some cases, should make use of external suppliers of

technology and related services. These next questions concern the different kinds of organisations which might supply the firm with services (e.g. consultancy companies, government research institutes or universities). As well as giving an indication as to the level of technological sophistication and openness of the firm, the answers can also give an indication of how well-developed is the external support system for technology development (sometimes called the 'national system of innovation').

Question	*Underlying themes*	*How to interpret the response*
Which sources of external expertise are you aware of?	Successful firms have a strong 'external' orientation and are open to ideas and support from a wide variety of sources beyond the firm	If the firm has little or no awareness of external resources it is likely to be limited in its ability to undertake innovation projects.
Which external sources have you made use of?		There may be barriers to wider access to external resources which can be resolved by changes in the policy environment or the composition of the national system of innovation.
What are the main barriers to your using these and other sources?		

Summary score

On the basis of the answers to these (and other) questions where would you position the firm on this scale?

Score	*1*	*2*	*3*	*4*
Typical characteristics	The firm is unaware of external resources	The firm is aware of external resources but not of how to access them	The firm knows about external resources and how to access them but this awareness is confined to a narrow field and occasional use.	The firm is well aware of a wide rage of external resources and knows where and how to access them. It has made use of a variety of such supports in enabling technological development.
Your assessment				

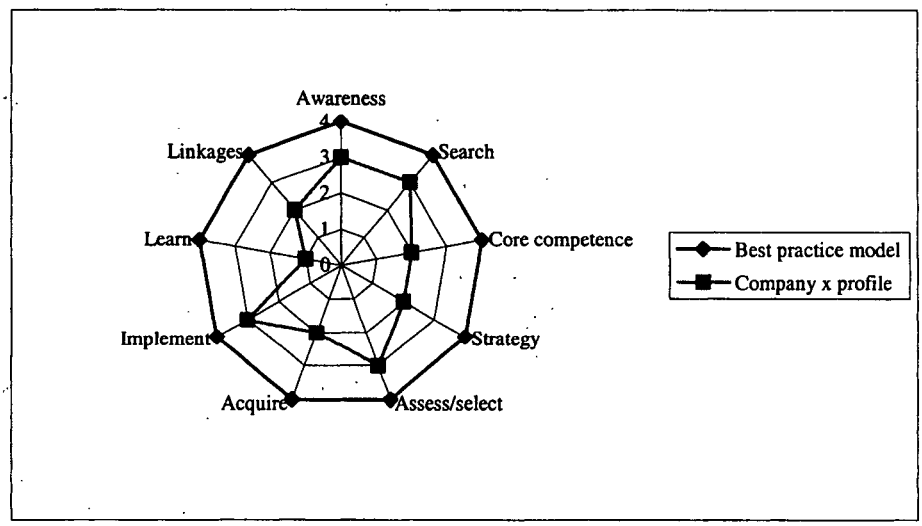
Overall assessment

Take each of the scores you have allocated at the end of each section and put them in this summary table.

Section	Your score	What does this mean?
1. Awareness		
2. Search		
3. Building core competence		
4. Technology strategy		
5. Assessing and selecting		
6. Acquiring technology		
7. Implementing		
8. Learning		
9. Linking to external sources		

You can also plot a simple profile, which gives a picture of the relative strengths and weaknesses in technological capability in this firm, as depicted in Figure A2.1.

Figure A2.1: Profile of Technological Capability



3. Case studies

The third level of assessment would involve a detailed set of interviews across the organisation and with several different people. The purpose would be to collect on a systematic basis and with example information on the firm's performance at each of the stages in the model.

To accomplish this the same framework can be used and the questions in both the survey and interview tools will be a helpful basis for the study. In addition there are some structured tools which can be used to help explore particular issues in depth. Examples might include competitiveness profiling, competence mapping and strategy analysis.

OTHER FIRMS (GROUP 7) IN THE CAPABILITY ASSESSMENT SAMPLE

Six other firms in additional sectors were included in the audit (LG Cable, Korea Zinc, LG Chemicals, Green Cross, Choonwae and Kuk Dong). Sectors covered included cable production, metal processing, medical equipment, chemicals, medicines and loading equipment. These interviews provided some additional perspectives on innovation processes within Korean firms. However, as the following selected evidence shows, the findings were broadly consistent with those from other types of firms and sectors. The six firms were, in the main, examples of technologically competent firms, with strong process technology, attempting to improve on their product creation skills through increased R&D.

Several firms continued to feel the repercussions of the crisis, having been forced to cut back on R&D against their better judgment and preferred strategy. At least one company was selling off parts of its business to TNC investors as a result of the crisis and increased competition resulting from an opening up of the domestic market.

1. LG Cable: focusing on product quality via process technology

LG Cable produced a wide range of cables in different materials and were particularly active in advanced telecommunications products. The company as a whole employed around 3,800 people in 2001 and around 200 researchers within its research institute including 30 PhDs, 120 Masters level graduates, and the remainder bachelor level graduates. Including the operating groups, which increased the overall research manpower to around 450 people, around 12% of the overall LG workforce were involved in research and/or applications development.

New technology projects covered cables, optics, machinery, electrical power, and product manufacturing technology. Being a global player, LG Cable increasingly faced foreign rather than domestic competitors, as it exited lower value product areas and moved into more specialized technology-based products. Lower-end competition tended to be domestic while high-end competitors were mainly from Japan and Europe, including Alcatel, Lucent, and Pirelli.

The firms scored highly in the strategic level 'C', but had yet to become a new product-based market leader. "I have to say we are not a real global player - as compared with the Korean semiconductor industry for example – we are still a long way from the frontier - we are still in the process of catching up and focusing primarily on improving quality". The company's competitive advantage was essentially one of a fast follower with low-cost, high quality offerings and, increasingly, new technology developments. More than 70% of its R&D was focused on optical and ultra high voltage cables and a small proportion on advanced materials. As with many Korean firms, leading-edge customers helped 'pull' its technology forward.

The firm looked ahead *via* technological forecasts and roadmaps, including an annual technology roadmap process which drew on emerging market and technical data. In terms of technological intelligence the company searched widely, both in Korea and especially overseas and made use of a number of foreign co-operations. They also had a number of co-operation projects with Korean universities and with government research institutes. The challenge for LG

Cable was to move away gradually away from a follower strategy and increase its capability to create new products.

2. Korea Zinc: using tacit skills to dominate a small global niche

Korea Zinc was a strong company in a small niche where it had achieved a dominant position. A high commitment to R&D had enabled the firm to remain close to worldwide developments and quickly capitalize on them. Like other large Korean firms in our sample, Korea Zinc was highly competent and technological strong, scoring highly within strategic level 'C' against the dimensions of awareness, search, acquire, improve, learn and capability building. The company's main strengths lay in applied, rather than basic research. In particular, it was adept at process technology and the skills in scaling up quickly from laboratory to full-scale production. These were essentially tacit skills and a source of protectable competitive advantage.

Korea Zinc was a recognized world leader in the production of zinc, lead and a variety of other metals which mainly derived from the refining of the first two. These included silver, gold, bismuth, cadmium and also sulphuric acid. The company was the only producer in Korea and exported between 30% and 40% of its output. It was a large global player in this niche having, for example, the largest zinc refinery in the world capable of 400,000 tonnes a year and subsidiaries in Australia and the US. Total turnover in 1999 was around US$7.9 billion and its market share was in excess of 9% of the total world production of zinc.

Korea Zinc's main technological focus was to reduce costs *via* the development of new processes and also to introduce new processes developed elsewhere in the world. The company's main skill was to speed up the time taken to introduce new production technology. Competent in technology intelligence activities, information gathering and strategy formulation, Korea Zinc concentrated on the mainstream of applications initially developed in laboratory scale. The company's long-term technology vision saw increasing environmental friendliness as central, with the ideal of clean waste capable of going straight into landfill. Overall, the firm was a technologically strong global player in a market which, although commodity-based, required consistent and continuing investment in technology in order to maintain a competitive edge.

3. LG Chem: international science-based competition, shaped by regulation

LG Chem was established in 1947 and had an annual turnover of US$5 billion in 2000. It was the largest chemical company in Korea and in the 1960s had diversified into electronics, oil and other sectors. From the 1st April 2001, it was divided into three companies: chemicals (US$4 billion turnover), household goods (US$1 billion) and life sciences (US$200,000). The firm had several R&D centers which employed around 1,000 scientists. In life sciences (the focus of the interview) LG Chem specialized in two areas (1) new drug discovery and early development and (2) bio pharmaceuticals (this began in 1983 and related mainly to proteins and growth hormones).

Sales were mostly to developing countries, due to restrictions and regulations on new drugs in the US and Europe. The firm had strategic alliances on both these continents and competed largely on the speed of discovery of new drugs. This was a highly technologically competent company, with most of the in-house scientists having been educated abroad in the US

and Europe. Recent changes in management systems had placed several technical and scientific staff in HQ, assuring a close link between business and technology strategy.

As far as the audit was concerned, this was an extremely impressive company, scoring Type D, creative against many of the eight categories of technology. The firm kept up-to-date information on the latest technological trends *via* conferences and two scientific advisory boards in the US and Europe. The company also encouraged expert panels and informal study groups in emergent technology areas. In the past, business strategy depended on the analysis of external technological trends and the initiation of follower projects. The firm recently moved to a system by which strategic reviews each year looked five to ten years into the future. The business strategy was then prepared, supported by a technology strategy, using international specialists and management consultants to help with processes and advise on regulatory affairs.

4. Green Cross: developing new products for an international market niche

Green Cross was established in 1967 and began to manufacture plasma fractions in 1970, and Ukrokinase in 1973, mainly for hospitals within Korea. It created a central research laboratory in 1980 and had major successes with the manufacture of Hepatitis B Vaccine in 1983, the development of the world's first Hemorrhagic Fever with Renal Syndrome Vaccine in 1988, a genetically engineered recombinant Hepatistis B Vaccine in 1988, and a Varicella Zoster vaccine in 1993. It obtained most of its raw materials from China and processed them in Korea for export to Germany. The firm had also established subsidiaries in China and Indonesia.

