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TECHNOLOGY LICENSING TO THE KOREAN
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The Case of the Swedish Multinational Enterprise ABB Carbon
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Abstract - Traditionally, multinational enterprises (MNEs) seem able to obtain license contracts from their partners in more efficient ways than their foreign direct establishments. Technology licensing is an alternative approach for market entry in which establishing position can be regarded as a long-term process of relationship development between actors. According to the network approach in the present study, foreign MNEs can obtain a strategic position in national industrial networks by complex interaction with industrial actors. The actors, e.g. firms, government agencies and other organizations, are connected through exchange relationships. The exchange of resources, i.e. a number of specific aspects of investment within those relationships, are important elements in the position development activities and result in a high degree of strength in the networks. However, in the market, it was recognized rather early on that the multiengineering nature of the technology should play an important role in the construction work. Case examples are given in which the foreign MNEs begin in the dominant technology position. An operational model is advanced which illustrates the development of position through licensing relationships. Empirical data on the Swedish MNE, ABB Carbon in Korea is analyzed by this model.

In the discussion concerning the changing technology in the power plant industry of the future and of its possible ramifications, it is necessary to specify different possible future dynamic developments for the importance of ABB Carbon’s interaction with others in the Korean industrial networks. The network position development is affected by different factors. The exchanges are shaped both by the activity and resource dependencies in the network as well as by the various actors’ strategies. The impacts of these interaction and their future dynamic impacts can be evaluated with respect to cost competitiveness for the industrial actors as well as for the structural change of the whole industry, i.e. with respect to the location of the production technology and position strength of the main actors. This can serve to find out the desirability of those developments in order to perform specific actions for entering a new market. In particular, the strong political and social character of networks indicates some significant aspects of how ABB Carbon should achieve a strong position associated with successful operations. Some such aspects are the government and industrial policies. The approach developed here has important strategic implications for licensing in network investment and the management of the firms’ positions in international business networks.

1. INTRODUCTION

In recent years, foreign MNEs have been maintaining their strong technological positions in relation to major local heavy industries, which characterized by technology licensing, have become the primarily driving force in network investment. Instead, the MNEs are now entering the coal power generation market with clean coal technology, because technology licensing to the heavy industries often leads to better profits and to more strategic advantages than could be obtained by continuing to directly establish business in some way. Due to the numerous licensing relationships between companies of an industrial branch, whole networks of connected exchange relationships have emerged. Because of the success of firms in sharing knowledge and experience, increasing resources commitments in networks of strategic relationships have become a primary strategy for the internationalization of the firms (Johanson
and Mattsson, 1984, 1988). By establishing the licensing relationships, the foreign MNEs can develop a certain position in national industrial networks by complex interaction with individual firms in the course of cooperative relationships. Their investment in these positions must therefore be based on the company’s specific relations to the main actors, e.g. buyers, end users, engineering firms, suppliers, government authorities, research institutes, and other organizations. One the interesting features of the Korean industrial networks consists of the relationships between the local firms and a number of foreign MNEs with high R&D activity. This kind of arrangement enables local firms to develop and to stay at the international competition level, or close to the level of the international quality standard. The scarcity of qualified technologies in Korea necessitates the long-term development between these foreign and local firms, and the more traditional forms of industry-government cooperation are essential (Lee, 1991, 1993). The dynamic behaviour of the Korean heavy industries consists of the acting together of economic, industrial, social and cultural parts, and characteristics of the main actors and by geographical distribution such as of the power plant industrial complexes and of the resources and the buyers. In particular, these dynamics are influenced by the construction of coal-fired power plants and in turn influence factors such as coal availability, possible uses of coal, development for processing of clean coal technology, a fully integrated know-how, and economic and environmental activities. The impact of these factors can be evaluated with respect to the requirements of clean environment, cost efficiency and the development of the Korean heavy industries, as well as for the structural change of composing types of power plants, i.e. with respect to the modernization of the power plant industry in the future.

The key elements of technological change in the power plant industry are related to a variety of issues concerning electricity demand, construction of coal-fired power stations, and international licensing for the location of production technology and main generating equipment. Such issues include the development of the global economy and industries in the evolution of establishing foreign suppliers, new technology and equipment and substitution for a utility fuel, technology development for power plant industry, constitution of pollution regulations, cost competitiveness, etc.

Heavy industries, engineering firms, buyers and the affiliated institutions are the main actors in the industrial networks of coal power generation. The actors are part of a process of gradual tightening of interfirm linkages and a gradual expansion of the firm boundaries (Lee, 1993). Their role, which changed in the development process, was to design a modern form for combined cycle power plants and to construct a number of coal-fired power stations through mutual interaction and by licensing from industrialized countries. In the case of combined cycle power plants, resource exchanges became both internal organizations and external networks of main actors. The exchange of information is a primary function in these external networks of main actors. The information is created through exchange relationships, these having become
the driving forces of the development of a network position. In the case of repowering applications, Korea Electric Power Corporation (KEPCO) was concerned with the problems of global warming and air pollution. Due to the prospects for greater use of coal feedstocks in the form of pressurized fluidized bed combustion (PFBC) or integrated gasification combined cycle (IGCC), systems appear to be improving rapidly. The Company described recently technological advances aimed at reducing harmful CO2 emissions and is interested in PFBC, or pressurized fluidized bed boilers, as a means of improving the efficiency of coal-fired power stations. Advanced coal-based repowering at present primarily involves either IGCC or PFBC technologies with gas turbines as the main new generating element. More specifically, the two loosely related technologies can be applied to repower existing steam plants. However, most of all power plants recently constructed by Korea Heavy Industries and Construction Co. (KHIC) attempts to adjust inconsistent expectations through intensive resources exchange between the Korean heavy industries and the related foreign suppliers and government authorities, thus promoting KHIC’s “monopolistic growth” as a whole. In the recent networks of power plant business relationships the main Korean actors and potential foreign suppliers are expected to play an important role in changing the networks. One characteristic of the situation was the rapid increase in the demand for electricity. It can be expected that the other Korean actors will strongly participate in the power plant business. Under such conditions, confidential relationships and mutual trust were assured by the expectation and achievement of sales growth. Conflict resolution between the Korean actors and the foreign actors, and within the networks, depend on marketing and growth expectation.

Today, the Korean power plant business networks are characterized by the organizing of interdependent actors in the networks on the basis of historically given structures. The networks emerged across the boundaries of firms and industry, by flexible specialization, continuous development of new technologies, R&D and cooperation. These were the main advantages for competition. The development of a network position which takes into account the condition of the turbulent environment is the top priority of newcomers. In the business networks of coal power generation the firms are gradually restructuring managerial, technological and financial resources in order to meet a great domestic demand. This creates a new context for the industrial networks. Here we will review the practical role of network position, which remains an important source of corporate growth.

2. RESEARCH PROBLEM AND THE PURPOSE OF THE STUDY

The previous section indicates many difficulties and problems which foreign firms encountered during their establishment in the Korean market (cf Lee, 1991). In particular, these problems can be attributed to national factors such as cultural and geographical distance, and differences in expectations, educational background, economic and industrial development level and
industrial structure, as well as factors related to the companies, such as their previous international experience, contacts in Korea, applied technology, knowledge of relevant business counterparts, etc. The problems the firms had to solve were due to both lack of information and a lack of understanding of situations. Consequently, a first aspect of the research problem of the present study concerns the empirical aspects of how to identify and solve emergent problems and how to act when entering this new market. A newcomer must develop a position of some sort in the established network, which is often difficult due to the long-term stable relations in the existing hardly structured networks.

Another aspect of this research concerns the theoretical framework. Historically, the studies of international business, foreign direct investment and the MNEs were mainly undertaken by economists (cf. Dunning, 1958, et al., and Dunning, 1989). An assumption in foreign direct investment theory is that the foreign investment decision is the result of a rational plan, which is decided and implemented by top management, and is at least implicit in many studies (cf. Trommen, 1966; Kindleberger, 1969; Caves, 1971, 1982; Buckley and Casson, 1976, 1985; Hymer, 1976; Dunning, 1980; Hennart, 1982, 1989; Reid, 1983; Anderson and Gatignon, 1986). The clear separation between the decision on entry and the implementation thereof, which can be seen in much of the literature, is not fruitful (Lee, 1991, p. 26). It is not explicit whether, and if so to what extent, the entering firms have any position in domestic or international markets, or any relationships with a number of important actors, viz. influential individuals, potential customers and government agencies. These may have an important bearing on the entry process through their actions. These aspects should be considered differently from those of the rational plan. This is an essential requirement of a network approach that focuses on the sequence of activities leading forward to a situation in which the firm has established a position in the market. It can be argued that foreign market entry should be viewed as network position development in the foreign industrial environment. Such a view raises a number of interesting aspects which are emphasized by the Uppsala School (cf. Lee, 1991, pp. 34-41). Foreign market entry is not so much a separate event as it is a more cumulative process taking place over time. The basic approach to this problem is the application of the network approach. In this study the issue is studied empirically at the same time as a theoretical framework is developed. The main theoretical contribution concerns the integration of the interaction and network approach (Laage-Hellman, 1989 and Lee, 1991). By studying interaction processes within relationships, the network position development over

1 The foreign direct investment, which is based on industrial organization theory or internalization theory, as well as most writings on global strategies, belong to what Forsgren (1989, p. 6) called traditional direct investment theory (Doz, 1986 and Porter, 1986).

2 The network approach is a major theoretical framework for this study. It focuses on research in international business and industrial marketing which has stressed the significance of lasting business relationships (cf. contribution in Engwall, 1984 and Håkansson, 1982). Subsequent studies (cf. Håkansson, 1989; Hägg and Johanson, 1982; Johanson and Mattsson, 1987; Laage-Hellman, 1989; Lee, 1991) have developed this interaction approach by extending the focus to industrial networks, defined as “sets of connected exchanging relationships between actors controlling industrial activities” (Engwall and Johanson, 1990).
time can be analyzed. The network position describes how an actor is related to others through external relationships (cf. Mattsson, 1985, Hägg and Johanson, ed., 1982, Håkansson, ed., 1987, ch 9). All positions in a network are a result of relationship development processes and are related to each other in a complex and multivarious way. Positions can also be created by individual firms which succeed in restructuring the networks. The network approach is a further development of the interaction model (cf. Håkansson, ed., 1982) with some fundamental assumptions regarding the characteristics of industrial markets. The network approach has been applied in different situations as a starting point for empirical studies. However, this approach has not been developed in detail so as to allow immediate analysis of the empirical problems which have confronted the Swedish firms in Korea. The process dynamic in particular needs to be elaborated. The model developed here is an analytical framework for the empirical study (Lee, 1991). In order to develop the model, theoretical concepts, mainly from the two approaches, mentioned above, were amalgamated to reach a compatible view of the phenomena in question.

This study shows how ABB Carbon’s strategic position has developed from interaction processes in industrial networks of relationships. To understand the process of Korean market entry, the problems that firms meet when entering the market and how they manage these problems must be considered. Against this background the purpose of this study is to describe and analyze the network position development of the Swedish firm, ABB Carbon, in the Korean industrial network of coal power generation, through the technology licensing to the main actors, and the consequences of future expectations and assumptions concerning such substantive issues. This process viewpoint is essential in order to describe the development of long-term interaction in the Korean industrial networks.

The importance of these empirical and theoretical aspects of the research problem justifies a study of the process of position development in the Korean industrial networks. This has a bearing on the global MNEs’ direct investment, transfer of technology and marketing to foreign markets (cf. Dumring, 1989). The basic idea of the present research is that firms invest resources in establishing and developing relationships with each other, thus becoming engaged in a wide network of connected relationships. This network is at the same time a strategic asset and strategic context of the firms as they develop their positions in the foreign industrial environments.

3. RESEARCH METHODOLOGY

In the present research project, the empirical study is based on in-depth interviews in three Swedish firms (ABB Carbon, ABB STAL and ABB Korea) which have been operating in the

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3 The empirical data is based on the previous research (Lee, 1987, 1991, 1993). The detailed analysis of the Swedish firms in Korea is described in Table 1:1 (Lee, 1991, p 15). There are 23 Swedish firms in Korea. ABB Korea is one of the largest firms established in 1972.
Korean market for several years. It is important to study the processes over a long period of time in order to analyze and understand the process of licensing relationship development and the establishment of network positions. The interviews were held both at the head offices in Sweden and at the affiliated companies in Korea. The case study covers the most expansive Swedish MNE’s sales subsidiary in different industries in the Korean market. During the different stages of the research, data were collected a number of times. The interviews dealt with the Swedish firm’s development of a network of relationships and positions with various kinds of actors in Korea. In addition, written material was obtained from both published and unpublished sources. It thus includes both primary and secondary sources. However, the focus of this empirical study is not an historical analysis. Rather, by making a comparative analysis of the two types of licensing networks (e.g. turbine and boiler) an attempt is made to bring into relief the basic character of the industrial networks of relationships existing in Korea.

4. THE CASE OF ABB CARBON AND ITS MAIN COMPETITORS

The analysis begins with the characteristics of the Swedish Company, ABB Carbon, and the activity of the Company is described briefly. The major chronological activities are described and analyzed. Afterward, the participating actors in the process of reaching the position in the industrial networks of coal power generation are described and analyzed.

4.1 The Company

ABB Carbon AB, one of the world’s major utility boiler, turbine and electrical equipment manufacturers, is one of the most successful subsidiaries in the Swedish part of the ABB Group. The Company has the responsibility for coal-fired power plants. The Company is

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4 Asea Brown Boveri (ABB) Group is an electrical engineering Company and is also one of the major multinational enterprises (MNEs) specializing in global electrical industries. This group is involved in the worldwide marketing of various kinds of power plants and equipment, as well as in servicing a wide range of systems generally related to buyers and end users, which comprises power generation plants, transmission, distribution, industry, transportation and application of electricity. ASEA AB (Sweden) and BBC Brown Boveri Ltd (Switzerland) have been merged since 1988. The Company is owned equally by ASEA and BBC Brown Boveri. Asea Brown Boveri Ltd, (Zurich, Switzerland) is the Holding Company and Corporate Headquarters of the ABB Group.

The group is a federation of national companies and uses a matrix structure for its organization. The whole group has approximately 214,000 employees in 1300 independently incorporated units, which have been divided into both whole and party owner companies throughout the world. Today, ABB has total turnover, viz. USD 29 billion. ABB’s worldwide activities are grouped into eight business segments comprising 65 business areas, each with its own profit responsibility for product development, production and marketing. The eight business segments are categorized and their orders received per business segment as follows (ABB’s Annual Report, 1991): Power plants 17%, Power transmission 16%, Power distribution 10%, Industry 13%, Transportation 6%, Environmental control 12%, Financial service 3% and Various activities 23%. The group has some 5000 autonomous profit centers. At the “bottom” the profit centers are beginning to reorganize into 10 persons, multifunction High-Performance Teams (Peters, 1992).

Geographically, the ABB Group is broken down into subgroups or companies in industrial countries. In the developing world, it is broken down into regions incorporating a number of countries. Company
involved in the worldwide marketing of industrial and utility boilers, turbines and equipment, as well as technology for coal-fired power plants. In addition, it services a wide range of systems generally related to buyers and end users, which comprise PFBC, Fossil Combustion Systems and Industrial and Utility Steam Power Plants. The company’s development was based on the establishment of ASEA in the evolution of the Swedish steam turbine. ASEA was founded in Sweden in 1883 and became the main Swedish firm in products and systems for power generation, transmission and distribution. In the case of PFBC system technology and plant, the Company developed into a leading manufacturer of boilers, and closely cooperated with ABB STAL at an early stage. ABB Carbon’s business operation has a pronounced high technological character with a number of assortment. For example, the company offers a wide range of boilers, turbines and several kinds of integrated equipment used in oil-fired thermal power stations, coal-fired power stations and LNG power stations. ABB Carbon has 176 employees and had a total turnover of approximately 90.2 million SEK in 1993 (annual report, 1993).

ABB Korea is one of the most important subsidiaries in the Asian market of the ABB Group. ABB Korea is organized as seven divisions (five marketing divisions; Power Plants, Robotics, Transmission & Distribution, Environmental Control, Traction and two administrative divisions; Financial, Planning & Marketing Development) and two joint venture companies (ABB-Woojin and Hyosong ABB Drives). Business areas are organized by ABB’s market segments, for which the global responsibility of real profits for the respective product areas is decentralized. Each division usually had contacts with the corresponding Company of the same product category in the ABB Group. ABB Korea functioned as a sales subsidiary (a commission Company) in terms of commission sales from a number of manufacturing companies. The company has approximately 90 employees and the total turnover in 1993 was USD 200 million.

The ambition underlying the organization is for the respective business segment directors (Company Executive Management and Corporate Staffs) to administer and answer for the activities all the way to the market. While retaining the responsibility for the operative co-ordination of the different business areas, the president of ABB Korea as country manager has distributed the primary responsibility for different divisional markets.

An important growth area for ABB Korea is the power plant segment. This segment is divided into nine business areas, viz. Gas Power Plants, Industrial and Utility Steam Power

managers are responsible for operations in each country in line with the global strategies of the business areas (ABB’s Facts & Figure, 1992).

5 Shewell, Zander and Porter (1991) explain the evolution of the Swedish steam turbine in connection with the development of the world class turbine manufacturers. High precision turbines were first developed by Gustav de Laval in the 1880s, and by Birger and Fredrik Ljungström in the 1890s. De Laval formed the de Laval Ångturbine Company, and the Ljungström brothers Svenska Turbinfabriks AB Ljungström, STAL. In 1959 ASEA merged STAL with de Laval Ångturbine and formed STAL-LAVAL. After the ABB merger it was also renamed ABB STAL. In 1989, ABB STAL was divided into ABB STAL and ABB Carbon.
Figure 1. The Organisation of ABB Korea

ABB Korea Inc.

- Administration
- Finance
- Planning & Marketing Development
- Power Plants
- Robotics
- T&D
- Environmental Control
- Traction
- ABB-Woojin Inc. 60/40
- HyoSong ABB 50/50

Source: ABB Korea

Plants, PFBC, Hydro Power Plants, Nuclear Power Plants, Power Plant Control, Fossil Combustion Systems and service. ABB Korea offers solutions for practically all power generation needs. The Power Plant Division usually contacts with ABB STAL and ABB Carbon in Sweden to market the various kinds of turbines, boilers and equipment, both to the heavy industries & engineering companies and to the end users in constructing power plants. In particular, the business area concerning industrial power plants is one of the most important in electrical engineering, and is performed by the division. ABB Korea holds a strong position in the industrial turbine (e.g. VAX and other specialized turbines, and technology) and CFBC system boiler areas.

The division has 60 employees (8 staff members, 16 marketing people, 11 engineers and in addition, 25 local secretarial and staff members are in the organization) and a 70% share of ABB Korea’s total turnover. One of the ABB’s functions included acquisition of Combustion Engineering (U.S.A) so that organization of the company is integrated by the Power Plant Division. The division also markets and installs the nuclear reactors and fossil boilers. ABB C-E International holds a 32 % market share of nuclear reactors, but the Company functions as an independent business. The Company has some portion of the operation in the division.

5. MARKET SITUATION AND STRUCTURE

5.1 Market Situation

Recently, ABB Korea has had two important product applications, viz. various kinds of turbines in different types of power stations and clean coal technology in PFBC plants.
(including fossil boilers), which it is marketing to the buyer and end users. In particular, the marketing depends significantly on the power development plan for the construction of two types of power stations, i.e. 26 coal-fired plants and 12 LNG/CCPP, which together will hold 56% of the total production of electric power. For example, the number of coal power stations are grouped so that the construction of new power stations and the repowering applications comprise 3.8% of the 56%, the other 18% comprising the construction of LNG combined cycle plants. ABB Carbon has, therefore, introduced PFBC technology in Korea. The two applications are concerned with the government energy-supplying policy. The government’s industrial guidelines issued for the modernization of the power plant industry in July of 1990 was again planned to promote a government-led monopolism in the industry. The issues were based on the previous government decision of August, 1980. The state-owned Company, KHIC, therefore, has a monopolistic position in meeting the demand for power plants in Korea.

To satisfy future electricity demands, the power development plan requires the building of new generating facilities capable of producing 35,965MW until 2006, which corresponds to 75 power stations (USD 56.3 billion). The demand has been estimated by KEPCO and the Ministry of Commerce and Industrial Resources (MCIR). The power stations are composed of five types of power station, viz. 14 nuclear (35%; 12,800MW), 26 coal (38%; 13,370MW), 12 LNG/CCPP (18%; 6,326 MW), 19 hydro (9%; 3,170MW) and 4 oil (1.3%; 452MW). According to MCIR if the power development plan should be successful for the construction of various kinds of power stations up to 2006. The composite share of the power stations will be changed as follows. For example, the share held by nuclear power stations will be changed from the present 37.3% share to 47.6% share. The share held by coal will also be changed, from 20.5% to 33.7%. Even the oil and LNG/CCPP will be changed, from 38.5% to 16.2%. The draft also indicates that the total generation capacity in 2006 will be 58,669 MW. Nuclear power will account for 39.6% (23,229MW), coal-fired 30.2% (17,760MW), oil and LNG 20% (11,711MW), and hydro power 10.2% (including pumped storage; 5,969MW) However, KHIC’s capacity can supply 15-20% (USD 11 billion) of the demand. The remaining demand will probably be met by either foreign suppliers with subcontracts or by domestic suppliers. Still, KHIC emphasizes that they will continuously maintain a leading position in the market in order to develop technological capacity and international competitive strength.

The national consumption of electricity increased annually by 11% during 1986-1991. The existing long-term power demand and supply plan was approved by the government in 1991. Subsequently, there has been a slowdown in demand growth in 1992 (e.g. a downturn in economic conditions, difficulties in securing investment capital and other factors. In order to cope with these changes portions of the power development plan have been revised and then

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6 Seoul Economic Newspaper (1993. 9. 18, p 2) explains the long-term energy plan announced by KEPCO in cooperation with MCIR.
approved by the government in December 1992. Under the circumstances the construction of four thermal power plants will be delayed. For example, initial operation of the Samchonpo Plants No. 5 & 6 have been postponed by two years; the Hadong Plants No. 1&2 have also been delayed. These are now scheduled to be completed in 1997 and 1998. As a result of difficulties in securing investment capital, the government has delayed the commitment of two new nuclear power plants for one year. With the delay of these projects, two LNG combined cycle units with 300 MW capacities will be added to the system in 1995 and 1996 to balance the medium-term supply and demand.\(^7\)

With regard to this, ABB Korea has estimated the potential demand to be between 5 and 6 industrial turbines per year from 1991 to 2001. Thus the Company will probably sell at least 1 or 2 turbines, as well as boilers, per year. There are two types of turbines, viz. back pressure and condensing type turbine in the market. Many Korean companies want to use the condensing type turbine in order to maximize short term efficiency. There are already other international competitors, such as GE, Siemens, AEG, Alsthome, Mitsubishi, Kawasaki and Hitachi.

The sales forecasts predict a certain and stable market in Korea. The market does not change quickly, nor will it be a dynamic environment in the future. In order to develop its network position, ABB Carbon should guard its major advantages, i.e. the introducing of new technology and the cooperation with KEPCO, KHIC, HHI and others, which have already built up good relations with the market. A significant difference observed between networks is that the Korean market is extended to include close contacts with counterparts as well as technological change in the construction of coal power plants in the future. ABB Korea is familiar with the Korean market, so they know how they are going to sell. This is a strength for ABB Korea when they implement their marketing strategies.

5.2. Market Structure

Recently, in the power plant market there has been a steady move in the direction of monopolistic market structure with significant direct foreign investment. Both the market and power plant industry are now dominated by KHIC and twelve foreign companies which compete for market shares. Due to the government’s industrial rationalization plan this situation will at least be continued until 1995. The market shares are based on orders placed up to 1991 (Growth in Power Facilities; KEPCO, 1991). There are six submarkets: Nuclear reactors (PNP), Fossil boilers (PFC), Large steam turbines (PSU), Gas turbines (PGT), Large hydro power station (PHP: Turbine and Generators) and Industrial steam turbines (PSI: 15-60 MW). These are divided between the above companies and are also organized in the market

\(^7\) Chun Sang-Kyun (1993) describes the electricity sales, growth in power capacity and power capacity planning on the research of “the long-term plan for power development in Korea”.
structure. In this study two of the six submarkets, viz. gas turbines and fossil boilers, are involved in the construction of the coalfired power stations, as shown in Figure 2.

**Figure 2. Market Structure**

![Market Structure Diagram](image)


In the gas turbine market the largest firm is GE, which has a 57% (2,240 MW) share and has a license contract with KHIC. The second largest firms are Westinghouse and ABB, which have 18% (700 MW) market shares respectively. ABB has a license contract with HHI. UTI has a 7% (275 MW) share and Toshiba has a 1% (30 MW) share.

In the fossil boilers market there are 12 suppliers. In particular, five large suppliers, viz. ABB C-E, Babcock Hitachi, Babcock & Wilcox, Steinmuller and Babcock Atlantique, which have a total of 82.5% (10,620 MW) of the market shares. The remaining seven suppliers have a 17.5% share together.

6. THE DEVELOPMENT OF LICENSING RELATIONSHIPS IN THE GAS TURBINE AND CFBC TECHNOLOGY AREAS.

According to the three-stage approach presented in the discussion of the development of licensing relationships, the first stage is mainly characterized by efforts to initiate interaction between Swedish and Korean actors. This is done by obtaining information about each other to make exchange possible. The Swedish actors’ activities are concentrated on the establishment
of positions in the Korean gas turbine and utility boiler networks. The second stage is characterized by the Swedish actors’ exchange activities, undertaken to establish contacts with indispensable Korean actors and thereby to build the licensing relationships with a few important Korean heavy industries. In this stage the competitors’ exchange activities are also described. The third stage is characterized by the actors’ activities in developing and institutionalizing long-term bonds and by integration of the relationships in the networks. The starting point focuses on ABB STAL and ABB Carbon in Sweden and its business operations with one or a few industrial actors (e.g. counterparts). This section is divided into three development stages.

6.1. The Position Initiation Stage

In 1958 ASEA signed a general sales contract with Gadelius’s Korean sales subsidiary in order to handle Korea’s demand for electrical equipment and power plant projects. ASEA held a 50% ownership of Gadelius. ASEA participated in the initiating business operations, since Gadelius had established a sales subsidiary in Korea in 1958. ASEA’s marketing activities were carried out by the Korean subsidiary of Gadelius. At that time Gadelius interacted with the Japanese subsidiary to exchange information in spite of a quite active marketing effort directed towards the Korean potential customers. It had been difficult upon introduction on the market to attract good marketers in order to increase the sales volume of different regions. However, Gadelius sold mine winders and windlasses on the Korean market and established customer relationships in connection with establishing a Korean agent, Hyupchang in 1970.

Until the beginning of the 1970s almost all turbines, and industrial-purpose and utility-purpose boilers were introduced directly by foreign suppliers, without any co-operation with the Korean heavy industries. The financial resources were made available through Japanese loans and foreign capital investment. During this period the power plant projects were conducted using previously arranged financial resources. For example, international credits were granted by the Korean government to build up power plants and industrial factories, some of which required steam turbines, boilers and electrical equipment. Most of the foreign credits came to Korea in connection with power plant projects and were related to orders to foreign actors, ASEA’s competitors, who supplied power plant projects to Korean industries during this period. The power plants were installed completely by the foreign suppliers. The technological capability of the Korean engineers within the heavy industries did not extend to such highly sophisticated industrial turbines and utility purpose boilers, and related equipment in constructing the power plants. However, the demand for turbines and boilers increased only slightly in Korea during the 1960s, probably because marketing was passive and the Korean

8 At that time Gadelius attempted to sell offset printing m/c, filling m/c and packaging m/c in the market. In 1979 the Company established the second sales subsidiary to develop marketing for air conditioning systems and ventilators.
firms were not in capital-intensive, mass-production and distribution industries. They were solely dependent on KEPCO’s supplying of the predominant amount of electricity, which was sent from hydro and oil-fired thermal power stations.

The strategy of Gadelius was first to achieve some sales in the Korean markets, where an agent, Hyupchang, was used with the primary aim of obtaining information by initiating contacts with potential customers. Thus, Gadelius indirectly initiated customer interactions through Hyupchang’s activities, which were characterized by its intermediate position in the information exchange. The agent was acting as a linking-pin between Gadelius and the Korean customers. There was also a cost reduction partly based on the fluctuating demand from textile and paper companies, or widely dispersed shipowners and steel companies with a small volume in Korea. Otherwise it was very difficult for Gadelius to interact with the potential customers who had no earlier experience of purchasing foreign products and technical services.