The opening up of the local market to TNC competition will create considerable competition in the next five years. Rather than price competition Green Cross offered high quality and speed of delivery. Technologically the company scored at the higher level of strategic band 'C' in most of the eight categories of technology activity. It used technology and patent road maps to determine future technological directions and collaborated extensively with firms abroad. Green Cross had two research centers, which together employed around 100 scientists of whom 20% had PhDs and the rest had Masters degrees. The core competence of the company was in the downstream of biotechnology, in the areas of fermentation and purification technologies and in research related to the manufacture of products from novel technologies.

As a result of the crisis, the company, which employed 1,200 people, was in the process of being split into two. The owner had divided up the businesses and was in the process of selling off divisions to TNCs. The vaccine part had already been sold to Rhine Biotech which purchased a majority shareholding. Green Cross's awareness of competition had led the firm to try and maintain a high level of R&D even during the crisis period as well as after. Although the company believed it needed to engage in more fundamental research because of the crisis this was not financially possible.

5. Choonwae: catching up in medical equipment technology

Choonwae, a producer of CAT scanners, ex-ray machinery and other medical equipment was established in 1972 and employed 228 staff in 2001. Its initial strategy was to import foreign equipment and provide local support to purchasers. A gradual accumulation of technological capability had moved the company into a strong market position. It exported to over 20 countries in 2000 and had developed a significant brand image as a supplier of

incubators and x-ray machinery. Choonwae's main competitors were Japanese, US and European firms and its market advantage lay in a combination of low price and high quality. Incubators were sold in 22 countries and operating tables in over 30. Its ambition was to be in the global top five suppliers of these kinds of equipment (it was in the top 20).

With respect to the technology audit, this firm scored highly within the strategic category 'C'. It was a highly competitive firm with a strong emphasis on technology learning and development. Hitachi, for example, was willing to view Choonwae a co-development partner and engage in a two-way technology collaboration. Exposure to export markets had kept the firm close to the technology frontier. However, most products were still follower brands with price and quality advantages. The company's longer-term strategy was to exit lower technology segments such as theatre lamps and move increasingly into higher-technology products like x-ray machines. The ability of Choonwae to achieve its goals will depend on sustaining its R&D commitment in order to master key technologies such as medical electronics.

6. Kuk Dong Co: moving from manufacturing to new product development

Kuk Dong was established in 1983 as a manufacturer of material handling equipment such as electric chain hoists, chain blocks and cranes. It exported to numerous countries around the world and boasted a range of certifications including ISO 9002, S mark (Korean Safety Standard) the European Union CE mark (Certificate of Conformity for product quality), and the NT mark (from the Ministry of Science and Technology and KITA for the development of new technology). The company had an annual turnover of approximately US$5 million and employed 65 people, 20 of whom were involved in technical services (seven in R&D, and the rest in the factory in quality improvement). This firm competed well in international markets and exported to a wide range of countries. It had about 50 competitors and spent the last five years developing a new product in which only two other firms have similar machines. The firm was highly capable in strategy development for a small firm, using a three to five year time horizon. Competitive advantage lay mainly in design, price and the ability to respond rapidly to customer needs. The firm faced various problems, ranging from accessing good sources of information on R&D trends through to skill shortages on the shop-floor. Kuk Dong used its links with universities and government labs as a means of improving quality.

NETWORK-ENABLED SERVICES OVERVIEW

A comprehensive list of business services that could be delivered over networks would be overwhelming, as almost any business service involving the storage or processing of information can potentially be a network-enabled service. The services discussed in this report represent the principal network-enabled services delivered today and provide a basis for evaluating the potential for future services.

Summaries of eight key networked-enabled services: call centers, medical transcription, animation, geographic information systems services, back office operations, including website content development and hosting, distance education, telemedicine, and tele-engineering are provided below. Under each of these topics, a definition of services is followed by market information, including a highlight of national leaders where possible, and an assessment of market potential. For network-enabled services where markets are relatively mature, available data is presented regarding market size and leading countries. In the case of more recently emerging services, however, the marketplace is not well defined and little market data is available.

Call Centers

While a call center can be a simple telephone-based shared service center for specific customer activities, today's modern call centers integrate traditional telephone-based services with e-mail, Web collaboration, trained consultants, databases, and online information support structure to interact more efficiently with customers. A center enables customer support to be provided around the clock, 365 days a year.

Call centers provide customer-related functions like marketing, selling, information dispensing, advice, and technical support. As such they are examples of synchronous network-enabled services. That is, they require real-time interaction with the customer. While traditional voice telephone call centers are now supplementing or replacing their voice interaction with instant messaging style Internet interaction, the requirement that the interaction occur in real-time remains. These can be best understood as inbound services, outbound services, or a combination of the two.

Inbound services:	Outbound services:
▫ Customer Support Center/Help Desk ▫ Technical Support ▫ Reservations ▫ Query Handling ▫ Claims Processing and Support ▫ Fax/Voice Mail ▫ Dial in Polls ▫ Contests/Event Registration	▫ Telemarketing and Product Launches ▫ Market Survey and Research ▫ Credit Verification ▫ Bill Collection ▫ Relationship and Account Management

Market

The market for call centers is large, as most businesses and organizations require some level of close customer (both internal and external) interaction and transaction. Industries that are leaders in outsourcing or outlocating call centers include: airlines, banks, insurance, financial services, legal services, communications services, ICT technical support, tourism, hotels, etc. Figure B1.1 provides examples of the use of call centers by these kinds of companies.

While emerging economies are rapidly entering the call center industry, it remains dominated by the developed countries. Ireland and India are two major emerging call center providers. Figure B1.2 provides details on call centers worldwide.

Assessment

The global market for call center services will grow, but will become more integrally linked with other network-enabled services, especially back office operations as these centers merge to form business process centers. For example, GE Capital Services, which opened India's first international call center in the mid-1990s, now employees over 5,000 specialists to collect money from

Figure B1.1:
Examples of Call Center Industry

Country	Company	Service
Singapore	Compaq	Telesales Product/solution inquiry Database analysis
Philippines	AOL	Registration Assistance Technical support Account and billing assistance Reactivation of cancelled accounts
Ireland	IBM	Computer customer service
United Kingdom	Morgan Stanley Dean Witter	Credit-card customer service

Figure B1.2: Call Centers Worldwide (1999)

Region/Country	Total Centers	Percentage
Canada	70,500	44%
United States	69,500	43%
Europe	12,750	7%
Other	7,250	4%
Worldwide	160,000	

Source: Call Center News Service

delinquent credit card users and perform data-mining.

Despite this potential market growth, Korea is not well positioned to engage in the provision of call center services. Major constraints include low English language competency and high labor costs.

Medical Transcription

Medical Transcription is converting sound-recorded medical information into written text. Doctors dictate medical information into sound recording devices, and the recorded information is sent to transcription services via data lines. A medical transcriptionist transcribes the information into standardized report formats. After the work is checked, the information is returned to the doctor or hospital through data lines. Information includes patient assessment, therapeutic procedures, clinical courses, diagnosis, and prognosis. Medical transcription services are an example of *asynchronous* services. That is, the information is sent in one form, processed, and returned at some later time (usually overnight).

Market

The market for this service is limited as issues of security and trust restrict the amount of work that can be outsourced. In addition, the current market may be saturated, as indicated by the tough competition that is driving down profits in India. According to a recent report released by Stevens International Consulting, India has approximately 200 medical-transcription firms, indicating a sharp rate of growth over the previous years' total included below, that employ nearly 10,000 transcribers. The global market will grow, however, once greater security measures are introduced and the public becomes more comfortable with medical data being transmitted overseas. While medical transcription continues to be performed primarily in the United States, India has become a significant player and other nations may follow. Figure B1.3 provides country detail for this services industry, where U.S. doctors remain the primary customers.

Figure B1.3: Medical Transcription Companies Worldwide

Country	Number of Companies	Percentage of Market
United States	383	74%
India	89	17%
Pakistan	21	9%
Canada	14	
Australia	3	
Bangladesh	2	
United Kingdom	2	
Nepal	1	
Philippines	1	
Saudi Arabia	1	
South Africa	1	
Total Companies	518	

Source: Medical Transcription Networking, 1999-2000 data.

Assessment

Some doctors are taking advantage of sophisticated voice recognition software (VRS) for transcription work. VRS allows a doctor to record and manage information on a desktop PC, thereby reducing the need for medical transcriptionists. VRS developers are currently contending with significant problems in the technology. Complex medical terms such as "cryoglobulinemia," dictated hurriedly by a doctor who is eating lunch, challenges the capacity of even the best VRS. These problems must be overcome before VRS can be seen as both cost-effective and practical for the average doctor.

Although demand for medical transcription services will grow, dominated by the American medical community, Korean firms are not well positioned to engage in the provision of this service globally. As with call centers, major constraints include low English language competency and high labor costs.

Animation

Animation is the process of simulating movement created by displaying a series of pictures, or frames. The process of hand drawing each frame has largely been replaced by computer-aided animation after the initial frames are hand-drawn. Although some of the final products of the animation process, such as entire cartoon shows, are often too large to be delivered over the network, drafts and portions are routinely exchanged electronically. More limited applications, such as animated characters for use on websites, fit clearly into the class of network-enabled services. Computers also assist in creating two- and three-dimensional characters and backgrounds, repeating designs to create herds or crowds, and synchronizing voices with images.

Market

Animation services can be relatively simple products, such as animated image files for use on websites as banners or pictures, and the design of three-dimensional logos. Computer-aided animation can also involve more complex three-dimensional modeling of human activities for instructional and diagnostic purposes, and modeling of industrial processes. Beyond entertainment, computer-aided animation is used in a wide variety of professions including science, engineering, education and training, and medicine. While little public data is available on this service, firms from China, India, Korea, the Philippines, and Vietnam are competing in this space, along with those from the U.S. and other Western countries.

Assessment

Animation is a global industry. Animation industry experts estimate that the value of worldwide commercial computer animation production totaled $25 billion at the end of 1999, with forecasts of a $40 billion market by 2002. Crest Communications estimates that U.S. companies can save 50 percent of their revenues from outsourcing this work to cost-competitive environments.

Korea was once a major player in the global animation industry. Over the past few years, however, much of the market for animation work has migrated to competitors offering lower labor costs. If Korea wants to continue to be a player, it will have to move up the value-chain and now produce original creative works with international appeal.

Figure B1.4: Types of Back Office Operations

Skill Level	Administrative	Technical
Low	Data entry clerical	Transcription; indexing & abstracting
Medium	Secretarial; data capture & processing; mailing lists	Website design & management; records management; rule-set processing
High	Accounting; payroll; electronic publishing	Software development; data-mining, problem-solving and analysis/prediction

Geographic Information Systems Services

A Geographic Information System (GIS) is a computer-based tool for mapping and analyzing geographic features and events. GIS is a computer

system that assembles, stores, manipulates, and displays geographically referenced information. The technology integrates database operations such as query and statistical analysis with visualization and geographic analysis benefits offered by maps. A GIS integrates spatial data with other data resources and can even use a database management system to organize and maintain sales, marketing, and product data. The information is then displayed visually to assist in decision-making.

Geographic data can be collected in-house or purchased from a commercial data provider. Data collection, storage, interpretation, conversion, and integration (including scanning and digitization) as well as digital publishing are being performed out-of-office, both synchronously and asynchronously. The most common type of outsourcing of network-enabled services that is used in the creation of GIS is data entry, which is necessary to digitalize paper maps.

Market

GIS is has a large potential market as it is being applied to areas such as agriculture, business marketing, electricity/gas, environment, forestry, geology, government, hydrology, land use planning, site planning, transportation, water/wastewater, etc. Products include both paper and electronic versions of:

- *Base Maps and Data* -- e.g., streets and highways, boundaries for census, postal and political areas, rivers and lakes, parks and landmarks, etc.

- *Business Maps and* Data – e.g., census/demography, consumer products, financial services, health care, real estate, telecommunications, emergency preparedness, crime, advertising, business establishments, transportation, etc.

- *Environmental Maps and* Data – e.g., environment, weather, environmental risk, satellite imagery, topography, natural resources, etc.

Assessment

The market for commonly produced "maps" (either paper or electronic) will increase in demand as companies move from text data to spatial data and maps become more accurate and up-to-date.

Although the non-necessity of English language skills may make the provision of GIS more appealing to Korea, achieving a significant market share would require extremely low labor costs. Data entry for GIS is a low-end network-enabled service, above which Korea ought to be positioning itself.

Back Office Operations (including Website Content Development and Hosting)

The so-called "back offices" of organizations perform two basic functions: first, processing transactions and second, compiling, analyzing, and supplying needed management information. Common back office activities that can be included in the network-enabled services definition are accounting services, check and security processing, claims processing and

payment, personnel processing, mail, and inventory control. More advanced services include rule-set processing, in which a worker makes judgments based on rules set by the customer (e.g., airline upgrades), and data-mining, situation analysis, and problem solving. Claims processing is an example of a back office service that is increasingly centralized. Insurance companies have standardized rules and formats for managing insurance claims, and this standardization has allowed for claims processing to be performed at any location.

Website content development consists of compiling and developing digital content for intra-organization dissemination, cross-institution usage, collaborative projects, public domain information, programs for public/specialized education, web content development and management, and developing animated movies. Website hosting involves operating a server on which multiple customers' websites are maintained. Internet service providers may provide Website hosting as a feature to individuals and small businesses. Larger businesses generally require a more individualized level of service than Internet Service Providers (ISPs) usually offer.

Market

Back office operations are often provided by Application Service Providers (ASPs). Although the term is used commercially to cover almost any kind of service that involves software, in this context, an ASP may be defined as a company that hosts and manages business applications (e.g., accounting, personnel management, customer relations management) from remote locations on behalf of a client. ASPs host applications at a remote data center and deliver the applications to the customer via the Internet or a private network. Human interaction with the client is minimal. ASPs offer companies the means to outsource their information technology needs.

Assessment

Many large businesses have established "shared services centers" to conduct back office operations. These are facilities that provide centralized operations to several divisions or entities within a corporation. Shared services centers may utilize call center technology as well as sophisticated Internet, video, and data links to perform services. These centers are the way of the future. According to Dun and Bradstreet, $200 billion of "business-process outsourcing" is farmed out each year. This is a large market that will grow.

Opportunity exists for the government of Korea to promote the growth of back office operations in the domestic market. There is also great potential for a few of the components of back office operations, such as website content development and hosting to be marketed internationally.

Distance Education

Distance education or networked learning may be defined as learning opportunities delivered remotely to individuals through the use of ICTs. Current use of information and communication technologies has allowed traditional education institutions to improve the quality of distance education programs, such as correspondence courses, that have been in place for a

while. Many companies around the world offer training online, primarily through the Web, but also via videoconferencing, CD-ROM and other technologies.

Market

Higher education is a prime growth area for distance learning. The Massachusetts Institute of Technology recently put the principal content of its courses online for free use without restriction. Of course, learning involves more than downloading course content. Some examples of more comprehensive higher education service leaders are shown in Figure B1.5.

Figure B1.5: Distance Education Examples

Country	Institution	Service
Korea	EduNet (Korean Education and Research Information Service)	Provides teachers and students at all educational levels with online content. Allows primary school teachers to share lesson plans.
Canada	Athabasca University	Largest MBA program in Canada offered entirely via the Internet domestically and internationally.
Jamaica	University of the West Indies	Educational opportunities for students in 15 Caribbean countries.
Mexico	Monterrey Institute of Technology and Higher Education	Offers almost 2500 courses to more than 80,000 students and 6,000 faculty members at 30 campuses in Latin America.
United States	National Technological University	18 degree programs in engineering delivered via satellite, the Internet, videotape, and CD-ROM.

Example: EduNet

EduNet, the online information service, www.edunet4u.net, established by the Ministry of Education in 1999 and sponsored by the Korean Education and Research Information Service, provides a wide range of educational services. Offerings include lesson plans and the opportunity to communicate with colleagues for teachers; study rooms, study aids, message boards, and chat rooms for students in elementary through secondary school; job services and information on study abroad opportunities to college-age students, and additional educational resources for parents. The project continually develops up-to-date resources in an effort to promote interactive learning through technology.

EduNet's goals are to become a comprehensive portal for a broad range of teaching and learning resource and to develop a marketplace for the education community.

Assessment

Distance learning is not a new concept as the examples above demonstrate. The World Bank's Global Development Learning Network (GDLN), operates in partnership with countries and learning institutions around the world serving 16 countries. The Network conducts learning activities through high-speed access to the Internet and a fully equipped multimedia learning room with computer workstations. It also provides videoconferencing services and manages the space, infrastructure, and a program of courses and seminars. This includes local marketing and promotion of the learning program and provision of administrative support.

Although Korea is hindered from promoting distance-education services in international markets by its language base, many uses exist for this service in the domestic market. Firms seeking to become market leaders in this area will need to focus on expertise and interactive delivery methods rather than breadth and stature.

Telemedicine

Telemedicine is the use of telecommunications and information technologies to provide health services, training, and information to health care providers and consumers. Telemedicine requires a multidisciplinary approach involving telecommunications, information technology, medical experts, general practitioners, hospitals, equipment suppliers, logistics companies, government agencies, social workers, and universities. It draws together a wider range of technologies including radio, analog and digital communications lines, e-mail, the Web, satellites, and remote sensors. Figure B1.6 provides typical service types.

Through telemedicine, health care professionals are able to deliver services to individuals in their own communities where services may not be otherwise available.

Figure B1.6: Examples of Telemedicine Services

Service	Description
Telemetry	Real-time relay of medically important data to a central location for monitoring, permitting a patient to stay at home rather than be in the hospital.
Store and Forward	Asynchronous delivery of medical services. Medical information is sent via a multi-media e-mail to a consultant or specialist who reviews material and replies accordingly.
Video Conference	Synchronous delivery of medical services through live video conferencing between a medically qualified practitioner and a consultant or specialist who assists the practitioner in real time (e.g., during surgery)

Market

While the need for these services is high, the ability of the remote and isolated in all countries and the poor in developing countries to pay for them is low. Market growth will depend upon donor and international assistance organizations' recognition of the potential impact of such services.

Assessment

Telemedicine can range from being an extremely high-end service to offering more basic services. For example, it was used extensively by United States armed forces during the Gulf War, where U.S.-based specialists used video teleconferencing to assist surgeons who were performing emergency surgery on the battlefield. In Cambodia, Massachusetts General Hospital (U.S.) cooperated with Sihanouk Hospital Center for Hope in Phnom Penh to assist rural nurses with conducting rural health clinics.

Rural Korean communities stand to benefit should the government chose to fund tele-medicine projects in the domestic market.

Tele-Engineering

Tele-engineering or collaborative engineering combines shared documents and design software to support engineering projects at a distance. Through the use of telecommunications and multimedia platforms, engineering occurs both synchronously (video and audio) and asynchronously (text, diagrams, and binary files.) Current technology allows for engineering collaboration through: audio/video conferencing, whiteboard sharing, file sharing and transfer, and joint file viewing.

Market

Because of the high value of the information involved, most tele-engineering is conducted within firms. Market data for tele-engineering activities is not available.

Assessment

Tele-engineering is a high-end service which enables the maximization of technical expertise and resources. In theory, the market for tele-engineering services should grow enormously, especially as the cost of vital components such as video conferencing decrease. Tele-engineering is an example of the kind of high-end network-enabled service of the future that will replace many of today's face-to-face interactions. However, because of the high value of transmitted information, such practices will tend to remain inside firms rather than be offered in the open market.