In 1971-1972 ASEA’s marketing was based on a combination of contact channels between the two actors, with the object of increasing demand and successively developing a pattern of interaction with customers. ASEA sold a steam balance and marine turbines, i.e. 32000 HP, to Hyundai Heavy Industries, which initiated a position in the shipbuilding market. Price and payment conditions for products were clearly negotiated between interacting parties; the delivery time and installation service, and the training of turbine maintenance were an essential function of ASEA’s supply capability. ASEA’s flexibility and adaptability were significant for initiating relationships with the buyers, and thus, for selling successfully. Consequently, ASEA had established a new position without affecting any evaluation of the network context. It took ASEA 14 years to achieve a position in the market through Gadelius and Hyupchang. This position was based on the building of a number of long-term, indispensable relationships.

6.2 The Position Building Stage

ASEA now had a certain position in the Korean industrial market. Nevertheless, ASEA did not increase its sales of power plant equipment or establish any marketing relationships in the period 1973-1974, probably because the Korean actors were affected by the first oil shock or were not in capital intensive industries. The Korean economy had limited resources due to an economic depression. After the first oil shock, which affected Korea’s economic development negatively in 1973, the government was very interested in saving energy. At that time, 53.5% of the nation’s total energy requirements were supplied by imported oil. “The cost of oil rose from less than USD 300 million in 1972 to over USD 1 billion in 1974, representing 14.9% of total imports” (Korea Trade association, 1982). Under these circumstances the government’s energy saving policy influenced the large Korean corporate actors’ establishment of heavy industry & engineering companies in 1975. Consequently, they were interested in industrial
steam turbines and boilers. Because of the 1973 oil crisis the Korean government chose to encourage the expansion and upgrading of production facilities. This policy allowed Korean companies not only to purchase products, equipment and technology at bargain prices in a buyer’s market, but also to build up strong manufacturing capability.

This circumstance affected HHI, which had a license contract with Foster Wheeler (U.S.A) to produce a utility boiler in building a large oil tankship in 1976. This was the first time HHI obtained a foreign license for a utility boiler for the shipbuilding market. The boiler produced steam energy to operate a steam turbine and a pressure-turning screw propeller. After this contract HHI could not obtain any building orders from any customers, so the license contract was liquidated. During the same year that HHI constructed the Donghae coal-fired power station the turbine and utility boiler were supplied by Hitachi to fire the Korean coal. Some of the equipment was supplied by HHI. On the other hand, the hard work and marketing control of ASEA’s personnel seem to be just as important, since the agent Hyupchang, and the few other initial relationships were little used in marketing products, e.g. mine windlasses. The Korean heavy industries estimated the market demand for the number of power plants required for industrial areas. They began to invest in manufacturing Korean boilers using a transfer of technology and licensing relationships with foreign suppliers. The activities of Korean actors were successively increased in connection with the production and distribution of the boilers.

The first nuclear unit was commissioned by KEPCO in 1978. Because of this, HHI, made contact with Westinghouse in order to obtain a license technology for the manufacturing of a large-sized steam turbine and various kinds of equipment related to power generation. With a licensing relationship with Westinghouse, HHI could be considered to have future business opportunities in the area of nuclear reactors. It was a crucial event for making progress in the near future. When the Koori Nuclear Power Plants 1 and 2 were constructed by Hyundai Construction, HHI estimated the requirement for the location of production facilities in order to manufacture power generation related-equipment in Korea and therefore invested great financial resources in its technological cooperation with Westinghouse. On the other hand, ASEA Korea concentrated on its marketing activities, which were organized as much as possible as ASEA’s whole marketing organizations. It had 6 employees and a total turnover of 38 million SEK in Korea. As the exchanges successively proceeded, a technical and social bond emerged between ASEA and HHI. It seemed that this contributed to ASEA’s selling of test equipment for diesel engines, high voltage test equipment and transmissions in 1979. Although this was not directly concerned with the marketing of industrial turbines and utility boilers, ASEA obtained experience of the establishment of relationships in the shipbuilding market. ASEA was very interested in obtaining a sales reference in the market and also in obtaining specific experience of the choice of entry mode.

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9 Interview with Chung Young Sup, Director of the Turbine Engineering Department at HHI.
In 1979 four Korean heavy industries, viz. HHI, SM, Daewoo and Hyundai Yangheang (the present KHIC) participated for the first time in the bidding for construction of two coal-fired stations, Poryoung Plant 1 and 2 (500 MW x 2), a project which was considered to be connected with technological localization in Korea. The Korean actors were very interested in building licensing relationships with foreign technology suppliers. All four Korean suppliers depended on their respective foreign partners for licensed high technology, for example, HHI-Babcock & Wilcox, Samsung-Foster Wheeler, Daewoo-Deutche Babcock AG and Hyundai Yangheang-Combustion Engineering. The definitive choice of supplier was made by KEPCO late in 1979. HHI won against other competitors. When co-operating with the foreign Company HHI could transfer of all kinds of licensed technology and know-how, because of its increasing technological expertise. The supplier could maintain his position by means of the continuous contacts with the customers, which erected a barrier to entry for newcomers. In this case HHI performed well and produced several types of heat transfer equipment, viz. super heater, wall and panels without the steam drum. The steam drum was purchased from the licensor, Babcock & Wilcox. The rate of supplying equipment was 75% localized in the project so that the foreign supplier sold 25% material share.\(^{10}\) After the initial installation in the power plants the supplier gained opportunities to sell spare parts as well as electrical equipment.

With regard to technological localization, the construction of large power plants, viz. Suhae and Samchonpo coal-fired plants, was supported by the government in an effort to obtain technically oriented interaction in order to build up a strong licensing relationship with Combustion Engineering (C-E). In this phase, there were two aspects in the business patterns for Hyundai Yangheang\(^{11}\) which were mostly concerned with the tightly knit networks of key personal relationships during day-to-day resource exchange activities. The first aspect concerned the situation in which financial support was needed from the government because a great capital investment was required in the initial stage of construction and the available financial support was not adequate. The second aspect was that KHIC should learn the process and pattern of project implementation from C-E, which was generally predominant. KHIC’s personnel, viz. directors, managers and engineers, visited C-E many times in order to attend technical meetings and negotiations as well as to participate in training course lasting a year, which were completely free of cost. C-E gave attractive technical information and good maintenance service to KHIC, creating strong technical bonds and thus affecting negatively the

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\(^{10}\) Interview with Kim Yong Hee, Senior Manager, Engineering Dept., Boiler & Power Plant, Industrial Plant Division. He cited a 25% foreign material rate which consists of engineering expense (7%), royalty (3%) and cost of steam drum (15%).

\(^{11}\) The Company was one of Hyundai Group’s subsidiaries during the 1970s, but was then acquired by Daewoo. Afterward it was acquired by the government to implement the industry rationalization policy in the beginning of President Chun’s period. As a result of this acquisition, the Company was owned by the government as a state Company and was renamed, Korea Heavy Industries & Construction Co. (KHIC).
relationships with ASEA, leading to a decrease in ASEA’s competitive strength. Later KHIC purchased several utility boilers from C-E in regard to project applications.

In 1982 the Fund of Energy Administration also became associated because of the cooperation between the government and KEPCO. The purpose of this organization was to carry out energy saving policies. The Fund had great financial resources. The amount of the Fund’s financial resources dynamically increased by up to approximately USD 380 million in 1990. Therefore, many companies conducted energy saving projects in order to make use of the financial resources. Most of the financial resources were applied to the purchase of industrial turbines and boilers for the power plant projects.

At the beginning of President Chun’s mandate HHI cooperated with two foreign companies to localize boiler manufacturing in Korea. At first the boiler was basically designed by Sulzer. Other equipment, viz. pulverize equipment, bumer and mill, were manufactured after receiving drawings from C-E. At that time HHI manufactured at least a half boiler which it then gave to KHIC, as the government had decided on a policy of industry rationalization. It meant that the power plant industry was dominated by KHIC in order to avoid great financial loss. In addition it could develop its own technological capability. After this period KEPCO attempted to concentrate on constructing nuclear power stations. Due to the construction of several nuclear power plants in this period, there were a few projects of the coal-fired power plants existed in the market. A number of nuclear power plants were constructed by KHIC. Due to the lack of business opportunities in Korea, HHI attempted to establish their business in the Middle East and the Company became a subcontractor for Westinghouse after obtaining some international orders. Major construction projects were in progress in the Middle East, so Korean business actors rapidly moved there, both winning contracts for construction projects and selling products and services. As a result of this business extension HHI also found ways to overcome western protectionism: first by responding to limits on the volume of construction projects with increased value-added per items; and second by diversifying its construction markets to other parts of the industry. The Business Division of Heavy Industries was established, and became a major driving force in business growth. In the period 1982-1983 HHI sold 5 boilers (100MW x 5) when constructing various kinds of plants in Saudi Arabia. Nevertheless the company’s technical cooperation with Westinghouse had become weak in its limited role of sub-supplier. 12 This depended on the company’s own technological capability for manufacturing and engineering, and international sales networks. However, the government and business actors concentrated on heavy investment in chemicals and heavy industries.

12 The background of this weak relationship was explained by Chung Young Sup, Director of Turbine Engineering Department at HHI. From the licensee point of view, Westinghouse supplied a license technology with some conditional factors whereas HHI’s business boundary was based on domestic market and the role of a subsupplier in the international markets. On the other hand, Mitsubishi was also one of the technology licenses, but the Company obtained different conditional factors so gained to a strong position both in domestic and South East Asian markets.
A new Company, ASEA Korea (a wholly-owned sales subsidiary), was established from a division within Gadelius Korea in 1983 because Gadelius had problems with the tax rules and the Korean laws and regulation. ASEA had 14 employees and a total of 174 million SEK a year. The important business areas for ASEA in Korea were same as that of the ASEA Group. In particular, the following equipment was important: automation equipment and deckcreans, turbines, boilers, subway locomotives and electrical equipment, control equipment for galvanization plants, power components, ASEA-SKF furnaces, and pressure equipment. One year later, the president of ASEA Korea, Mr. Gert Andersson, came from Sweden. He recruited 12 personnel (making a total of 26 employees) and organized the divisional structure to be the same as that of the ASEA Group in Sweden.

The cumulative activities were performed by ASEA’s marketers who were in the process of building relationships. Later on, ASEA succeeded in concluding a sales agreement respectively with Junjoo Pulp & Paper and Hanil Fibre Co. to install a steam turbine in 1982 and 1983. The project with Junjoo affected the relationships with ASEA negatively, leading to major conflicts with SSHI. Therefore, ASEA Korea built up a relationship with the Company to install a steam turbine, but the main contractor was SSHI. This had such an adverse effect on ASEA’s business that SSHI wanted control over all the activities in influencing the previous project of Junjoo & Pulp and Paper. However, ASEA installed the steam turbine at Hanil Fibre Co., chiefly in order to increase its credibility to the end user and even with SSHI, thereby reinforcing its dominant position by building relationships. An effort was made in this period to speed up the growth of ASEA in Korea by adding turbine and electrical equipment to the assortment. Some of ASEA’s financial resources invested in building new relationships were established and maintained to exchange information and resources in the power plant industry. The work was carried out in close contact with important individuals at certain companies. In other example, an order for international project (SHOIBA) was obtained as an effect of the building of a confidential relationship with HHI during the construction of a process system plant of saline water conversion in Saudi Arabia. A gas turbine (GT35: 17 MW) was installed at the Saline Water Conversion Corporation. On the other hand, the patterns of information exchange and customer contacts were supported in connection with the power plant network of relationships. As a result of its activities, ASEA and potential buyers respectively were positively connected in exchange resources. For example, a few sales contracts of various kinds of electrical equipment were signed between ASEA and its major buyers for re-export to

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13 Lee (1993, pp. 16-17) explains the conflict between ASEA, Junjoo Pulp & Paper and SSHI. ASEA obtained an order for approximately 30 million SEK from Junjoo. The project was composed of a few packages, viz. training, installation and spare part supply. A new contract was awarded by Junjoo Pulp & Paper and an installation of AP type turbine was provided, but they found that a few items were missing when installing the steam turbine. This led to disagreement, "great psychic distance" between individual actors during negotiations. As a result of this, the general impression for this period was that the development of relationships were dissatisfactory.
Moreover, ASEA secured two large contracts with state-owned customers [Pohang Iron and Steel Corporation (POSCO) and Pusan City] in different business areas. The first contract, when the largest state-owned Company, POSCO, attempted to modernize its production system. A great portion of the equipment and plants, viz. electromagnetic piping, steel making equipment and steering systems for flatness control, were installed at POSCO. The second contract, for a turn-key project on the Pusan subway, was secured after hard competition with Kawasaki, Mitsubishi and Siemens, who participated in the final round of bidding for the project which ASEA won in 1985. A large amount of electrical equipment, e.g. control equipment, complete power supply and signalling systems for the subway, were supplied and installed by ASEA. Recently, the maintenance of high quality service has been more important than the installed equipment and instrument itself. In particular, the volumes sold by ASEA to specific public customers could be quite convincing in the short-term perspective with regard to other types of business assets. Two important relationships created a stable atmosphere among public customers. Consequently, the position of ASEA, POSCO and Pusan City were closely interlinked with government authorities, institutes and auxiliary actors. ASEA, therefore, was able to keep its position as a major supplier to the state-owned customers because the relationships would thus be positively connected, depending on whether the government administrative units were performing complementary activities. One year later, the company’s total turnover had dynamically increased to 628 million SEK in Korea.

The development of ASEA in Korea was continuously made in the construction field. An international project order (SAFWA) was obtained from Kuk-Dong construction Co. in 1987. The Company bought ASEA’s GT35 type of turbine (18.5 MW), which was installed at the Ministry of Defence and Aviation (MODA) in Saudi Arabia. ASEA obtained this order because of its international relationships and ASEA Korea’s marketing efforts. After this event ASEA’s turbine set the norm for the competitors, e.g. Siemens, Mitsubishi and Kawasaki, in the Korean construction industry. Unfortunately, technologically superior competitors tend to make light of marketing ability. Even if they have success in the market by introducing a good type of turbine, boiler and equipment, some of them neglect to make the best of sales opportunities as the market grows. The major Korean heavy industries, construction and engineering companies, HHI, SSHI, Lucky Engineering, Pacific-and Kuk-dong Construction Co., utilized ASEA’s turbines and electrical equipment in constructing power plants during 1983-1988, because of ASEA’s experience, technological and marketing capabilities. These products reached on an average 70-75% of the total turnover of ASEA in Korea.15 This was

14 Lee (1993) explains ASEA’s position established in relations to the Korean actors in the construction market where the relationships were thus be positively connected depending on whether the Korean actors were performing shipbuilding and engineering projects in the international markets. For example, Daewoo purchased electrical- and automation equipment and marine measuring instruments to install on a ship of the US Line. ASEA sold high-voltage transmission, instruments and other equipment to the Pacific Construction Co. and to Lucky Engineering respectively for reexport to Bangladesh, Burma, Malaysia and Nepal. 15 Interview with Håkan Borin, Director of the Power Plants Division at ABB Korea.
accentuated as the marketing and relationship-building efforts resulted in the shipment of hardware to major Korean companies with the accompanying financial and other complementary exchanges. These activities created technical, knowledge, legal, economic and social bonds in the new relationships. The sales volume increased every year. This put ASEA at a strong advantage in its position building in the market.