Because of Korea's strong human capital, an opportunity exists to encourage the utilization of this network-enabled service in the domestic market. Opportunity exists as well for export of this service through overseas Koreans engaged in the engineering sector. Once a sufficient overseas branding of Korean tele-engineering services emerges, Koreas will then be well-positioned to capture a large share of the global market.

Figure B1.8 provides a summary of the information provided in Appendix A, indicating Korea's potential in promoting the growth of the eight identified network enabled services.

Figure B1.8: Summary of Korean Market Potential

Network-Enabled Service	English Language Necessity	Competitive Labor Costs	Potential for Korean Businesses
Call Centers	High	Low	Domestic uses.
Medical Transcription	High	Low	Low market potential.
Animation	Low	Low	Decreasing market share due to high cost labor.
GIS	Low	Low	Low market potential.
Back Office Operations	None - High	Medium	Opportunity to promote domestically. Website content development and hosting could be promoted internationally.
Distance Education	None - High	High	Domestic uses.
Telemedicine	Medium	High	Domestic uses.
Tele-Engineering	None - Medium	High	Opportunity to promote domestically and to export to Korean ex-patriots. Long-term international market potential.

NATIONAL PROVIDERS OF NETWORK-ENABLED SERVICES

In addition to deriving economic benefit from utilizing network-enabled services, numerous countries around the world have actively engaged in the provision of such services. Appendix B provides an overview of eight global leaders: India, Ireland, Japan, Jordan, Malaysia, the Philippines, Singapore, and the United States and offers examples of what activities have succeed and which services could be offered by Korean firms.

Each country's section begins with E-Readiness ratings for five national-level attributes and concludes with a summary of the nation's capabilities. E-Readiness ratings measure each country's ability to participate in the global digital economy by answering key questions:

- Connectivity – Are networks easy and affordable to access and to use?
- E-Leadership – Is E-Readiness a national priority?
- Information Security – Can the processing and storage of networked information be trusted?
- Human Capital – Are the right people available to support e-business and to build a knowledge-based society?
- E-Business Climate – How easy is it to do e-business today?

Assessing the capacity of nations to participate in the new economy is an art, not a science. Existing statistical categories overemphasize the old economy and old technology, and rapid changes in technology and markets quickly make relevant statistics out of date. Numbers are blind to cultural differences. Because of these shortcomings in the data, a broad range of qualitative and quantitative factors are taken into account. The E-Readiness ratings combine a dynamic evaluation of the relevance and accuracy of available quantitative data with an understanding of myriad cultural, institutional, and historical factors relevant to the actual situation in each country. The ratings are by nature general, not definitive. They provide an initial basis for understanding what is in each case a complex situation.

Using the networked approach, These assessments were developed with the assistance of governments and in-country experts from private industry in the countries rated. The ratings are based on the latest information available globally and locally and their conclusions are current.

INDIA

"The Silicon Valley of Asia"

Figure B2.1: E-Readiness Rating--India[2]

Connectivity	E-Leadership	Information Security	Human Capital	E-Business Climate

India's economy is a mixture of traditional village farming, modern agriculture, handicrafts, a wide range of modern industries, tourism, and a multitude of support services. While significant economic growth over the past decade permitted a significant increase in real per capita private consumption, a large share of the population, perhaps as much as 40 percent, remains in deep poverty.

In the network-enabled services realm, a particular challenge facing India is its weak telecommunications infrastructure. Reliability of telecom networks is below global standards on domestic circuits. Bandwidth availability is poor. However, over the next two years, India will develop a fiber-optic network that should greatly improve bandwidth. More than a dozen companies will connect 200 cities, towns and villages through 400,000 kilometers of fiber-optic cables. Total expenditure is projected to exceed $6 billion. To compensate for unreliable connectivity, companies providing NES have invested heavily in contingency plans, often buying power generators, with multiple, redundant backups to guaranteed 24x7 connectivity.

India has enjoyed strong growth in the ICT industry over the last decade despite these obstacles due to three major factors:

- A large pool of low-cost English speaking, computer literate, skilled professionals. While most people appreciate the cost value of Indians, major U.S. companies like American Express are learning that not only have the saved costs (40-50 percent by shifting work from the U.S. to India), but the quality of work has improved. For example, eFunds International has cut the number of data processing errors for one client by 90 percent. In terms of cost, hiring a college graduate in India is like hiring a high school graduate in the U.S.
- Stable legislative and economic framework and special incentives for establishing network-enabled services provided by federal and state governments.
- A virtual 12-hour time zone difference with the United States, facilitating overnight service for asynchronous network-enabled services.

[2] Key: See *Ready? Net. Go! Partnerships Leading the Global Economy,* McConnell International, 2001.

Blue	The majority of conditions are suitable to the conduct of e-business and e-government.
Amber	Improvement needed in the conditions necessary to support e-business and e-government.
Red	Substantial improvement needed in the conditions necessary to support e-business and e-government.

As a result, widespread network-enabled services operations are opening across India including call centers, medical transcription services, back office operations including credit card processing, website content development, and animation. Geographic information system services are also emerging.

Example: Crest Communications

Over a four-year period, Crest Communications, a Mumbai-based company, spent a few million dollars to develop a graphic studio and train 40 people in animation techniques. However, a major obstacle that Crest felt, like many of its fellow Indian-based networked-enabled service providers, was market entry into the lucrative U.S. economy. To overcome this, they partnered with an independent Hollywood filmmaker to market them abroad. This promoter recently acquired a contract for a feature for Crest. While it will be written and dubbed in Los Angeles, the Crest animators will do the majority of the production, for half the cost of a U.S. firm, creating the look of the film from sketches sent to them from the United States.

Implications for Korea

India will continue to be a major global player because of its provision of low-cost labor. In June 2001, NASSCOM, India's National Association of Software and Service Companies, announced an aggressive program to work with the government to promote continued growth in network-enabled services. India is also making strides in moving up the value-chain, with the growth of its software industry. Its unique combination of engineering skills and large labor pool indicate that it will continue to be a global force. Korea should avoid the temptation to compete with India's primarily low-end network-enabled service offerings, and should instead use network-enabled services to improve its existing strengths, namely in the manufacturing industry.

IRELAND

"The Celtic Tiger Economy"

Figure B2.2: E-Readiness Rating--Ireland

Ireland has experienced strong overall economic growth, particularly in the 1990s partially as a result of its leadership position in network-enabled services. Whether it be call centers, software programming, or back office financial services, Ireland's successes can be attributed to:

- Strong government support with a focus on partnership with industry. Strong growth can be attributed to a long-term investment in education, and a policy decision by the Industrial Development Agency (IDA) to target select areas of international service activity, particularly financial services, software, and what was then known as

teleservices—the forerunner of today's network-enabled services. In addition, corporate taxes are low.

- Responsive regulatory and legal environment.
- Long-term investment in education has produced a large workforce of young, well-educated, English speaking people.
- Excellent telecommunications infrastructure. Over the past ten years, Ireland has invested more than $5 billion in telecommunications infrastructure. Ireland now has one of the most advanced telecommunications systems in Europe offering a reliable fully digital system.

As a result, in 1998 alone, over 60 companies chose Ireland for establishing call centers, making Ireland a leader in pan-European call center industry, with the IDA claiming Ireland as having 30 percent of all pan-European call centers in the European Union. Between, 1994 and 1995 alone, Telecom Ireland's international toll-free traffic grew 600 percent. Current companies operating call centers include: Best Western International, United Parcel Service, ITT Sheraton, Rand McNally Media Services, Gateway 2000, Lexmark International, Informix Software Ireland, Siemens, Dell, America Online, American Airlines, and Oracle.

Two concerns face Ireland's network-enabled services industry in the medium-term. First, the demand for skilled ICT professionals and the economic growth generally have created upward wage pressure, which is beginning to reduce its competitiveness when compared with countries such as India. Second, Ireland's network-enabled services industry has had an almost entirely export-oriented focus. The industry began and has continued as an enclave within the overall Irish economy. As a result there has been little diffusion of the benefits such as increased efficiency of operations and improved supply chain management to Irish companies. This threatens the sustainability of the Celtic tiger phenomenon.

Example: The International Financial Services Center (IFSC)

The IFSC was established in 1987, and is now a vital part of the Irish economy with direct employment of more than 7,000 people. (*www.ifsc.ie*). The center is a leading worldwide location for international banking, investment funds, corporate treasury, and insurance activities. Companies involved with the IFSC include: Bear Stearns, Bank of America, Chase Manhattan, Citibank, General Electric Finance, Sumitomo Bank, Deutsche Bank/Morgan Grenfell, and Société Générale.

With the current trends in global outsourcing of business activities, the IFSC is taking on activities such as shared services centers, back office support, and customer support services. In 1999, the IFSC employed an estimated 2,500 people in these activities. The outlook for greater opportunity is bolstered by the fact Ireland has seen a growth in international companies outsourcing back office operations in Ireland. These companies include AIG, Bankers Trust, Citibank, Merrill Lynch, and Fidelity Investments.

Implications for Korea

Ireland benefits immensely from a populace of native English speakers. In the future, however, higher labor costs will limit its ability to maintain its status as a major provider of low-

end network-enabled services. Unless Ireland takes action now to move its offerings upward on the value chain, it will face the danger of stalled growth. To avoid the same prognosis as Ireland, Korea needs to make continued efforts to ensure that the benefits of information and communications technology are diffused throughout society, particularly to SMBs and traditional industries.

JAPAN

Figure B2.3: E-Readiness Rating—Japan

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]		[illegible]

Japan currently ranks as the world's third largest economy behind the United States and China. While growth has been sluggish through the 1990s, Japan has built a technologically powerful economy characterized by government-industry cooperation, a mastery of high technology, and a strong work ethic.

The government of Japan has set a goal to connect all Japanese businesses, government offices, schools and homes by 2010 through a "Fiber to Home" project. Current investment in telecommunications infrastructure is $33 billion annually and by 2007 is forecast to reach a cumulative $500 billion.

Example: @Network

@Network (San Jose, CA), an Internet outsourcer, operates a call center in Tokyo to serve customers targeting Japan's markets. The Tokyo facility also acts as a regional hub for @Network's network, providing its main link from San Jose, CA, with Beijing, Shanghai, Hong Kong, Seoul, and Singapore. Other facilities are being planned for Fukuoka, Nagoya, Okinawa, Osaka, Sapporo, and Sendai.

Implications for Korea

Japan is not a major global provider of network-enabled services for several of the same reasons that hinder Korea: low English language competency and high labor costs. To compete with Japan, Korea must continue to concentrate on integrating technology into its core industries in an effort to move its products and services upward on the value chain.

JORDAN

Figure B2.4: E-Readiness Rating—Jordan

Connectivity	E-Leadership	Information Security	Human Capital	E-Business Climate

Since the mid-1990s Jordan has suffered recession, debt, and high unemployment. Economic difficulties can be attributed to the small size of the Jordanian market, the fluctuations in agricultural production because of irregular precipitation, the lack of capital, political instability in the region, and the presence of refugees. These factors have made it necessary for Jordan to seek substantial foreign aid. In September 1997 Jordan and the United States signed a third and final agreement to write off the country's debt of more than $1 billion to the United States. Soon after, the World Bank announced another large loan to revitalize Jordan's economy.

While lacking an advanced telecommunications infrastructure, Jordan has begun a serious effort to join the networked world. Under the leadership of the royal family, the Reach Initiative has produced a detailed roadmap for Jordan to move forward in developing a software industry.

As Figure B2.5 suggests, Jordan is attempting to model itself on the most rapidly advancing emerging economies.

Figure B2.5: Reach Initiative Comparison Chart

	India	Ireland	Israel	Jordan
Number of Software Services Firms	500	600	300	50
Number of Employees	200,000	19,000	10,000	1,250
Total Sales of Software and IT Services	$4 billion	$5.2 billion	$1.2 billion	$22.3 million
Number of Employees Per firm	340	32	33	25
Total Exports of Software and IT Services	$1.7 billion	$4.9 billion	$700 million	7.5 million
Major Export Markets	U.S. E.U. SE Asia Japan/Aus Other	E.U. U.S.	U.S. E.U.	U.S. E.U.
Major Export Market Activities	Offshore programming Outsourcing ERP Consulting Data processing Multimedia	E-commerce Internet applications Development tools Localization Call Centers	ASP E-Commerce development tools CAD/CAM Multimedia	Packaged applications Custom applications Offshore programming Multimedia
Top Sources for Foreign Direct Investment	U.S. Japan U.K.	U.S. U.K. Germany	U.S.	U.S. U.K. France
Leading Multinational Investors in Software and IT services	Microsoft Novell Oracle Computer Associates Adobe Informix	Microsoft Computer Associates Novell Oracle Informix SAP Symantec	IBM Sapiens Cisco systems Siemens Digital SAP Madge	None

Adapted from The REACH Initiative: Launching Jordan's Software and IT Services Industry (http://www.reach.jo/documents/reach.pdf).

Implications for Korea

Despite its efforts, Jordan will not succeed in creating a world-class software industry, as it lacks the requisite critical mass of talent. One strategy that it may choose to pursue is to create a niche software market, much as Israel has found success through its security products. Korea should monitor Jordan's progress, viewing Jordan's experiences as a laboratory for creating a niche software industry.

MALAYSIA

Figure B2.6: E-Readiness Rating—Malaysia

Connectivity	E-Leadership	Information Security	Human Capital	E-Business Climate

Until 1997, Malaysia experienced over a decade of uninterrupted economic growth. The country entered a recession in 1998 as the regional financial and economic crisis intensified. The economy rebounded in 1999, and performed well during 2000. The government plays an active role in the economy as investor, economic planner, approver of investment projects, and public and private procurement decisions.

Malaysia's ICT infrastructure is sparse, with low telephone and computer penetration, and is fairly limited to urban centers. A small number of ISPs and the absence of an independent regulatory agency inhibit the spread of network access, although the cost of access is moderately priced. Transportation and postal services mirror the ICT infrastructure; not robust to begin with, it weakens to non-existent in the rural areas. Even between the Multimedia Super Corridor in Cyberjava and Kuala Lumpur, the public transportation is poor and creates an obstacle in attracting workers.

Example: Multimedia Super Corridor

The Multimedia Super Corridor (MSC) is a state-of-the-art information technology hub located outside Kuala Lumpur. Begun in 1996 under the management of the Multimedia Development Corporation, the MSC strives to:

- Attract both world-class technology-led companies to Malaysia, and develop local industries.
- Offer a productive, intelligent environment within which a multimedia value chain of goods and services will be produced and delivered across the globe.
- Maintain excellence with multimedia-specific capabilities, technologies, infrastructure, legislation, policies, and systems for competitive advantage.
- Provide a test bed for invention, research, and other groundbreaking multimedia developments spearheaded by seven multimedia applications.
- Be a world of Smart Homes, Smart Cities, Smart Schools, Smart Cards, and Smart Partnerships.

While response has been favorable to the idea of the MSC, global companies have been slow to establish a presence. To drive development of the MSC, seven primary areas, called "Flagship Applications" have been developed. These applications are listed in Figure B2.7.

Figure B2.7: MSC Flagship Applications

AREA	PURPOSE
Electronic Government	To reinvent government using multimedia and information technology to improve productivity, and create a collaborative environment that fosters the ongoing development of Malaysia's multimedia industry.
National Multipurpose Card	To develop a common platform for a Multi-Purpose Smart Card that will enable government and private application providers to implement standard solutions without duplication of effort and investment.
Smart Schools	To help Malaysia make the critical transition from an industrial economy to a knowledge-based one.
Telemedicine	To provide greater and easier access to higher quality healthcare for all Malaysians.
Borderless Marketing Centers	To create electronic marketplaces that increase business efficiency and service across different time zones.
World Wide Manufacturing Webs	To provide an environment for high value-added manufacturing activities to be pursued using multimedia and information technology.
Research and Development Clusters	To ensure that the MSC is an attractive location for companies to develop next-generation multimedia technologies and innovations.

Source: www.mdc.com.my/msc/flagship/index.html

The Telemedicine application, an example of network-enabled services, involves four pilot programs:

- *Mass Personalized/Personalized Health Information and Education.* This project involves the sourcing and development of information and educational materials followed by the construction of a generic database.

- *Continuing Medical Education.* This project will provide information and enhance the capability of healthcare providers.

- *Tele-consultation.* This project will connect healthcare providers in a multipoint manner to share opinions and provide mutual support.

- *Lifetime Health Plan.* This project will see the development of personalized lifetime health plans, in which a person's health record will be maintained throughout the life of that person, enabling health care providers to provide patient-focused and continuous care.

Implications for Korea

Although Malaysia's Multimedia Super Corridor has not met with the success that was once envisioned, Malaysia has retained its strong commitment to creating a domestic information society. Korea stands to benefit from Malaysia's lessons-learned, particularly in the tele-medicine field.

PHILIPPINES

Figure B2.8: E-Readiness Rating—Philippines

Connectivity	E-Leadership	Information Security	Human Capital	E-Business Climate

The Philippine economy is a mixture of agriculture, light industry, and supporting services. Through 1998 and 1999, the economy saw deterioration and subsequent recovery due to the Asian financial crisis and poor weather conditions. While successive governments have focused on economic reforms to help the Philippines match the pace of development in the newly industrialized countries of East Asia, reform moves slowly. Corruption and recent political turmoil have hindered the reform progress.

Poor telecommunications infrastructure in the Philippines remains an obstacle to the growth of e-commerce in the country. Interconnection issues amongst the various telecommunications players have yet to be resolved.

Network-enabled services in the Philippines include back office operations, call centers, and customer services of companies like AOL, Caltex, and Citibank. In addition to these services described in Figure B2.9, the Philippines is competing with Korea for animation services.

Figure B2.9: Network-Enabled Services Offered in the Philippines

Category Of Services	Example	Description
Corporate Back Office	Caltex	Treasury, human resources
Data Processing	Sealand UPS	Shipping documents Shipping documents
	SPI Technologies	Digitize library card catalogues Digitize technical manuals Maintain U.K. voters' lists Digitize archive for U.S. Dept. of Justice
Engineering	Bechtel Fluor Daniel Parsons	Blueprints, engineering designs Blueprints, engineering designs Blueprints, engineering designs
Internet Service Center	Barnes & Noble AOL	Process Internet orders Answer customer e-mail
Medical Transcription	Kumar	Transcribe doctors' dictation
Corporate Shared Services	Procter & Gamble	Shared accounting functions
Corporate Technology Suppor	Citibank	Systems Development and Support
Website Center	Asian Sources Medi	Maintain large website

Source: http://www.rent-a-team.com/philippines_as_center.htm

Implications for Korea

The Philippines have been successful in attracting consumers of networked-enabled services because of its low labor costs and the high level of English language competency among its workforce. Korea should view the Philippines as a major provider of low-end network-enabled services with which it cannot compete.

"The Intelligent Island"

Figure B2.10: E-Readiness Rating--Singapore

Connectivity	E-Leadership	Information Security	Human capital	E-Business climate

Singapore has a highly developed and successful free-market economy. The business environment is open and corruption-free, prices are stable, and per capita GDP is the fifth highest in the world. The government promotes high levels of savings and investment through a mandatory savings scheme, and spends heavily in education and technology.

Singapore's telecommunications infrastructure is among the world's best. To promote the further growth of the information industry, the country has installed Singapore ONE, the nationwide, high-speed, fiber optic broadband network that provides multimedia applications and Internet services to all homes, schools, and offices.

Example: iCall Systems Inc.