It took ASEA fifteen years to build up the necessary relationships with the Korean actors. The relationships at this stage are shown in Table 1. The table shows the results for the actors studied and for their different types of relationships. With the large number of actors involved it was obviously important that different relationships be built, in order to develop a position. The total number of relationships, approximately 35-40, were built by ASEA Korea’s power plant division.

6.3 The Position Integration Stage

In the period 1988-1989 KEPCO began to offer construction orders for coal-fired power stations again. For example, Poryong Power Plant 3 and 4 and Samchonpo Power Plant 3 and 4 were constructed by KHIC. KHIC had a limited capacity when constructing Poryong 5 and 6 power plants, so the orders were directly given to the American Company, Combustion Engineering. At the beginning of construction the natural circulation form of drum boilers were chosen. The drum boilers were installed at Poryong 1, 2 and 3 and 4 coal-fired power plants. Later on, KEPCO wanted control over supplying the electricity in concerning the demand concentration in a peak consuming time. Therefore, the Company began to purchase DSS type (e.g. the type of daily stop system) of boilers when constructing coal-fired power plants to enable a flexible production capacity of electricity in order to be adaptable. Likewise, other Korean heavy industries developed the same boiler systems in order to adjust the market requirements. Private factories need to install turbines and boilers to set up their own power plants for supplying electricity and energy. The power station is usually based on a capacity of 15-60 MW. Nowadays, the utility boiler manufacturing field is an important business area in Korea. The foreign technology supplier should consider the fact that the main Korean actors can manufacture almost all equipment after purchasing some significant foreign engineering skills. If the foreign suppliers intend to enter the power plant field in order to compete with the other suppliers they might not be able to participate with their own products in bidding for projects in Korea. The foreign suppliers experienced several disadvantages compared with domestic companies due to the cost advantage of local equipment and the well-developed international technological co-operation. As a result of this business pattern, the foreign
supplier can only expect to obtain revenue in the form of royalty income and engineering expense when building technology licensing relationships with the Korean actors. 16

ABB Korea was confident of selling as many turbines and boilers as could be produced by the coordination of all of ABB STAL's and ABB Carbon's activities with their employees. In 1989 ASEA and BBC tried to integrate their marketing networks and their organizations in Korea. The marketing items of turbines and boilers were co-ordinated and reduced by ABB Korea to adapt to market requirements.

ABB Korea became a successful licensor to KHIC in both the nuclear reactor (PNP) and fossil boiler (PFC) business area. The Company even held the position of supplying steam turbine and equipment to KHIC when constructing the Panwol combined cycle power plant. 17 ABB Korea and KHIC negotiated detailed plans with each other in order to exchange hardware. All hardware was shipped to KHIC for assembly and installation within the power station during 1988-1989. ABB STAL and KHIC are specialized in supplying turbine, specialty boiler and power plant equipment, which are used in different parts of a power station. Given the fact that they were supplying complementary equipment to the Panwol Industrial Corporation (end user) and having complementary competence, ABB STAL and KHIC not only partly coordinated their marketing activities but also engaged in cooperating on technical matters on a collective basis when constructing the Panwol combined cycle power station. In the project they submitted a common technical application, but the actual main contractor was KHIC, which purchased a VAX turbine (60 MW) and equipment from ABB STAL ABB STAL, working as a subcontractor, was able to draw on their competence and add technical know-how resources of their own. KHIC has had the best contacts with the buyers. ABB STAL has been able to benefit from KHIC's buyer relationships. By developing cooperation with KHIC, ABB STAL increased the integration of its relationships and coordinated activities in different nets. ABB co-operated with other actors in various ways to adjust its marketing organization and to obtain external resources. This was focused on their ability to offer complete systems. Consequently, ABB STAL obtained a joint reference for building the power station. The construction period took over three years. However, for various reasons the expanded cooperation between ABB STAL and KHIC did not develop satisfactorily. As a result of the cooperation, the power station was constructed, but an explosion occurred in the newly installed VAX turbine and the gear box broke down during the initial operation. The power station had difficult functional problems with the surrounding turbine. The technical cooperation and locally manufactured equipment were not combined well during the construction period. The repairs took over one year. The technology and the quality of the

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16 Interview with Kim Yong Hee, Senior Manager of Engineering Dept. at the Boiler & Power Plant, Industrial Plant Division, HHI.

17 This project was developed through a previous relationship which had been maintained. The project was initially performed by technical cooperation between ASEA and KHIC in order to construct a combined cycle power station at Panwol Industrial Corporation in 1987. The main contractor was KHIC, and turbine and related equipment supplier was ASEA STAL.
turbine were questioned by the buyers, which was more problematic for ABB STAL. The competitors began to criticize ABB’s lack of technological capability and maintenance of service. The degree of ABB’s reliability was diminished. To develop marketing and customer relationships, ABB Korea considered changing the supplying item from the VAX turbine to the former AEG KANES turbine for a specific period. This was because ABB had acquired a German Company, AEG KANES, in 1989 and had changed the company’s name to ABB Turbine. The Company has taken over their business activities.\(^{18}\) The former AEG turbines were introduced and also had sales references in the Korean market.

As competitors created new markets with their own advanced technology and the whole market began to grow, the leading companies managed to participate in the final round of bidding for turbines and boilers nearly identical to those of competitors. This is what is meant by minimizing the loss of sales opportunities, a factor that contributes to integrating the strength of relationships. For this phase, some important factors related to ABB’s activities concerning its competitive position should be analyzed from the buyer’s point of view. This is concerned with the Panwol project. ABB Korea reacted very slowly in repairing the turbine and gear box, because the technical investigation was performed by a specialist sent by ABB STAL.\(^{19}\) The issue of emergency technical problem solving was important in strategy debates concerning the technical demonstration for KHIC, the buyer-end user and its competitors. Such slow reaction gave ABB a great technical disadvantage. The extended time required for the repairs of the turbine and gear box was detrimental to their image. The end user was very sensitive to the technical disadvantages of utilizing the VAX turbine and equipment. For example, the Panwol contract aggravated the situation, as Panwol Industrial Corp. had a major agreement with several manufacturing companies to supply both energy and electricity. At that time the supply was delayed by one year because of the time it took for the repairs. This carried a penalty clause of 154 million SEK for failure to supply on time. This involved the Power Plant Division of ABB Korea. The sales engineers had discussions with KHIC and ABB STAL in Sweden to solve the problems. This placed ABB Korea in a difficult situation, impairing their credibility in their relationship to KHIC.\(^ {20}\) Afterwards ABB Korea did not maintain any continuous strong relationship with KHIC.

From the technical point of view, this was seen as a significant disadvantage to its competitive power in the market. During the repairs the competitors, Siemens, Kawasaki and Mitsubishi, criticized ABB’s technological ability. At this time Siemens invited Samsung Heavy Industries \& Engineering to undergo technical training for one year in order to apply their

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\(^{18}\) Interview with Sten Olof Andersson, Area Manager (South Asia; Japan, Korea \& China) of the Industrial Turbine at ABB STAL.

\(^{19}\) Interview with Choi Ki-Soon, Manager of Generation Dept., Panwol Industrial Corporation (Combined Cycle Power Station).

\(^{20}\) Korea Heavy Industries \& Construction Co. (KHIC) is the largest corporate actor in the power plant industry and one of the affiliated companies of KEPCO. The Company usually has an extensive technical cooperation with foreign high-technological suppliers and domestic shipbuilding \& heavy industries. Due to the technical cooperation with ABB STAL, KHIC still has a major conflict with Panwol.
system to the end. After training Siemens created strong technical bonds with two Samsung subsidiaries. The subsidiaries’ exchange of hardware and technical information are often conditional on the technical bonds to Siemens. In practice, it was problematic for ABB STAL to overcome the difficult situation with the resulting loss of credibility with the buyers. Otherwise, the main engineering companies would consciously attempt to recommend the VAX turbine to end users in order to obtain high technological advantages and efficiency.

After this critical event of the Panwol project, ABB Korea has a new marketing strategy in cooperation with the main actors in different ways in order to adjust its market situation and requirements. It means that ABB Korea can also recommend some other types of turbines for the buyers on a short-term. This marketing strategy is considered by ABB Korea as a way to avoid competitive disadvantages when establishing new relationships. For example, one relationship was built up between ABB Korea and Ulsan Petrochemical Utility Supply Company (UPUSC). The relationship was to be integrated into ABB’s network of relationships because the UPUSC project was finally negotiated between the two parties. Instead of the VAX turbine, ABB recommended the AEG KANES turbine to UPUSC for producing their own electricity and energy. As ABB Korea might still find it necessary to establish a new relationship, the interdependency is low in the beginning and then gradually develops into a relation with strong bonds. Significant growth has to include more technological problem-solving through mutual adaptations, as well as a flexible choice of turbine types, boilers and equipment.

The importance of the power-dependence relationship should be emphasized in this stage. Powerful corporations such as KEPCO, KHIC and HHI obtained highly stable positions for their businesses through state-owned organizations and through their relationships, particularly with government agencies, which were integrated by close social and political contacts. These corporate actors could act on the basis of their own power in combination with the possibilities provided by the inter-organizational structure. This allowed them to pursue a range of goals related to valuable resources. However, ABB Korea’s top management believed that a political contact person should establish a strong political bond in order to be efficient. The prime needs regarding political contacts in marketing activities are to create and utilize the relationships, which can cause conflicts with rival companies operating in the power plant industry. He should ideally have extensive resource exchanges with establishments in the buyer network of relationships and with the marketing contacts from which strong long-term competition is expected. It could be said that a powerful corporate actor is one who controls valuable resources and has exchange relationships with others who control resources, such as government ministries and authorities, labour unions, banks, customs office, competitors etc.

Therefore, the top management of ABB Korea needed to work on the political level, and thereby become a member of the tightly integrated network of relationships regarding

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\(^{21}\) Interview with Lee Bong Joo, Manager of Industrial Project at the Power Plant Division, ABB Korea
interdependent resources, capabilities and atmosphere. This meant that many strategic actions were decided at a very high level. ABB Korea’s top management conducted strategic negotiations with the different directors of KEPCO, KHIC and HHI. ABB Korea, however, has often drawn strength from strategic cooperation with the power corporate actors, viz. KEPCO and HHI, as well as from the acknowledgement of people with technical know-how. This is despite the fact that the top management of ABB Korea has a weak position in the political network of relationships. Moreover, ABB Korea integrated the network of Combustion Engineering’s relationship by acquiring the Company in order to enter the nuclear reactors market. The Company had a strong position in the market. ABB Korea is now one of the major suppliers in Korea. In the nuclear reactors market two orders were obtained by Combustion Engineering and were placed in 1991 so that the Power Plant Division of ABB Korea also held a 32% (4000 MW) of the market share. This situation favours the sales of the VAX-, other types of turbines and boilers, which thus have a strong competitive position. The total turnover of ABB Korea was approximately USD 500 million.

Through the integration of relationships ABB Korea knows that the organizational structure within KEPCO and HHI are analyzed by the same level of personnel of ABB Korea,22 because there are able to exert both an internal and an external influence on the networks of relationships. Various kinds of information exchanges could ensue from the stable relationships, depending upon how tightly the relationships are integrated. ABB Korea and HHI plan to become cooperating partners on both domestic and international markets when the industrial permit is given in the future. To improve the strategic capability of its positions, the integration of relationships is significant for developing its position management, while still retaining the relationships of coordination activities in the context of the Korean network environment.

Let us now look at the relationships. Table 1 shows the development of relationships during 1958-1994. The relationships have involved many parties in the development process. The number of relationships as a result of the exchange resources is illustrated from ABB Korea’s point of view by the statistical data.

The relationships at this stage, e.g. position integration stage, were shown in Table 1. With the large number of actors involved it was obviously important that the different activities be co-ordinated, and the relationships be connected, to integrate the position. Consequently, the integrated relationships also consisted of several coordinations, which are required to

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22 Lee (1993, pp. 25-26) explains some statistics from the individual contacts and the frequency of visits which are illustrated in Table 5:2. The Power Plant Division of ABB Korea has 16 marketing personnel and 8 staff members, and 11 engineers are engaged in marketing matters on both an individual and a collective basis, by personal contacts and visit in cooperating meetings. These meetings occur on the average four times a week and at least once a month. With respect to the buyer relationship, the contacts and visits are also necessary to deal with other types of partners, viz. complementary suppliers (ABB’s subsidiaries and other turbine and boiler makers) and auxiliary actors (government ministries; MICR, MOST, MOE and MOF, government authorities; KOPEC, KERI, KNFC, KDHC, KEPOS, KESCO and banks, accountants, lawyers and consultancy).
Table 1. Number of Relationships during the Position Development Process

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<tbody>
<tr>
<td>Main Supplier (ABB Korea - ABB STAL)</td>
<td>(4)</td>
<td>(16127)</td>
<td>(12/36)</td>
</tr>
<tr>
<td>ABB Carbon</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Main Actors (Heavy Industries &amp; Engineering Companies)</td>
<td>2</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Buyers &amp; End Users</td>
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<td>8</td>
<td>16</td>
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<tr>
<td>Complementary Suppliers</td>
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<td>2</td>
<td>3</td>
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<tr>
<td>Main Supplier’s Auxiliary Relationships</td>
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</tr>
<tr>
<td>Total Relationships</td>
<td>10</td>
<td>30-35</td>
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<tr>
<td>Duration (Years)</td>
<td>14</td>
<td>15</td>
<td>6</td>
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Note: (Main competitors/Total competitors). A number of foreign competitors and Korean buyer & end users dropped during the periods are not included.

manage wide-range relationships, so that the total number of relationships increased from approximately 30-35 to 50-55. Since then they have been building both reciprocal and long-term relationships. ABB expected positive results from both actors for accomplishing the gradual development of mutual exchange relationships. In ABB’s case the results led to extensive marketing efforts in the integrating relationships.