Established in 2000 and headquartered in Singapore, iCall Systems provides web-based call center services through a network of partner call centers in China, Indonesia, Malaysia, Myanmar, Pakistan, the Philippines, and Thailand. According to company literature, iCall System does not require downloading of specialized software, and is fully supported by major Internet browser software. Presently, online customer service is provided via a text-based chat interface. iCall Systems is testing Voice-over Internet Protocol (VoIP) services. In its first ten months of operation, revenues were $500,000, mainly from local customers like Singapore Tourism Board, Holiday Inn, and Samsung. (See www.internet-callcentre.com)

Implications for Korea

Singapore has set an ambitious goal of becoming Asia's premier information technology hub. Thus far, the major pillars of the strategy have included creating a secure infrastructure for e-business, formulating pro-business policies and legal frameworks, and increasing user confidence in online transactions. Singapore offers Korea many lessons-learned in the creation of a dynamic information society, particularly in the area of integration of ICT into everyday life of students and citizens, and the successes of reform of traditional rote learning methods.

Figure B2.11: E-Readiness Rating—United States

Connectivity	E-Leadership	Information Security	Human Capital	E-Business Climate

Despite the current economic downturn and prevalent uncertainty over the short-term, the United States has the most technologically powerful, diverse, advanced, and largest economy in the world. U.S. business firms enjoy considerably greater flexibility than their counterparts in Western Europe and Japan in decisions to expand capital plant, lay off surplus workers, and develop new products. At the same time, they face higher barriers to entry in their rivals' home markets than the barriers to entry of foreign firms in U.S. markets. U.S. firms are at or near the forefront in technological advances, especially in computers and in medical, aerospace, and military equipment, although their advantage has narrowed since the end of World War II. The onrush of technology largely explains the gradual development of a two-tier labor market in which those at the bottom lack the education and the professional/technical skills of those at the top and increasingly fail to get pay raises, health insurance coverage, and other benefits.

Domestically, companies of all sizes are engaged in network-enabled services. For example, there are 69,500 call centers in the United States, estimated to grow to 78,000 by 2003, employing seven million telephone agents. In the field of medical transcription, annual revenues within the U.S. approach $10 billion.

Example: Telemedicine

As shown in Figure B2.12, Telemedicine is enjoying a rapid growth in the U.S. Early adopters of telemedicine include emergency medicine and mental health specialists.

Figure B2.12: Total Clinical Tele-Consultations (U.S.)

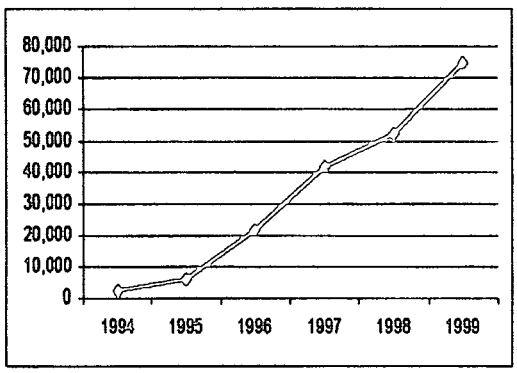


Figure B2.13 shows some details of the increase in telemedicine services in the United States. Officials at the Association of Telehealth Service Providers, the

organization that produced the figures noted above, could not pinpoint factors driving the increase in telehealth projects. However, the organization suggests one possible explanation could be that significant levels of Federal Government funding gave rise to an increase in telemedicine pilot projects.

Figure B2.13: Telemedical Activity for Most Active Clinical Specialties

	1996	1997	1998
Mental Health	2,886	7,404	11,974
Cardiology	2,282	6,839	3,469
Dermatology	1,958	2,345	3,278
Orthopedics	1,083	2,306	2,556
Neurology	555	699	801
Infectious Diseases	323	851	1,514
Internal Medicine	861	1,940	2,080
General Surgery	575	1,026	2,161
Pediatrics	371	572	1,161
Total	10,894	23,982	28,994

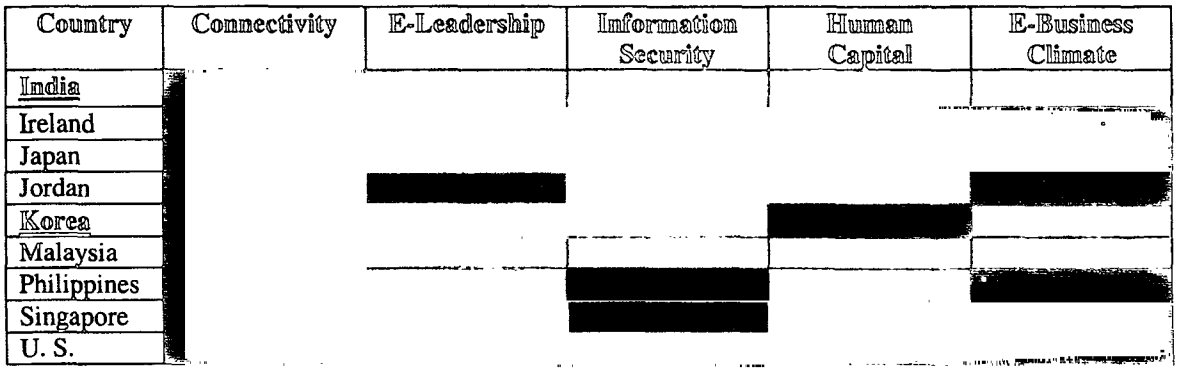
Implications for Korea

In relation to Korea, the United States is more trading partner than competitor in the provision of network-enabled services. The U.S. can also serve as a useful example of both successes and failures. For example, as discussed elsewhere, the rise and fall of trucking and logistics portals provide useful lessons for Korea.

SUMMARY OF LEADERS' CAPABILITIES

To enable cross-country comparisons, the E-Readiness ratings of all nine network-enabled services leaders are summarized in Figure B2.14. Note that the attributes are fully described in chapter 2 of the main report.

Figure B2.14: E-Readiness Ratings for Selected Countries



The general ratings do not provide sufficient detail to make determinations about national capacity to provide network-enabled services in the contingent attributes Connectivity, Information Security, and Human Capital. Accordingly, they are discussed further below.

Connectivity

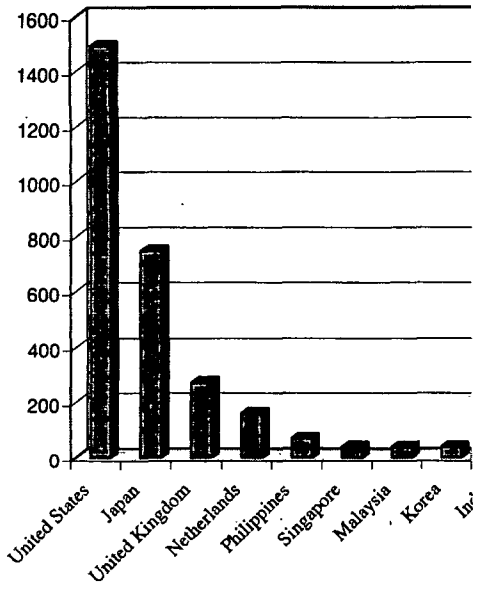
The general rating measures primarily the infrastructure within a country. This is important for the spread of information society and its benefits to all citizens. However, since network-enabled services are likely to be both an internal and export marketed service, it is useful to focus on external bandwidth.

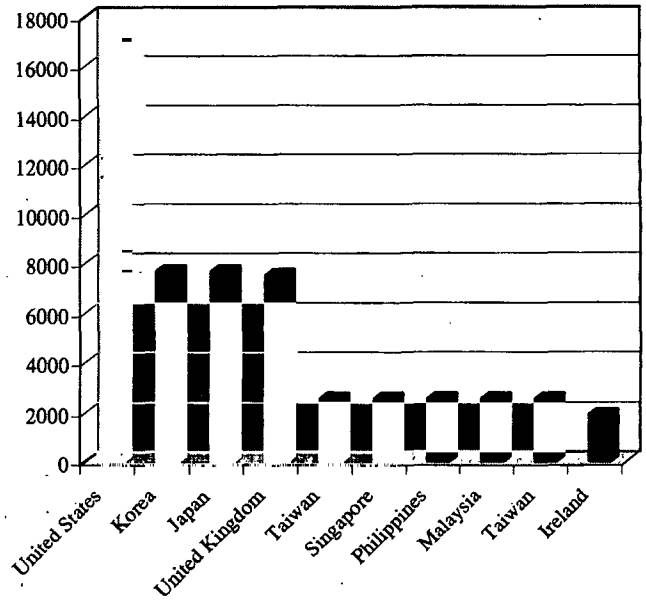
A great deal of investment is currently occurring to increase connectivity around the world. Firms such as Global Crossing are laying high bandwidth fiber optic cable at a rate that is rapidly changing the balance among countries in terms of connectivity.

In particular, it is useful to note that Korea will be increasing its international bandwidth to put it on a par with Japan and the U.K., outstripping other Asian nations and other providers of network-enabled services.

Figure B2.15 shows the submarine cable bandwidth to selected countries as of June 1999 and December 2001 (projected). Note the 10:1 difference in scale. Countries discussed in this chapter but not shown in the figures have lower bandwidth than those shown.

Figure B2.15: Undersea Fiber Optic Cable Bandwidth





Information Security

The ratings for Information Security combine all three factors discussed in Chapter 3—intellectual property protection, privacy protection, and systems security. Because different network-enabled services require different levels of security in each factor, Figure B2.16 provides a more detailed assessment of these areas in selected countries.

Figure B2.-16: Components of Information Security Ratings

Country	Overall Rating	IPR	Privacy	Systems Security
India		Medium	Low	High
Ireland		High	High	High
Japan		High	High	High
Jordan		Low	Low	Low
Malaysia		Medium	***Medium***	Medium
Philippines		Medium	Low	Low
U. S.		High	Medium	High
Korea		Medium	Medium	High

Of the nine countries identified as major participants in the global network-enabled services marketplace, three have demonstrated that the majority of information security conditions are suitable to the conduct of e-business and e-government, as is indicated by the blue ratings. Three countries, including Korea, have demonstrated that improvements are needed before a high level of trust can be placed in the security of digitalized information, as indicated by the yellow ratings. Two countries, as indicated by

the red ratings, have demonstrated that substantial improvements are needed in the area of information security.