6.3.1 The Recent Business Area of Gas Turbine Technology

To manufacture gas turbines the Korean companies attempt to build up licensing relationships with foreign technology suppliers. Lately, the manufacturing of gas turbines has been one of the most significant industrial issues in Korea. It has become an important business area in the market, because there is a dynamic tendency for developing Korean heavy industries, viz. KHIC, HHI, Halla, Ssangyong and Samsung to make strenuous efforts to establish local gas turbine manufacturing plants instead of importing equipment from foreign countries. Gas turbine technology is significantly associated with nationally strategic industries, viz. power, aviation and defence related industries. Although it requires great technological know-how to manufacture high value added products, Korea had previously invested little capital in developing gas turbine technology. Therefore, KHIC and the Korean firms had imported all technology and equipment. In particular, the Western countries not only a great amount of capital in the advanced technology but also directed a high degree of technological protectionism towards NICs, which did not have this type of technology. Due to the lack of gas turbine and related technologies, the Korean companies should have necessarily to develop the technologies in the licensing relationships, but they are highly depended on the foreign technology and the know-how incorporated in the gas turbine production. Under these
circumstances, the Korean companies made strenuous efforts to develop its production technology so as to obtain orders from the domestic buyers. It means that they became aware of the importance of strengthening their own abilities in R&D and business development. However, the technology has many advantages as compared with nuclear power technology. The large domestic demand will thus be increased when the Korean companies construct combined and fully integrated combined cycle power stations. For example, the period required to construct of gas power station is one seventh shorter than that required to construct nuclear power stations. The gas power station produces a high cost efficiency energy and consumes a low amount of natural gas. The structure is simple and compact as well as demanding only a low maintenance cost. Furthermore, the Korean people consider that air pollution is high become when a large number of power stations consume a great amount of oil and coal. This opinion strongly influence the government to implement environmental control and new regulations. On the other hand, the opinion referred to situations when the rate of supplying electricity had decreased and the construction of new power stations was delayed. Under this circumstance, the demand for gas turbines had therefore increased for the construction of hospitals, building and manufacturing factories. These facilities must construct their own power stations. These factors are largely concerned with both the location of gas turbine production plants and the impact of the development of gas turbines on other related industries. It can be expected to be a driving force in influencing related industries, which will have to develop their own production technologies in order to produce high quality products and adapt to the power plants. Consequently, the three companies mentioned above have already built up licensing and technological relationships with their respective foreign counterparts.

Let us now look at the licensing relationships and joint ventures in gas turbine technology. Table 2 (page 27) shows the foreign technology licensing to the Korean corporate actors who are represented in manufacturing a wide range of gas turbine in the power plant industry.

Today, there are five technological relationships between Korean and foreign companies. Firstly, one of the largest companies in the Korean heavy industry, Hyundai, purchased USD 7 million of piping equipment to assemble a gas turbine at Anyang/Bundang combined cycle power station (300 MW) in 1990.23 Due to the technological complexity of the short construction period, an order was directly given to ABB Korea from KEPCO so as to cooperate with HHI. A gas turbine and other equipment were purchased from ABB. At that time HHI sent two technical specialists to the ABB subsidiary in Switzerland to stay for one week.24 ABB concentrated on selling equipment by arranging technical cooperation for a feasibility study as well as training related to the power station. As a result of this co-operation

23 Interview with Lee Bong Joo, Manager of Industrial Project at the Power Plant Division, ABB Korea.
24 Interview with Gwack Ho-Young, Manager of the Engine and Machinery Division at HHI.
ABB created strong technical and knowledge bonds with HHI. These events made it possible for HHI to obtain a technical license with a highly qualified foreign supplier in April 1991 in order to manufacture gas turbines. At the same time ABB was also looking for a Korean partner.

In 1991 HHI’s business team (six people; three directors and three middle managers) visited ABB’s subsidiaries (Mannheim and Baden) and HQ (Zurich) twice in order to obtain their technical cooperation. Several business meetings were arranged between HHI and ABB. ABB also sent three technical specialists to HHI to build up stable technical relationships. According to HHI’s analysis a market breakthrough was achieved by ABB STAL in connection with the GT 10 gas turbine taken over from Swiss Company, Sulzer Escher Wyss AG in 1990. Furthermore, ABB has high technological capability, extensive international business and acquisition. These factors would probably make it quite advantageous for Hyundai to co-operate with ABB rather than with Westinghouse. On September 19, 1991 ABB Power Generation Ltd. (Baden in Switzerland), signed a license contract with HHI to produce gas turbines in Korea. The 10 year contract period runs until December 30, 2001. The contract is for three types of gas turbines, viz. type-8 (46.9 MW), type 11-EN (81.6 MW) and type 13-E (147.2 MW). The three types of turbines are used in both fossil power plants and combined cycle plants. The contract condition is that newly developed and improved types be automatically included into the license agreement. In addition, the gas turbine for simple cycle power plants can be manufactured without limit, although the gas turbine for combined cycle power plants might require an application permit before utilization. Two counterparts, HHI and ABB are still waiting for the industrial permit from MCIR. As an example of co-operation, one type of personal contact with HHI consisted of ABB’s development process pertaining to the daily routine work and future resource exchange activities. In particular this co-operation resulted in a successful exchange of technical information which strengthened the relationship between HHI and ABB. HHI has proven their ability to manufacture gas turbines and to solve technical problems for the end user.

In preparation for the license relationship and the local manufacturing, HHI could enhance the importance of the technological co-operation with ABB Korea-ABB Power Generation. Then two actors expected several interesting developments will be occured in other relationships. As a result of the progress in co-operation, some of the main competitors’ initial contacts with potential customers were influenced by the technical relationship between

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25 The annual report (ABB STAL, 1990) explained the gas turbine marketing activities in connection with the GT10 gas turbine. Five turbines were sold–two for China that were ordered by a Hong Kong-based American Company, as well as three for Sweden. Two of the Swedish plants, in Karlskoga and Angelholm, are combined cycle plants consisting of a gas turbine with a waste heat boiler and steam turbine. This type of generation plant produces electrical power in a highly efficient manner. Overall efficiency will also be very high, since waste heat is utilized in a district heating system.

26 Interview with Chung Young-Sup, Director of the Turbine Engineering Department at HHI.

27 Interview with Kim In Soo, Senior Manager of the Project Development Department at the Engine & Machinery Division, HHI.
### Table 2. Technology Licensing to the Korean Gas Turbine Manufacturers

<table>
<thead>
<tr>
<th>Specification</th>
<th>Technology Supplier</th>
<th>Turbine Types &amp; Capacity</th>
<th>Purpose</th>
<th>Contract Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHI</td>
<td>ABB Power Generation Type 8, Type 11-EN (Sweden/Switzerland) 46.9 - 147.2 MW</td>
<td>Cogeneration</td>
<td>1991-09-16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KHIC</td>
<td>G.E (U.S.A)</td>
<td>10 - 230 MW</td>
<td>Cogeneration</td>
<td>1991-06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halla</td>
<td>Nuovo Pignone (Italy) 2.8 - 123.4 MW</td>
<td>Cogeneration</td>
<td>1993-04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stewart &amp; Stevenson (U.S.A) 1.3 - 57.8 MW</td>
<td>1993-06-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Siemens (Germany) - 150 MW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climof, MMPA</td>
<td>20 - 40 MW</td>
<td>1993-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Polchunof, Asad (Russia)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Roskorturo (Joint Venture) 1.5 Mw</td>
<td></td>
<td>1993-11</td>
<td></td>
</tr>
<tr>
<td>KIST</td>
<td>Solar (U.S.A)</td>
<td>Saturn T 1500 &amp; 5 Other Types 1.4 - 12.5 MW</td>
<td>Cogeneration</td>
<td>1992-01</td>
</tr>
<tr>
<td></td>
<td>Niigata (Japan)</td>
<td>NGT1-S &amp; 4 Other Types 0.3 - 2.4 MW</td>
<td>Emergency</td>
<td>1992-01</td>
</tr>
<tr>
<td></td>
<td>G.E.(U.S.A)</td>
<td>0.2 - 1.0 MW</td>
<td>Aviation</td>
<td>1992-12</td>
</tr>
<tr>
<td></td>
<td>Pratt &amp; Whitney (Canada) LM 2500</td>
<td>Industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SDC Turbine (Russia)</td>
<td>2.5 - 12.5 MW</td>
<td>Cogeneration</td>
<td>1993-10</td>
</tr>
</tbody>
</table>

**Source:** Author’s own investigation in the period 1993-1994.

ABB and HHI. In particular, the strongest Korean supplier, KHIC, competes now strongly against HHI. However, on the steam side Hyundai continued a license contact from 1978, and the Company has been building a technical relationship with Westinghouse. The specifics of the license are for the manufacturing of large-sized steam turbines, and generators, nuclear bunkers and other related supplementary equipment, even though Hyundai has a license contract with ABB. In the medium-sized steam turbine HHI still attempts to contact a few

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28 Westinghouse, received an initial payment of approximately USD 1 million from HHI in 1981. The Company recognized that a sublicense from HHI could give the same license technology to HICO, e.g. one of Hyundai Group’s subsidiaries in 1985. Thus of HICO’s entire industrial activities were included into the business area of HHI. The first contract period was 12 years as of November 6, 1978 - November 5, 1990, but the period has become prolonged by 8 years, and runs until November 5, 1998.
foreign suppliers to build up a technology licensing relationship. This is concerned with transfer of technology. Consequently, HHI is very interested in obtaining a few reference objects in the Korean market through involving in the construction of their own power plants, e.g. Hyundai Electronic and Korea Aluminium.

Second, KHIC signed a license contract with General Electric (GE) in June of 1991 so that GE is now supplying turbine technology and equipment to KHIC. This contract was developed through a previous relationship which had been maintained since 1978. GE has gained a reputation for marketing and service maintenance of steam turbines and related equipment. After the technological agreement KHIC began to build up an assembly line factory and operation plants in Changwon Industrial Area (southern part of Korea). The purpose of gas turbine utility is cogeneration. The capacity of the manufacturing factory will be to produce 150 Million Kw gas turbine per year. This business is concerned with advanced technology to produce high value added turbines in connection with the construction of power plants, which KHIC will get improved technological evolution from the foreign resource-dependence relationships to their own dynamic behaviour in order to construct power plants in the future. This has a bearing on the location of production plants and technology. There is also a political factor, Korea has an import surplus in the trade balance. Still, a large number of gas turbines were supplied to several power stations, viz. Ildo combine cycle, and Kunsan, Pyoungtack, Ulsan combustion power stations and others. 70% of the total number of gas turbines was supplied by GE, but a wide range of gas turbines (10MW-230MW) will be produced by KHIC in the future. KHIC considers that the technology will successively be transferred to them during a specific period.

Thirdly, Halla Heavy Industries has built up four types of technological relationships with foreign suppliers. Due to the development of total energy system the company has, in fact, been making strenuous efforts to develop its technological relationships so as to become aware of the importance of strengthening their own abilities in R&D and business development. Siemens has a license contract in supplying turbine technology and equipment to Halla in 1991. The company is constructing a production plant in the Eumsung Industrial Area (Middle part of Korea). The production capacity will be 150 Million Kw. The purpose of licensing relationships is concerned with 100% location of the production technology in the future. The company will use from 22-48% Korean materials until 1995, from 48-68% in 1998 and about 85% until 2000. Halla has also developed technological cooperation with an Italian and an American Company. In April of 1993 the Italian Company, Nuovo Pignone had a license contract for supplying turbine technology (2.8-123.4MW) to Halla. The American Company, Stewart & Stevenson, has a license contract with Halla since June 22, 1993 in order to produce gas turbines (1.3 -57.8MW).

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29 Interview with Lee Hyun Koo, Chief of Changwon Factory at KHIC.
The Company and KIST (Korea Institute of Science and Technology) built up joint venture relationships with four Russian defence-related companies, viz. Climof MMPA, Polchunof and Asad. By transferring defence-related technology, Halla and KIST have at present a common cooperation for producing the gas turbine affiliated equipment. These actors established a joint venture Company, Roskorturbo, to produce 1.5 MW gas turbines for military aircraft use as well as a middle-sized gas turbine (20-40MW) for industrial turbine. The company is located in St. Petersburg.

Fourth, Ssangyong Heavy Industries organized a business division for gas turbines in January, 1992. By investigating and initiating contacts with potential suppliers the Company has built up technological relationships with two foreign suppliers, viz. Solar (U.S.A) and Niigata Engineering (Japan). The first contract for technological cooperation was based on the manufacturing of a set of combined cycle power plants. In August of 1992 the Company obtained the second license contract, which was based on manufacturing a set of emergency power plants. The Company strategy is to sell two types of turbines, in combination with having mobilizing new technologies and equipment from the suppliers. It obviously gave the Company a few opportunities for development of its own capability to localize production technology in a short period. The Company installed a power package line of gas turbine within the second diesel engine factory in Changwon and then completed assembly line and operation plants so as to produce 100,000Kw per year. In this case the process of licensing is similar to that of Halla. The development process is divided into three stages. During the first stage, from 1992-1993, the Company prepared for the establishment of its basic business. During the second and third stages the Company will obtain its own techniques for package system design, strategic equipment and material production, in order to approach completion of gas turbine manufacturing technology in the period from 1994-2000. Moreover, the whole technique of the package system design will be completed for themselves so as to attempt to make local the production of important complementary equipment. The Company made decision to invest in the gas turbine business because the market environment is going to change in meeting the great demand for gas turbines in Korea. The issue was based on the utilization of 13 years experience in diesel engine technology and business. It is possible for Ssangyong to combine different technologies and implement business diversification. Therefore, it is important that Ssangyong become engaged in the gas turbine business activities and in building relationships with foreign suppliers. Two types of gas turbine, i.e.14,000-12,500Kw (Solar) and 300-4,000Kw (Niigata) will be manufactured in the future. Consequently, the Company estimated that the sales forecasts predict a certain and stable market in Korea. The market will be a high stake one in the period 1998-2003.

Fifth, Samsung Aviation developed two types of technological relationships with three foreign suppliers. Three license contracts were taken between Samsung and their foreign

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30 Interview with Chun Myung Soo, Manager of the Gas Turbine Business Team at Ssangyong
partners in December 1992. The first type of technology was to produce aircraft turbine. The capacity of the gas turbine is 0.2-1.0MW, which is supplied by G.E. and Pratt & Whitney (Canada). The second type of technology is to produce small-sized industrial gas turbines (28MW), which are supplied by G.E and SDC Turbine (Russia). The company began to construct a production plant in 1992 and it will be finished in 1996. The purpose of utility is cogeneration and industrial uses. The resulting supply networks of the gas turbine technology is shown in Figure 3.