In order to receive a high rating in the protection of intellectual property rights, indicated by the IPR column, a country must be a signatory to numerous international conventions, and have an enforcement mechanism in place to assure public abidance by international law. A country will receive a high rating in the privacy component if adequate legal protection is in place to ensure consumers' personal privacy. Systems security ratings are determined by the strength and effectiveness of the legal framework to address and prosecute computer crimes, authorize digital signatures, and enable public key infrastructures.

Human Capital

Finally, for Human Capital, the general ratings can be supplemented for the purposes of network-enabled services provision by looking at three additional areas—reputation as a high tech leader, English language prevalence, and education that is relevant to providing network-enabled services. Figure B2.17 provides a more detailed assessment of these three additional areas in the nine selected countries.

Figure B2.17: Components of Human Capital Ratings

Country	Human Capital	High-Tech Reputation	English Prevalence	Relevant Education
India		High	Medium	Medium
Ireland	[redacted]	High	High	High
Japan	[redacted]	*High*	Low	High
Jordan		Low	Low	Low
Korea	[redacted]	High	Low	High
Malaysia		Medium	Medium	Medium
Philippines		Medium	Medium	Low
Singapore	[redacted]	High	Medium	High
U. S.	[redacted]	High	High	High

All nine selected countries received Human Capital ratings of yellow or above, indicating that the majority of the three components necessary to participate in the global network-enabled services marketplace are suitable. Countries were rated on their high-tech reputation on the basis of their status as a technology producer and innovator. English prevalence is rated according to the proportion of the population that has achieved fluency. Finally, countries were rated on the basis of the level of training reached by participants in the information technology sector.

IT DEPLOYMENT AMONG SMALL FIRMS IN KOREA

Introduction

Since the financial crisis that occurred at the end of 1997, the Korean economy has undergone a variety of fundamental changes. One of the most noticeable was the increase in the importance of small and medium sized enterprises (SMEs) in the economy as the economic power and rationale of *jaebols*, Korean conglomerates, have weakened to a significant degree.

For SMEs in Korea to accelerate their growth further, it is essential for them to achieve a higher level of informatization, or processes involving the innovation of business systems or any other solution-providing systems through the application of information technology (IT).

In Korea, the informatization level of individuals reached 23.2% as of Jan 1st, 2000, the highest among all OECD countries. By comparison, the OECD average marked 10.9 %. Despite this strong showing, the informatization level of Korean firms has remained relatively low, as revealed in some indicators such as the relative number of Internet hosts or the extent of E-business employment in their businesses (OECD, *STI Scoreboard*, 2001).

The Korean government has made every effort to assist SMEs including improvement of their information systems to enhance their ability to utilize the Internet and other information networks. However, the IT deployment of SMEs in particular has remained unsatisfactory.

The main purposes of this report are three-fold: First, to assess and analyze the current situation of the utilization of IT, especially network-enabled services (NESs), among small businesses, second, to identify the impediments to IT deployment, and finally, to suggest relevant policy recommendations to expand SMEs' use of IT and networks in business. To address these, the Korean team visited 25 Korean SMEs that were utilizing a certain degree of IT, interviewing IT related personnel at each firm in accordance with a structured questionnaire.

The organization of this report follows the structure of the questionnaire: Basic data on the sample companies, inventory of IT system, IT applications, network enabled business processes, IT deployment, and barriers to deployment of IT and network-enabled services. Some policy recommendations are provided last.

Basic Information on the Sample Companies

The sample companies consisted of 25 Korean SMEs located in the Seoul metropolitan area and were selected from the same industry, i.e., the electrical and electronic equipment industry (SIC 36), in order to reduce any possible inter-industry biases. The number of their employees ranged from 22 to 130, averaging 59. However, the ratio of IT specialists remained as low as 3.2% of the total, representing 1.8 persons per company on average.

Table B3.1: Number of Employees of the Sample Firms

Number of employees	Cases	Percentage (%)
22 ~ 50	13	52.0
51 ~ 75	6	24.0
75 ~ 100	3	12.0
101 ~130	3	12.0
Total	25	100.0

Source: KIET survey results, November 2001.

Their sales revenue for the most recent year reached US $ 12.7 million on average, with the range between US $ 0.5 million and 123.1 million. In terms of revenue, their major customers were large manufacturing firms (43.6 %) and other manufacturing firms (19.9 %), revealing that 63.5% of their revenue was coming from the manufacturing sector. In contrast, wholesalers and distributors, and government accounted for 17.7% and 14.0%, respectively. Retail customers occupied the smallest percentage of 4.8%.

The sample companies had invested a considerable amount in the IT area: the average value of per company investment reached US $ 1.1 million. Of this amount, 64.0% was allocated in hardware and the remaining, in software.

Inventory of IT System

The sample firms had purchased all their computers, and their average number of computers per employee was 0.56. However, almost 60% of the computers had Pentium III processors or more advanced models. All the sample firms, except for one located in an isolated area, had a LAN and all had Internet access. As Internet access method, 88.0% of the firms utilized leased line or DSL, while the remaining 12.0% relied on dial-up modem. Therefore, it was concluded that the sample firms had a certain level of infrastructure for their businesses' use of the Internet and IT.

IT Applications

The most commonly used applications turned out to be for word processing (100% of the firms) and accounting and budgeting (96.0%), followed by network related activities (72.0%) and others activities, ranging from 12.0% to 60.0%. Applications for accounting and budgeting, and word processing represented the largest amount of computer utilization: their approximate monthly use time per company reached 122 hours and 105 hours, respectively, while the others were used for less than 100 hours.

The most popular operating system (OS) software among Korean SMEs was Windows 98 (45.1%) for PCs, and Windows 2000 (33.3%) for mainframes. For word-processing software, MS-Office (30.8%) followed by HWP, a Korean word processing application, (24.4%) was the most popular for PCs, while APACHE (33.3%) was most used for mainframes.

Table B3.2: Purposes of Using Network Access Facilities (Multiple responses)

	Cases	Percentage (%)
E-mailing	21	21.9
Business information and business research	15	15.6
Place orders	8	8.3
Make payments	6	6.3
Receive orders	10	10.4
Receive payments	7	7.3
Exchange business data	11	11.5
Submit requests	5	5.2
Receive approval	6	6.3
Web site administration	1	1.0
Printer sharing	1	1.0
File sharing	2	2.1
Information exchange	1	1.0
ERP system	2	2.1
Total responses	**96**	**100.0**

Source: KIET survey results, November 2001.

Network-enabled Business Processes

Network access was available to all the sample companies but one, and the most popular type of network access facilities was the Internet (72.7%). Intranets were established only by 18.2%. The most frequent use of network access facilities was for e-mailing (21.9%), and obtaining business information and conducting research (15.6%). So accomplishing basic business needs was the most important network use. However, only 10%, or less, of the firms had implemented higher-level business functions such as receiving orders and exchanging data with customers.

Table B3.4: Activities Possible by Visiting Company Home Page
(Multiple responses)

	Cases	Percentage (%)
Obtain information about your products	25	45.5
Obtain financial and operating information about your company	13	23.6
Place and modify orders on your company	12	21.8
Track status of orders, production and shipment	3	5.5
Exchange delivery and payment data	2	3.6
Total responses	**55**	**100.0**

Source: KIET survey results, November 2001.

All the sample firms had their own company homepage. Over half of the firms were outsourcing services such as designing, commissioning and hosting of the website while 76.0% maintained their website in house. Websites were relatively well established, but their functions were limited to a basic level. Activities that could be done by visiting company homepages included obtaining product information (45.5%) and financial and operating information (23.6%). However, order placement and modification through the company website were available only on 21.6%. Moreover, order tracking and the exchange of delivery and payment data were available on approximately 5%.

This dearth of advanced functions is related to the lower degree of integration between the network access arrangements, and the internal IT systems and other computer applications. Such integration was available on a full scale for only 24.0%. No integration existed for almost half 50%, and the remaining 24.0% had partial integration.

The survey questions regarding utilization of e-commerce sales, (defined as the whole order-fulfillment process from order booking to payment), also showed that Korean SMEs are still at the beginning stage of e-commerce. As high a percentage as 72.0% of the firms were not engaged in e-commerce sales at all. Only one firm was reaping all of its sales through e-commerce, while the remaining six firms had figures ranging between 5% and 80%.

The effort to maintain network access entails expenditure for the IT area. The sample companies' expenditures on IT were revealed to be disappointing, with 84.9% of the total spending less than 5%. The average IT systems maintenance expenditure by the companies was 7.0% of their total expenditures. However, without two outliers that had ratios of 80% and 30%, the sample firms' average would have been as low as 2.5%. Of the IT expenditure, 54.4% was allocated for in-house activities, while 45.6% went toward external purchases.

Table B3.5: Annual IT Systems Maintenance Expenditure
(As percentage of Total Expenditure)

	Cases	Percentage (%)
0%	1	4.2
0.1 ~ 0.9%	4	16.7
1.0 ~ 2.0%	8	33.3
3.0 ~ 4.0%	2	8.3
5.0%	6	25.0
10.0% or more	3	12.5
Total responses	24	100.0

Source: KIET survey results, November 2001.

Outsourcing services were very popular among the SMEs. Many of them outsourced a variety of IT services. Web page development and web page hosting, which accounted for 26.1% of the total, were the most common, followed by systems and software maintenance (15.9%), hardware acquisition (14.5%), and software design (13.0%).

Table B3.6: Types of IT Services that Companies Outsourced
(Multiple responses)

	Cases	Percentage (%)
System design	1	1.4
Hardware acquisition	10	14.5
Software design	9	13.0
Hardware Maintenance	7	10.1
Systems and software maintenance	11	15.9
Data Processing	3	4.3
Web development and hosting	18	26.1
Services provided by ASPs	2	2.9
Others	8	11.6
Total	**69**	**100.0**

Source: KIET survey results, November 2001.