**Figure 3. Supplier Networks of the Gas Turbine Technology in 1994**

6.3.2. The Recent Business Area of PFBC- and IGCC Technology

Utilities and independent power producers (IPPs) at present are focused on the use of natural gas-fueled gas turbine for most repowering applications (Stambler, 1993), but the greatest cost advantage lies in using natural coal with regard to operation of coal-fired PFBC and IGCC plants. The price is continually changing in the coal vs. gas relationship. Until recently, coal prices had to be around $1.50/MMBtu and gas prices over $4.50/MMBtu for coal to be cost-effective. Furthermore, now the cost of using advanced coal gasification technology is much lower than it was a few years ago and the standard differential no longer is $3.00 for coal to look attractive. It is emphasized that the relative merits of competing technologies depend not only on performance needs but also are site specific. Consequently, syngas-fired plants can compete quite effectively with natural gas-based stations in the near future. The capital costs might be higher for gasification or fluidized bed combustion systems, but assuming that present capital and non-fuel operating and maintenance cost advantages of the current generation gas-based combined cycle technologies over their coal-fired alternatives have diminished.

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31 Tom Hewson (1993) comments the capital and non-fuel operating and maintenance cost advantages of the current generation gas-based combined cycle technologies over their coal-fired alternatives have diminished.
trends continue over 20-30 years, these could be offset by lower delivered fuel costs for coal (Thumb, 1993).

By comparison of the two technologies, either PFBC or IGCC technologies with gas turbine are primarily involved in the advanced coal-based repowering, which is the main new generating elements. With regard to technological innovation in the competition, there are two significant aspects in commercializing PFBC and IGCC systems. Firstly, the flexibility of technological adaptation has been significantly pointed out by a specialist, Hewson (1993) as follows “AFBC has the advantage of being commercially proven technology with a range of design sizes and conditions available” 32 Most of those designs use coal-fired boilers rather than combustion turbines. This impelled Westinghouse to carry out studies for the application of innovative gas turbine designs-such as an advanced GTW machine-with AFBC. Secondly, by combining with the existing steam turbines, the two technologies have also respective advantages. When evaluating either an IGCC or PFBC repowering approach, it is important to see which method matches up best with the existing steam turbine equipment. Steam turbine throttle conditions will have a major impact on the relative advantages of IGCC (including whether the plant will burn natural gas at first, then switch later to syngas) or PFBC. For PFBC you tend to need higher steam pressure conditions; if the match calls for lower pressure levels, then this might favor IGCC (Weber, 1993).

Reviewing prospects for commercializing PFBC and IGCC, the technological innovation is also dependent on sulfur content when choosing the coals which might favor IGCC in one case and PFBC in another. In particular, there are seven major technology suppliers, viz. Texaco, Shell, Destec, GE, Westinghouse, Siemens and Mitsubishi in IGCC business area. Four of those suppliers are, therefore, developing technology in cooperation with other companies. For example, a new IGCC group of those companies made three demonstration projects, viz. GE 6FA/7FA, Siemens V94.3 and Westinghouse-Mitsubishi 501F/701 designs which will come on-line, in the middle of 1990s, based on linking gasification technique to advanced gas turbines with rotor inlet temperatures of 2300 F and above (Holt, 1993).

When approaching the repowering applications in Korea, the former president of KEPCO, An Byoung Hwa was interested in studying both PFBC and IGCC system technologies. Therefore, he visited the Vartan Plant in Stockholm in 1991.33 After the visit KEPCO contacted ABB and asked them to send three engineers who would concentrate on training personnel in system engineering and operation. In 1992 the investigation team of

32 This technology is based on FBC. Atmospheric FBC has been widely used in several smaller unit applications.
33 The background, based on empirical evidence (Stambler, 1993), indicates that ABB provided the gas turbine for the American Electric Power Tidd system (and also awarded B&W a two years lease for facility integration) pointed to that project and also to the many hours of reliable operation accumulated by the 250-MW plant in Vartan, Sweden. In particular, the Vartan experience was seen as good proof of the performance and reliability of pressurized bubbling bed systems.
KEPCO visited a few foreign suppliers in order to observe newly constructed coal-fired power plants. After this investigation the Company has been carrying out extensive research in connection with gathering new technical information. It has also participated in international conferences in order to be able to perform repowering projects in the future. Therefore, KEPCO wanted to receive feasibility reports from the suppliers until July 1993, but the degree of interesting new technology diminished when new president of KEPCO assumed office. As a result of the change in top management, the feasibility reports were delayed until April 1994. In this phase, due to the problems with obtaining financial resources, one of the most important issues in the repowering project has been considered to be the extension of the life cycle of the old existing power plants (e.g. those that have been operating for 20-30 years). This phase was not only influenced by the government’s policy on recovering the domestic coal businesses but also by the establishment of the Ministry of Environment (MOE). The important issue of business recovery should be emphasized when choosing new technology connected with building coal-fired power plants in the near future. Therefore, KEPCO has already decided to choose CFBC technology in the long-term. After its entry into the Korean market, KEPCO directed its own organizations (e.g. Power Planning Department of KEPCO, Mechanical Engineering Dept. at the Fossil Project Division of KOPEC and KERI) to pursue a range of goals related to valuable resources and technology in the future. At the same time KERI is carrying out a coal gasification project to develop their own technology without any foreign cooperation. Still, the time consumption is relatively high, so as to suggest that the foreign technology will be purchased and combined with its own technology in 1996. It means that it takes at least 2 or 3 years for KEPCO to analyze and make a decision on purchasing its one or two system technologies. The cooperation with KEPCO’s affiliated companies, e.g. KOPEC and KERI, are important for KEPCO’s role as one of the important factors for developing a wide range of gasification technologies. KERI and KOPEC can thereby improve its gasification technology by conforming to the local market requirements. In the future KEPCO and KOPEC will probably obtain the results of its research comparing PFBC with IGCC system technology. Therefore, ABB Carbon and ABB Korea should attempt to increase the frequency of visits and other personal contacts in order to facilitate the exchange of general and technical information with KEPCO, KOPEC and KERI.

The choice of PFBC and IGCC systems are not only dependent on the operational function of the existing CFBC technology and but also a few conditional factors, e.g. the foreign Company has its own advanced technology, worldwide marketing and operation references, and is capable of short term delivery. As the power plant system purchasing is directed towards newly developed technology (e.g. technological, economical and

34 Interview with Lee Soon Byoung, Deputy General Manager of Power Planning Department at KEPCO.
35 Interviews with Lee Soon Byoung, Deputy General Manager of the Power Planning Dept at KEPCO and Kim Nam Soo, Senior Mechanical Engineer of the Mechanical Engineering Dept. of the Fossil Project Division at KOPEC.
environmental advantages), and as technology changes rapidly and large number of power plants are demanded, technology utilization is a major variable for assessing the power plant industry’s competitive strength, as well as a determinant of buyer decisions. Particularly in the Korean market for technology-intensive turbines, boilers and related equipment, consideration should be given to the perceptions of the buyer and end user regarding the technical choice on offer. This is particularly true when the buyer is the Korean Electric Power Corporation (KEPCO). The technical choice is focused primarily on the National Economic Five-Year Plan. The foreign Company can help the buyers to achieve this main objective, which is clearly an important route to obtaining sales over a long period and also enables local companies to localize technology and to develop the power plant industry to the international level. The foreign company can sell its technology and related equipment to KEPCO and their Korean business partners.

7. THE LEVEL OF CFBC TECHNOLOGY AND SUPPLY REFERENCE BETWEEN MAIN MANUFACTURERS

The analysis begins with the differences in technical standard between the main manufacturers. The marketing reference to circulating fluidized bed combustion (CFBC) system boilers is described briefly. The situation of the major technological cooperation with the Korean heavy industries, significantly dependent on the main manufacturers’ supply reference in the international market, are described and analyzed.

7.1 The Differences in Technical Standard between the Main Manufacturers

As we can see in Table 3, the technical standards of CFBC differ between the main manufacturers. The differences in technical standard, which is a result of the level of combustion technology, is illustrated from KEPCO’s point of view by the analytical data.

Since the development of a specific CFBC system was created by each manufacturer, the main differences between them are emphasized as follows. The classification of coal-based combined technologies within CFBC systems is based on five important elements, viz. number of boilers, form of boiler circulation, combustion chamber, cyclone and external heat exchanger. Firstly, the almost all the CFBC systems have one boiler. Secondly, all three manufacturers have use a similar drum form for natural circulation, but ABB-CE & Lurgi has an extra operating function of constraint circulation in the external heat exchanger. Thirdly, there are two types of equipment, i.e. heat equipment and heat transfer equipment installed in the combustion chamber. Neither ABB-CE & Lurgi and Foster Wheeler utilize heat equipment in the combustion chamber. Alstom, however, has installed heat equipment and some heat transfer equipment. Fourthly, there are some differences between the European and American
Table 3. The Differences in Technical Standard between Main Manufacturers

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>ABB-CE &amp; Lurgi/Sweden - Switzerland &amp; Germany</th>
<th>Foster Wheeler/U.S.A Ahlstrom/Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Boilers</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Form of Boiler Circulation</td>
<td>Drum Form of Natural Circulation</td>
<td>Drum Form of Natural Circulation</td>
</tr>
<tr>
<td></td>
<td>*Constraint Circulation within External Heat Exchanger</td>
<td></td>
</tr>
<tr>
<td>Combustion Chamber</td>
<td>No Heat Equipment within Combustion Machine</td>
<td>No Heat Equipment within Combustion Machine</td>
</tr>
<tr>
<td>Cyclone</td>
<td>Installation of Steel Plate &amp; Internal Equipment, Impossible Absorption of Heat</td>
<td>Installation of Steam Cooled Tube, Possible Absorption of Heat</td>
</tr>
</tbody>
</table>

Source: Author’s own investigation is based on the information from KEPCO

styles in the structure and operating function of the cyclones. Two of the European manufacturers, ABB-CE & Lurgi and Ahlstrom use the same structure as well as using absorption of heat. However, the American manufacturer, Foster Wheeler, has installed steam cooled tubes, so as to make possible heat absorption. Fifthly, the three manufacturers have operating function, i.e. installation of steel plate & internal equipment and impossible respectively different external heat exchangers. ABB-CE & Lurgi has a fluidized bed heat exchanger (FBHE) and has installed internal combustion tubes. Foster Wheeler has an integrated recycle heat exchanger (INTEX) and has installed combustion tube, but Ahlstrom has not installed any extra heat exchanger. Consequently, the main manufacturers all have their own in technical advantages. However, Ahlstrom and ABB C-E & Lurgi have more technological advantages and cost efficiency than Foster Wheeler does. They have nevertheless engaged in different types of minor business operations before the establishment of the technological relationships. This was particularly so in respect to government involvement during their establishment, when several contracts were made which made two European suppliers well-versed in Korea. Both of these suppliers developed strong technological relationships with KEPCO-KHIC and HHI. Thus, these relationships allowed the largest Korean heavy industries, KHIC and HHI to not only purchase CFBC boilers, related equipment and technology bargain prices in a buyer’s market, but also to build up strong
manufacturing capabilities. This circumstance affected one of the two European suppliers (ABB Carbon), which attempted to introduce a new PFBC system boiler, because the Korean Government chose to encourage the modernization and upgrading of coal-fired power plant facilities in combination with a repowering programme made to reduce harmful Co2 (pollution) emission.

7.2 The Technological Level and Supply Reference

7.2.1 The Technological Level

**International Level:** There is a 170MW boiler, which is commercialized and is in operation, but the capability of design which is possible to construct a super large size, 300MW. The manufacturers are improving in the technologies and related equipment in order to promote for the use of coal and natural gas. This is concerned with technological development in marketing the combustion technology and the construction of large-sized power plants for buyers. They described recently technological advances aimed at reducing harmful Co2 emissions. The most advanced coal-based repowering at present primarily involves either PFBC or IGCC technologies with gas turbines as the main new generating elements.

**Domestic Level:** After 1986 major Korean heavy industries, viz. KHIC, HHI and SHI developed technological cooperation (including licensing) with the foreign suppliers in order to produce and supply small-sized industrial boilers.

7.2.2 The Korean Technological Cooperation in Connection with Supply Reference

Table 4 shows the marketing references of CFBC system boilers in the world market. These were the main products on the market before the marketing of the new PFBC or IGCC system technologies. There are four established major foreign suppliers, viz. ABB-CE & Lurgi (Sweden-Switzerland/Germany), Foster Wheeler (U.S.A), Ahlstrom (Finland) and Tempella (U.S.A) in Korea. These firms depend heavily on marketing and production of increasingly

**Table 4. Marketing Reference of CFBC System Boilers**

<table>
<thead>
<tr>
<th>Supplier</th>
<th>ABB-CE &amp; Lurgi</th>
<th>Foster Wheeler</th>
<th>Ahlstrom</th>
<th>Tempella</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Supply Reference</td>
<td>43 (17%)</td>
<td>12 (5%)</td>
<td>109 (43%)</td>
<td>20 (8%)</td>
<td>67 (27%)</td>
</tr>
<tr>
<td>Size: Over 100MW</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: KEPCO’s investigation is based on the information presented by the foreign suppliers in August of 1993.
advanced technology gas turbines and boilers in the construction of combined cycle and coal-fired power plants. To attain the required size, most of these foreign suppliers first became strongly license-oriented technological cooperations (see Table 5), established subsidiaries and joint production plants in Korea.

ABB-CE & Lurgi supplied 43 boilers which are operating in the world (1993). The Company has a 17% market share. In Korea ABB-CE & Lurgi has two license contracts in supplying boiler technologies and equipment to KHIC. The first license contract was taken on April 13, 1987 between KHIC and C-E. The second was taken on July 7 in the same year between KHIC and Lurgi. After the license contracts C-E and Lurgi had developed a relationship. The size of Lurgi’s boiler was then improved by C-E to adjust its market situation and requirement (i.e. increasing the demand for the large size of industrial power plants). From the point of view of technology licensing, this was seen as a significant advantage for C-E’s competitive power in the market. During the competition with the other suppliers, ABB has maintained a strong technological relationship with KHIC, which has made it possible to sell one CFBC system boiler (ABB C-E & Lurgi) and 2-3PC boilers (ABB’s 500MW PFC) per year. In practice, it was a good marketing result and reference for ABB Carbon to initiate relationships with the few important potential buyers and end users. Otherwise ABB Carbon would consciously attempt to recommend the PFBC plant to main actors and end users by arranging seminar. Both frequency of visits and marketing activities influence the buyers’ motivation when purchasing. They want to obtain great technological advantages and efficiency. These activities are performed on the basis of maintaining earlier credibility with buyers.

Recently, three large-sized boilers have been supplied. The capacity for maximum operation is 150MW, but an order for a boiler with a volume of 250MW has been obtained in connection with the construction of a power station in Gardanne, France. The power station will be finished by 1995.