Barriers to Deployment of IT and Network-enabled Services (NESs)

Most of the sample firms were keenly aware of the need to utilize the Internet and other networks in conducting their business, but at the same time they understood that there were many impediments and barriers to their improved use of IT and network-based services (NESs).

The twelve main impediments identified may be grouped into three categories: The first category includes technological and expertise problems related to the lack or shortage of relevant technology, expertise, and skilled manpower within the company. The second covers cost and financing problems regarding the high cost and funds needed to purchase and maintain necessary software, hardware and technology and to adapt and integrate existing internal systems to IT and NESs. Finally, the third grouping includes environmental and infrastructure problems involving the use of IT and NESs. Individual problems in each category are as follows.

Technological and expertise problems

(a) Lack of in-house technological and business expertise to identify and develop IT and network applications
(c) Technical difficulty in adapting and integrating existing business processes to IT and networked enabled processes
(k) Shortages of trained and skilled IT personnel

Cost and financing problems

(b) Cost of adapting and integrating existing business processes to IT and networked enabled processes
(d) Cost of running a dual system: a paper-based system and an e-commerce system
(f) Lack of financing to deploy new technologies
(h) High cost of third party technology and consulting services

1. Environmental problems
   (e) Limited use of e-commerce among major customers
   (g) Concerns about security and privacy
   (i) Lack of secure payment settlement mechanisms
   (j) Uncertainty about authentication mechanisms
   (l) Lack of standards

Table B3.7: Barriers to Deployment of IT and Network-enabled Services by Category

Number of cases (percentage)

Category	Technological & Expertise Problems				Cost & Financing Problems					Environmental Problems						Total (%)
Item	(a)	(c)	(k)	Sub total	(b)	(d)	(f)	(h)	Sub total	(e)	(g)	(i)	(j)	(l)	Sub total	
The most important	7	0	1	8 (34.8)	5	2	2	1	8 (34.8)	1	1	0	0	3	5 (21.7)	23 (100.0)
2nd most important	4	3	4	11 (50.0)	6	1	1	0	7 (31.8)	1	1	0	1	0	3 (13.6)	22 (100.0)
Third most important	1	6	0	7 (31.8)	4	1	4	0	8 (36.4)	1	2	1	1	1	6 (27.3)	22 (100.0)
Total (%)	12	9	5	26(38.8)	15	4	7	1	27(40.3)	3	4	1	2	4	14 (20.9)	67 (100.0)

Source: KIET survey results, November 2001.

At the category level, the survey results shows that two categories, technological and expertise problems, and cost and financing problems, both of which 34.8% of the sample companies selected, were more important. Roughly speaking, over one third of the companies were suffering from both kinds of problems in deploying IT and NESs. Next, environmental problems related to the security, standards, and extent of IT use in the industry was cited by 21.7%.

Putting the most, second most, third most important categories of problems together, technological and expertise problems, and cost and financing problems assumed higher importance among the sample companies: Their ratios turned out to be 38.8% and 40.3%, respectively, while that of environmental problems remained almost the same at 20.9%.

At the level of a single problem, (a) the lack of relevant in-house expertise to identify and develop IT and network applications was cited as the most important problem by 30.4% of the companies. The second most important (21.7%) was (b) the cost of adaptation and integration of existing business processes to IT and NES processes, and the third (13.0%) was (l) the lack of standards.

Putting the three most important problems together, (b) the cost of adaptation and integration was cited by 22.4%, followed by (a) the lack of in-house expertise (17.9%), (c) technical difficulty in adaptation and integration (13.4%), and (f) the lack of financing to deploy new technologies (10.4%).

From the results of the ratio comparison above, it can be concluded that the most important problems that Korean SMEs faced in deploying and utilizing IT and NESs mostly involved lack of technology and expertise, and cost and financing.

The in-depth interview conducted by the Korean survey team disclosed a more detailed picture on the barriers that Korean SMEs had encountered. In regard to the category of problems of technology and expertise, many SMEs felt that they had difficulty in finding and recruiting people fit for the specific needs of their companies, despite the growing number of IT experts coming into the Korean economy from schools and private institutes in recent years. In spite of the many education and training programs available to SMEs, it was not easy for them to find programs offering the necessary technology and expertise suitable for their needs.

Regarding the second category of cost and financing problems, these problems mostly involved the cost of software and hardware acquisition, and the cost of the maintenance of the acquired software and hardware such as ERP, MRP, and network servers.

Some SMEs also indicated that there was discrepancy between their on-line operations through the Internet and network use, and their off-line operations within the company because of the prohibitive cost of establishing the relevant systems necessary to connect these two kinds of operations. For instance, in fulfilling orders, the actual delivery and distribution of products could not follow the on-line process in a timely manner in many SMEs.

It was also shown that some SMEs had difficulty in maintaining IT personnel in terms of cost efficiency unless they were fully engaged in e-business. That is why in many SMEs, at early stages of IT, the main IT-related functions were e-mailing and file sharing.

In regard to the third category of environment and infrastructure problems, many SMEs were worried about the security of their internal information, i.e., that accounting and customer information would be divulged to other companies when they expanded their use of IT and NESs. Such concerns over security were more serious particularly to SMEs that had outsourced these functions.

Also, other SMEs indicated that there is a lack of industry standards in the IT industry, e.g., in the area of high speed Internet networks. At the same time, SMEs' internal business processes had not been standardized fully enough to expand the use of IT and NESs, particularly ERPs.

In addition to these problems classified by category, many SMEs cited other serious barriers such as the negative mindset of their CEOs to the use of IT and networks. Since many SME CEOs were part of an older generation that generally did not understand the necessity of new computer-based operations very well, they often showed aversion to the introduction of new IT or NESs into the operation of their business.

More importantly, managers in many SMEs believe that cost saving, or achieving efficiency through the utilization of IT and NESs, was realized in the long term, and thus they thought they should focus on saving direct manufacturing costs that could be earned in the short term.

Policy Recommendations

The survey done by the Korean team also queried the sample SMEs on the degree of their satisfaction with the effectiveness of the Korean government's IT assistance policies on a five-point Likert scale, from 1(very unsatisfactory) to 5 (very satisfactory). It was revealed that the average degree of SMEs' satisfaction with the Korean government's policies remained as low as 2.72 (out of 5 points), and no companies chose 'very satisfactory.'

For its part, the Korean government, mainly through the Small & Medium Business Administration (SMBA), has made every effort to assist SMEs in expanding the deployment and development of IT and NESs, thereby enhancing their ability to utilize the Internet and information networks.

The government's recent policies in this regard can be summarized as follows. First, it has constructed a foundation for SMEs' information systems, including the building of a model for evaluating the informatization extent of SMEs, their education and training on IT, and assistance in website establishment. Second, the government has created a comprehensive information network to provide information related to SMEs through the SMBA's home page, enabling SMEs to collect, share and exchange information among each other. Third, the government has supported the enhancement of SMEs' operation efficiency by helping them develop information-based management systems such as e-business, ERP and MRP.

Despite such efforts, the results have not been evaluated as satisfactory even by the government. According to a survey conducted by the government in early 2001, the extent of the informatization of Korean SMEs was evaluated as only 47.8 out of 100.0 points. To cope with this situation, the government has recently accelerated its efforts, e.g., by launching 'The Project for Informatizing 100,000 SMEs.'

While recognizing the large role the Korean government has played until now in assisting SMEs, the following policy recommendations are suggested, based on the survey results, in order for the government policies to reap better outcomes.

First of all, schools and private institutes should provide education and training programs oriented to satisfy the direct IT needs of SMEs, thereby cultivating able IT employees. Next, funding assistance from the government should include not only the initial acquisition of software and hardware, but also their maintenance after purchase. The government should also consider the off-line side of companies' operation when they assist SMEs' on-line operation through IT and NESs. In other words, for manufacturing firms, IT is not an end, but only a means. Thus, timely off-line operation should follow on-line operation. In addition, the government should improve the environment and infrastructure regarding security in IT-based businesses, including strengthening relevant laws so that companies can use IT without any security concerns.

While education and training programs have focused on middle-level managers, or lower-level employees, who were directly engaged in IT- or network-related work, the education of CEOs and other higher-level managers of companies should be conducted as well. Finally and most importantly, government policies should encourage SMEs to believe that investment in IT and NESs pays many dividends in the long run, thereby prompting them to continue long-term investment.

SUGGESTED ISSUES FOR SURVEY OF KOREAN SMBS

The following criteria are suggested considerations for the formulation of a survey of Korean SMBs to determine how current business information needs are being met and how informational service offerings (business information services portals) can be improved to meet existing needs.

What services are currently being consumed. For example:

- Business Development
  Starting, managing, or marketing a business
- Financial Assistance
  Sources of capital and credit from public and private sector lenders
- Legal and Regulatory Information
  Labor, environment, tax, health, and safety
- Market Information
  Domestic and global business trends; price forecasting
- Diagnostic Services
  Benchmarking SMB performances against industry leaders
- Networking Services
  Contacting sub-contractors or suppliers
- Consulting and Technical Support
  Government, university, or research institute-sponsored assistance
- Continuing Education
  Technical training and distance education programs
- International Outreach
  Export promotion, trade financing, and international partnerships

The provider(s) and medium of most frequently consumed services. For example:

- Government
- Private Sector
- Online
- Other sources
- Best Practices

In order to identify key testimonials from SMBs regarding the positive impact that the utilization of online business information services have made, for use in a promotional campaign, key considerations could include:

- The length of time that an SMB has been connected to the Internet.
- Whether Internet connection has enabled interaction with suppliers and/or customers.
  If yes, how this has changed customer/supplier relationships.
- Whether distance learning opportunities have been utilized.
  If yes, how has the knowledge gained through such programs improved business.
- How the Internet has helped an SMB to save time, improve efficiency, or increase profits.

IMAGING

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