In the international market Foster Wheeler supplied 12 boilers that are operating in the power stations. Recently, the Company has constructed 8 boilers and has a 5% market share. In Korea the Company developed a technological relationship (including licensing

<table>
<thead>
<tr>
<th>Foreign Supplier</th>
<th>ABB-CE &amp; Lurgi</th>
<th>Foster Wheeler</th>
<th>Ahlstrom</th>
<th>Tempella</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Buyer</td>
<td>KHIC</td>
<td>SHI</td>
<td>HHI</td>
<td>Daewoo</td>
</tr>
<tr>
<td>Date of License Agreement</td>
<td>1987-04-13 (C-E vs KHIC)</td>
<td>1991-09</td>
<td>1987-11-11</td>
<td>1991-03</td>
</tr>
</tbody>
</table>

Table 5. The Situation of Technological Cooperation with the Korean Heavy Industries

Source: Author’s own investigation.
with SHI in September, 1991. SHI is one of the large potential suppliers invested in the Korean heavy industry. It can be expected that SHI's technological development will be successful in the near future. Recently, a large-sized boiler has been supplied. The capacity for maximum operation is 120MW but a boiler with a volume of 250MW has been ordered and is being constructed in York, U.S.A. Construction of the power station will be completed in 1996.

Ahlstrom has supplied the majority of boilers, 109 boilers. Now 85 boilers are operating among the supplied boilers in the world. The remaining number of boilers have been constructed elsewhere. The Company has a 43% market share. In Korea Ahlstrom has a license contract with HHI. The contract was taken for a period of 10 years, from November 11, 1987 - December 31, 1997. The Company is specialized in manufacturing and marketing small sized boilers, e.g. 10-20 MW, in the Korean market. Most of the supplied boilers were installed during construction of the industrial power plants. Recently, three large-sized boilers have also been supplied. The capacity of maximum operation is 165MW but a boiler with a volume of 230MW has been ordered and is being constructed in Turow, Poland. The power station will probably be constructed in 1995.

There are also three other important foreign suppliers for HHI, viz. Babcock & Wilcox (U.S.A), Combustion Systems (U.K) and Deutche Babcock AG (Germany). They supply industrial and combined cycle boilers, internal combustion, BFBC and other system boilers. The first supplier, Babcock & Wilcox has seven license contracts for supplying boiler technology and related electric power equipment to HHI. The industrial and combined cycle boilers are classified into five types of boilers (e.g. capacity; FH: 5-80 Ton/HR, HCFH: 90-160Ton/HR, PFI: 45-270Ton/HR, PHT: 160-360Ton/HR, PFM: 90-270Ton/HR). The Company has maintained the contracts for 10 years. The period for all five license contracts is the same, from March 3, 1982 to March 3, 1992. Almost all the types of boilers are only oil-fired. The internal combustion are boilers of two types, viz. RBE (e.g. capacity: 300-3500 Ton/HR) and RBC (300-3500 Ton/HR). The fuel consumption is based on both coal and oil. The contract periods run 13 years, from March 8, 1979 to March 7, 1992. Another HRSG boiler has been introduced on the market, but the marketing activity and product uses are both passive. The contract period is 5 years, from July 1 to November 18, 1991. The second supplier, Combustion Systems, has a license contract with HHI and has supplied BFBC system boilers (e.g. capacity: 5-50 Ton/HR). The contract period run 10 years, from April 23, 1984 to April 22, 1994. The third supplier, Deutche Babcock AG has supplied incinerators and different boilers from those previously mentioned. These are viz. Roller Grate (150-1000TPD), Opposed Motion (100-150TPD) and Rotary Kiln (10-200 TPD). The Company has a 10 years license contract period, from November 17, 1984 to November 18, 1994.

Tempella supplied 20 boilers and has a 8% market share. In Korea the Company has a license contract with Daewoo Heavy Industries since March, 1991. It has already introduced
power plant technology, boiler and the related equipment to KEPCO. This equipment is related to the construction of small-sized industrial power plants. The remaining 67 boilers (27%) have been supplied by several other companies.

**Supply Reference of the Korean Heavy Industries:** Approximately 16 industrial boilers are presently operated, as almost all boilers are combined cycle systems. The capacity of power production is under 40MW.

8. ANALYSIS OF THE NETWORK POSITION DEVELOPMENT

In this chapter the network position development is empirically illustrated with examples from the three stages of the process. In particular, this empirical illustration is based on the previous case study, ABB STAL (Lee, 1993). The achieved network position derives from the process described in the above analysis of dyadic relationships developing into networks. The network position is analyzed as follows. Firstly, the strength of the network position is illustrated by strong and weak bonds in the network of exchange relationships. Secondly, position and network dynamics are described as a position (e.g. initiating PFBC net) which is emerging and changing from the existent strategic positions. Thirdly, the overall network structure is seen as positions related to other important connected positions within the structure of network relationships. The section concludes with a summary of the different features of network position development.

8.1 The Strength of Network Positions

The marketing strategies of ABB Korea were related to the strength of its network position, which is based on various integrated relationships. These relationships helped to build up strategic positions, so that marketing networks could be occupied and could be adapted to the response from the competition. ABB’s strategic position for meeting competition can be classified into two dimensions. The competitive position concerns the public and private sectors, which form the boundary of the network. This was based chiefly on the strong positions, which were integrated through cumulatively aggregated strong bonds in the relationships. The effects of the strong bonds were due to the vigour of ABB Korea’s strategic marketing response. This is illustrated in Figure 4.

ABB has successively developed three positions in the electric power generation equipment networks. The positions are grouped into three types respectively, viz. turbine, PFC & CFBC and PFBC system boiler networks, which were all characterized by the stable function of the member of different actors’ relationships. In the turbine and PFC & CFBC areas, ABB Korea has developed a strong position through various strong relationships based on a long historical structure (e.g. the position was built by 35 years running business
Figure 4. The Strength of ABB Carbon’s Network Position

<table>
<thead>
<tr>
<th>Strong</th>
<th>Public and Private Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Position</td>
<td></td>
</tr>
<tr>
<td>Weak</td>
<td></td>
</tr>
<tr>
<td>*PFBC</td>
<td></td>
</tr>
</tbody>
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New Age of Co-operative Relationships

relationships). ABB Korea was otherwise mostly involved in tightly knit day-to-day exchange relationships in the networks, whereas ABB’s another position was weakly developed in the PFBC marketing networks. This was due to the connections in the three types of network relationships, viz. industrial turbines’ and PFC & CFBC’s, were to be connected in environmental application of new technology. Due to the market demands, it was necessary for ABB Korea to concentrate on marketing a large volume of nuclear reactors, fossil boilers (PFC & CFBC), and new technology for the PFBC plant as well as the equipment to KEPCO, KHIC and HHI in heterogeneous markets. The supply volume dynamically increased in the period 1989-1993. The short-term consequences of a strengthening of the supply position might be very significant in the equipment net, nevertheless sporadic orders of industrial steam turbines were continuously obtained and supplied to the end users. The conclusion to be drawn is that ABB Carbon and ABB Korea were closely connected with KEPCO-KOPEC, KHIC and HHI. In addition to this, more than one third of the nuclear reactors, fossil boilers and equipment were supplied by ABB C-E International. The main emphasis of this case is put on the buyer relationships and intensive formal and informal contacts, focusing on the main buyers, KEPCO (including KOPEC, KERI and KHIC) and HHI, and linked with various strong bonds. The strength of the position is dependent on cumulatively aggregated bonds from individual to inter-organizational positions. The positions of individual actors depended on the number and quality of their cooperative relationships. The variation of ABB’s marketing activities, as reflected in the relationship pattern, are based primarily on the strength and properties on the individual level as well as the size of ABB Korea and its a significant position in the industry.

A number of different individual actors in the Power Plant Division of ABB Korea are in regular contact with the buyers and end users regarding marketing matters. There are frequent visits, negotiations and mutual adaptations related to marketing development. This is
a very important process, directed at the integrating of strong relationships and the planning of future activities with special regard for the PFBC plant. Thus, a stable balance between the individual actors’ relationships and business confidence are obtained. Stability was required until ABB became familiar with the processes of its buyers and end users. The stability was based on ABB’ own technological capability and organizational competence in adjusting to the buyer and end user side. Both sides attempted to rationalize day-to-day operations. These enabled ABB Korea to intend connecting with other positions and to enter into new relationships. The strength of the network positions was therefore developed by gradually identifying direct and indirect relationships in both the tightly and the loosely coupled networks. It provided an intensive way of developing actions, e.g. towards PFBC, in marketing matters from a strong position and to further defensive actions against their competitors. It was frequently suggested that information, resource control and mobilization are a threat to the competition. Still, according to KEPCO's and main actors’ evaluation in 1993, ABB has a strong position but it will be difficult for ABB to reach a top technological level with the cooperation of main actors in a short period. Unfortunately, the competitors continuously attempted to break down entry barriers in order to co-operate with KEPCO and KHIC. In the project of repowering plant, for example, the American companies, Texaco and Shell have already introduced IGCC technologies equivalent for the PFBC. The introduction was very valuable in preparing for a feasibility study of the repowering plant. The attitude towards the instruction of the researchers in KOPEC and politicians were clearly expressed, and positively influenced their later choice. The introduction activities affected an American style of power plant in dominating the involvement of government authorities. This was the initial measure in planning the market entry. The marketing opportunity will be dependent not only on the Government Seven Plans, but also on the maintenance of existing strong positions in the network relationships.

The Ministry of Commerce and Industrial Resource has an antitrust suit against the state companies in 1994, seeking divestiture of KHIC's market monopolism. Although it is not the main focus of the legal case raised by the MCIR, a part of KHIC’s initial defensive position is that the break-up of the KHIC system's “rational monopoly” would result in a loss of economic efficiency. This issue is also at least implicit in the policy debate concerning the entry of ABB Carbon or Texaco, Shell and others into KHIC's monopoly market. The KHIC's position was that this power generation market was a rational monopoly and that wasteful duplication of facilities would result if competitive entry were permitted and protected.

The age of the co-operative relationships is dichotomized into the classes “new and old”. The relationships with buyers, KEPCO-KHIC and a few government authorities, end users and engineering companies have lasted about 22 years old. The focus is on the positions of Industrial Turbine and PFC & CFBC boiler Networks so as to be defined as "old". The age of the relationships was not directly dependent on the strength of the position in relation to
the competition. However, the strength of relations might have a stabilizing function by maintaining a strong competitive position and integrating strong horizontal relationships. The content of a strong competitive position has been emphasized as a basic characteristic of buyer-supplier relationships in industrial markets. All maintenance activities can serve to develop the long-term relationships and various kinds of strong bonds generally support the strengthening network position. As a result of these activities, ABB was able to sell 2-3 PFC (PC) and one CFBC system boilers.

In the area of PFBC plant ABB has a weak position in the network relationships on the basis of its short historical structure. As it is only two years old, it can be defined as "new" when considering the age of co-operative relationships. After the introduction of PFBC system technology into Korea the initial growth process could be explained by the direct technological relationships on the basis of environmental requirements (e.g. political and people’s opinions on air pollution) and indirect power-dependence relations in a loosely structured network. To develop a strong network position of the PFBC technology, ABB should attempt to attain extensive cooperation with the main actors, viz. KEPCO-KOPEC, KHIC and ABB’s international units. In particular, ABB should prepare for a wide technology-oriented marketing in combination with persuasive influential advertisement, e.g. towards the main Korean actors. It is obvious that ABB’s individual actors could make use of the process developed during the successful Wakamatsu PFBC plant project in Japan, utilizing the experience of marketing matters obtained at that time. It is also important for ABB building power-dependence relationships. The power-dependence relations are characterized by the powerful individual connections, e.g. towards politicians, industrialists, bankers, journalists, etc. Afterward the development pattern of the PFBC chain will probably depend on the strength of the present network position, which will result in some suggestions for the design of repowering policy action. According to the repowering policy, KEPCO and KOPEC continuously play an important role in the development of the PFBC plant network. The two former actors always co-operate with KHIC and with three major heavy industrial actors (including their foreign technology suppliers) in order to attain a substantial development of the power plant industry. A partial development is also being carried out by HHI and other important heavy industries, i.e. SHI, Daewoo, Hall and Ssangyong. They have an intensive technological cooperation with their foreign partners for a 5 years period. Therefore, it is absolutely necessary for ABB Carbon-ABB Korea to continually analyze its strategic position in relation to KEPCO-KOPEC, KHIC and at least four major heavy industries, as well as other actors of importance, and to develop technological relationships with some of those major buyers and heavy industries. Consequently, ABB Korea has developed much stronger positions in both the industrial turbine and the PFC & CFBC boiler networks than it the PFBC (system boiler) network. Recently, ABB Korea has gained control over resources by the rapid market
expansion on the strength of its competitive position, when connects the tightly structured
turbine and PFC & CFBC boiler networks.

8.2 Position and An Initial Emerging PFBC Plant Network

ABB’s position was developed through both short-term, intensive interaction and long-term, stable interaction between it and the various kinds of actors in the turbine and PFC & CFBC boiler networks of relationships. These relationships could be characterized as being stable, even when taking changing positions into account. The development of new industrial projects were dependent on certain driving forces; industrial policy, new technology applications, strategy of resource exchange activities/organizational action, and conflicts in the corporate actors’ relation to the network. These influenced ABB to identify and delimit their networks, after the position building or integration stage (see Lee, 1993, pp. 34-38).

The major buyers & end users, KEPCO,KHIC, HHI, SHI and as well as other buyers, Pacific- and Kuk-dong Construction, have continuously bought turbines, boilers and equipment from ABB Korea. The Company was an old supplier in comparison with others; nevertheless, ABB did not qualify as a permanent supplier. The number of buyers changed frequently in the industrial turbine and boiler networks. In addition to this, different types of ABB turbines and an increasing number of PFC & CFBC boilers were sold and their sales were dependent on the buyer industries and the market situation in the period 1984-1988. This favored the development of strong bonds between the buyers, engineering companies and others. The variation in the orders made it difficult for ABB to adjust to a different technical level. The possibility of adjusting to present and new buyers depends on the volume of resource exchanges and the size of the project. ABB had to mobilize more resources to the remaining buyers to avoid competition. ABB’s position was connected to the supply structure of KEPCO-KHIC and HHI, so the situation around ABB’s position was always changing in some ways. In this type of change, individual relations strongly influences ABB’s relationships with them. There are some distinctions between those suppliers who have had technological relationships with KEPCO-KHIC and HHI and those who have not, for example, in terms of the degree of confidence, trust and loyalty in repeat purchasing behaviour. However, a consistent selection of the same suppliers was made by KEPCO-KHIC and HHI in the period 1989-1994 in order to construct a number of different types of power stations. The sales volumes might have been generated by the suppliers, but also important for ABB’s position was that it was in fact strengthened by the VAX- and other specialized turbines, PFC & CFBC boilers and technology. These have created some major network changes in both installing various kinds of power plants and concerning the integration relationships. The network position also changed because of the influence of emironmental factors.
In the analysis made of the emerging PFBC plant network, it is possible to identify changing motivations and patterns, going from strong structures to the establishment of new, weak relationships. Weak and strong relationships are illustrated in Figure 5. An initial emerging PFBC plant network is based on the development of relationships connected to the chronological chain, e.g., Gadelius-Hyupchang-ASEA Construction’s office-ASEA Korea-ABB Korea, as a matter of creating a PFBC base on the position integration stage. ABB’s new PFBC plant network and changing position in its buyer and other important relationships are dependent on these weak and strong bonds in the Korean industrial turbine and boiler networks.

Figure 5. An Initial Emerging PFBC Plant and ZGCC Technology Networks

Explanation: Weak PFBC Plant Relationship

--- Weak IGCC Technology Relationship

--- Strong Fossil Boiler (CFBC or BFBC, HRSG) Relationship

Due to the plan of repowering projects, the PFBC plant network has emerged initially with strategic action oriented to new technology and aims at influencing the main actors, relationships and subnetworks. This has had some effect on network positions in relation to previously unconnected technological relationships regarding advanced new construction processes. It influences their ways of connecting and handling different relationships. The action is primarily implemented from ABB’s position in Korea and is considered strategic. It is a matter of building connections between networks and subnetworks. It may aim at
establishing new specific relationships from the existing PFC & CFBC boiler networks. The specific characteristics of network relationships in resource terms can consequently be identified for different times, methods, and purposes, as regarding the requirements of network environment. It is an investment process in the sense that costs and future revenues appear in the PFBC plant network of exchange relationships. It means that the PFBC plant network will structurally influence its future relations to its network environment and thereby also influence the network structure. Obviously, an important reason for such actions may be resource interdependencies, which will have to be handled between ABB Korea and the buyers or complementary Korean suppliers (e.g. license manufacturing for PFBC technology related equipment). The future development of the PFBC plant network is dependent on the rapid growth in marketing, regarding both new projects and KHIC and major heavy industries. These will develop and change dynamically in connection with the relationships required in the construction of PFBC plants. The efficient handling of ABB’s activities is performed within relationships already established in the industrial turbine and boiler networks, but ABB did not perform any extensive introduction of PFBC marketing or establish any new organization with respect to sales engineers. This means that they will have to build up new specific relationships for providing a feasibility study (e.g. exchange of technical information and training) for KEPCO-KOPEC and KHIC and adapt their organizations in order to minimize conflict and adjust to the relationships between them.

One of the foreign suppliers, General Electric, has strong relationships with both KEPCO and KHIC after having supplied both a license technology for industrial turbines to KHIC and large turbines to KEPCO. Instead of the GE-KHIC technological relationships, HHI has a strong relationship with Westinghouse from supplying license technology and equipment for steam turbines (the company is one of the strongest competitors to KHIC in the future). Furthermore, seven potential newcomers, Texaco, Shell, Destec, GE, Siemens and Westinghouse-Mitsubishi have IGCC technologies, and already have contacts with the Korean actors for introducing their technologies and marketing references. In particular, two American projects, viz. the 260 MW Tampa Electric Company and the 268 MW PSE Energy/Destec, are based on Texaco and Destec gasification technologies, respectively. Both projects are also combined with a GE Frame 7F gas turbine combined cycle. It will also be an important technical adaptation for the IGCC technology to match up best with the existing steam turbine equipment in the future. In particular, the three newcomers have technological cooperation with GE and Westinghouse (e.g. innovative gas turbine designs - such as an advanced Westinghouse machine - with AFBC) in order to combine with gas and steam turbines. This makes it possible for steam turbine throttle conditions to have a major impact on the relative advantages of IGCC (including whether the plant will burn natural gas first, then switch later to syngas) and thus maximize technological advantages and high efficiency. By estimating market entry the companies may rapidly penetrate the coal power generation market during 1996-
1998. One of the major suppliers, ABB, is highly dependent on developing a position for building up new PFBC relationships in Korea. Thereby ABB’s organization can be effected by the connections with the different actors involved, which are mostly to be found in the industrial areas for power generation in the country. The company’s PFBC technology and know-how are involved when marketing the different types of turbines, boilers and equipment incorporated in their power plant projects. Consequently, the network dynamic is continuously dependent on a number of weak and strong relationships which affect the structure of the networks. For example, there are 15 weak relationships initiated on the basis of emerging PFBC plant network. These were changed from 18 weak- and 34 strong relationships in the position integration stage.

The specific type of network relationships carried out affects the structural changes of the different parts of the networks when compared to the situation during the recent position integration stage. Thus, the development of a strategic position is crucial here, and it should be possible to combine relationships with gradual and dynamic changes. The dominant feature in ABB Korea’s relations to the various kinds of indispensable actors is its long-term investment in networks. We have seen the long-term consequences of changing from a weak position to strong one, as well as the subsequent development of an initial PFBC plant network from the strong CFBC position, which could be very significant in terms of network dynamics. It is therefore important to analyze the position in relation to network.

8.3 The Network Structure

The structure of the PFBC plant network is based on all of ABB’s weak and strong relationships, with many numbers of actors interconnected in the overall structure of industrial networks (see Lee, 1993, p.40). Various kinds of relationships exist within ABB’s total networks, which are embedded in the Korean power plant industry. For 36 years the overall structure of the networks has been made up of ABB’s interconnection of all nets of a certain type and of all actors’ relationships in these nets. The structure of these nets is temporary as it changes over time, but it is a historical structure.

The partial boiler nets, e.g. structure of PFBC plant network depicted in Figure 5, show the relations from the perspective of ABB Korea (ABB Carbon). ABB can throughout identify certain weak and strong links in the network. By identifying the different links ABB can predict several important strategic implications for the design of industrial actions in the future. For example, they can predict if the Korean government authorities (including KEPCO and KOPEC) will choose IGCC technology for the repowering programme during the period 1998-2000. ABB has presently the weak links in their own PFBC plant network. Under such circumstances ABB may attempt to integrate the network of the American actor’s relationships by acquiring one of those companies (Texaco, Shell and Destec) to be connected with its own
company's strong links in the IGCC network. New structural interconnection will probably lead to the same situation as in that of ABB C-E International case. In this case the partial nuclear reactor nets were restructured by an acquisition of C-E International. As a result of this acquisition, the network obtained a position strengthened by integrating C-E’s international units and their nuclear reactor networks. The weak links of the network will be strengthened when the overall network structure is satisfactorily developed by ABB. This involves the reinforcing of cooperation with certain types of actors or the building up of some new relationships. The creation of stability is combined with continuous small changes in the network relations of actors, but dynamical changes are required in developing a network of relationships.

The development of new industrial projects are dependent on certain industrial policies in combination with new technological applications, which requires the building of new power generating plants as regarding the requirements of network environment. The structuring role is an important function in the networks when competing with other suppliers for new plan projects or when implementing a whole process of the power plant project. Process innovation is heavily dependent on the existing close cooperation and the need for lower cost fuel and high energy efficiency. This creates strong links in relation to the network position.

9. CONCLUDING REMARKS

A major observation in this study is that technology licensing to Korean buyers is an important basis for Swedish MNC’s entry and establishment strategies. The technology licensing of ABB is characterized by a gradual development, e.g. the establishment of Gadelius’s sales subsidiary, an agent, a joint Company, and a wholly-owned sales subsidiary. ABB developed a strategic position in Korea by initiating, building and integrating relationships with various Korean actors and international units. ABB’s international experience and previous performance helped its establishment in the Korean market. ABB’s wide range of turbine specialization, boilers, electrical equipment and technology were required in the market. At that time ABB had worldwide experience, so it was well informed of establishment strategies, in particular for turbines, and BFBC and CFBC system boilers in power plant industry. As 38% of the power plants of the future will be coal-fired so that Clean Coal Technology, PFBC and IGCC system technologies are significant in the construction of coal-fired power stations in order to obtain higher efficiency and be more cost-effective. Advanced coal-based repowering at present primarily introduces either IGCC or PFBC technologies with gas turbines as the main new generating elements. The marketing activities are not only dependent on increasing the demand for electricity but also on reducing air pollution so as to adapt to the environmental requirements. Atmospheric FBC has been widely used in several smaller unit applications but PFBC has the advantage of being commercially proven technology with a range of design sizes.
and conditions available. The country-specific characteristics are important in this context, and it is primarily the country specific advantages - including psychic distance - which determine localization. ABB gradually increased its investment in Korea by establishing, reorganizing, integrating and using its knowledge of the Korean network environment and marketing. The long-term perspective is fundamental to the future global operations of its branch Company. The market commitment has provided the knowledge, which will probably make it possible to establish facilities for the final stages of manufacturing, e.g. to produce simple products and assemble equipment, to adapt special applications of different power plants and provide service in the Korean market.

Through its position development in Korea, ABB gained valuable business experience during the period of Korea’s developing economy. An important aspect is that the close relationships (e.g. close individual contacts in the human network of relationships) between supplier, buyer & end user and engineering companies after ABB’s ability to deal with diversified strategic problems in the market. ABB therefore became capable of solving problems and continued to develop relationships with the various actors through creating strong bonds in order to obtain stable orders. These bonds were interconnected with ABB’s position to make it possible to gather information and transmit this information across ABB’s international units in order to respond quickly to the industrial activities. After establishment, the industrial policy and cultural difference influence allowed ABB to build technical cooperation with the major actors. Project contracts must depend on technology licensing to the buyers and practical cooperation. Regarding this point, ABB’s Korean personnel resolved several complicated problems in cooperation concerning two previous factors. By establishing district sales office in Pusan city, a strong position and relationships in the southern industrial area were built. The integration of the nationwide position and the local nets of relationships helped ABB to create a strong position in the market after a relatively long period of development. ABB succeeded in utilizing the external resources, i.e. assets in the form of relations with various main and auxiliary actors. ABB has thus adapted flexible actions for mobilization and for coordination of internal resources.

The coordination with ABB’s international units are important for ABB’s role as one of the leading suppliers of technology, with a wide range of turbines to conform to the local requirements. This strategy of specialization is a significant factor in building new buyer relationships. ABB’s high stake in the market is indicated by its role in the development policy for the local power plant industry. This requires strong technical bonds in cooperation and technical problem solving in service networks, which builds up confidence in ABB. The establishment of ABB C-E International in the business area of nuclear power plants allowed sufficiently efficient to supply their nuclear reactor, fossil boiler and equipment to major buyer & end user. Because of the need for integrating with the Korean main actors and the developing market ABB invited some engineering companies to participate in a special training
course. The training covered subjects such as improvement of feasibility studies, project application and implementation (e.g. installation and operation of specializing turbines and boilers). The importance of this is underlined by the fact that the major competitors perform this in a highly systematic way. However, ABB’s position in the Korean networks is very strong because its technology, turbines, boilers and equipment are utilized by the major industrial actors and is the most cost efficient method both for producing high-efficiency energy and electricity, and for maintenance. In the Korean market the consideration of how efficient equipment is very important for the buyers & end users (KEPCO, KHIC and HHI) perceptions regarding the technology available. This is particularly true when the largest buyer & end user recognized that.

In order to integrate with the market, ABB’s close interaction is necessary with the major buyers, KEPCO, KHIC, HHI (including the engineering companies). Thus, important competitive elements will be continuity of contact, fairness in dealing, design, training, supervision, delivery, installation and maintenance. For instance, a license contract with HHI was extended to create another project. Such cooperation involved effective exchange activities in performing a common project in the Indonesian market. In this situation ABB continued to obtain sales projects from HHI in order to construct their own group’s power plants. The large number of relationships that ABB had built up in enabled close contacts and quick gathering of information. This ABB has thus been able to gain great advantages breaking the entry barriers, which defines its position against competition. This position gives great possibilities in marketing the PFBC system. Reviewing prospects for commercializing IGCC technology, KEPCO plans on modernizing coal-fired power plants and repowering programme. Regarding this point, the utilization of IGCC technology is included into one of the Government Seven Plans so that the IGCC systems, Texaco and Shell gasification systems, will probably have to begin running in the period 1998-2000. The American competitors especially have political support for strengthening their power-dependence relationships since the American Embassy has strong political relations with the government authorities. This has made it possible to obtain technical cooperation with the Korean main actors. Therefore, G.E and Westinghouse could continue to obtain large orders for nuclear reactors and other type of power plant projects. This is a significant positive factor for developing a strong position in the market.

There are three factors significant for ABB’s ability to maintain its a strong position in the electric power generation equipment networks. Firstly, ABB should guard its major advantages, i.e. securing stable demand through specialization turbines, as well as cooperation with KEPCO, KHIC, HHI and the other main actors, who have already integrated with the market. The rapidly increasing demand for electricity in connection with the development of the economic situation and the long-term modernization plan for the power plant industry has favourably influenced ABB’s relations with the competitors already established in Korea. The
potential Korean (e.g. companies have foreign license technologies) and other foreign companies, however, might encounter resistance, in the form of closed protectionism (e.g. a monopolistic supplier, KHIC’s main relation chains). This type of situation characterizes the electric power generation equipment networks, which although they have a rigid structure are loose in special respects. Secondly, the introduction of one of ABB’s successful international projects, e.g. the first firing of the PFBC boiler at EPDC Wakamatsu in Japan, is significant for future marketing promotion in Korea. Japanese utilities are the most demanding customers in the world. It takes skill and determination to satisfy them. Due to close cooperation between ABB in Sweden and Japan, the dedicated PFBC team in Kobe was put to the test at the Wakamatsu plant and they solved all the current problems. The plant has captured the attention of Japan’s power industry and its success will determine the future of PFBC plants in Japan. This makes it possible to bring them one step closer to their goal of becoming a recognized supplier to Japanese power utilities. Thirdly, ABB must be able to understand the country’s political system and be sensitive to cultural differences when considering the technical complexity involved. Some relationships of ABB will have developed by the orientation of the strong connections, e.g. toward politicians, industrialist, journalists and bankers, etc. Thus, the relationships will provide bridges to other networks, “the infrastructural relationships can be crucial for securing long-term survival for companies otherwise mostly involved in tightly knit day-to-day business relationships” (Hallen, 1992). Furthermore, in order to do important business, ABB must perform business lobbying. For example, there are important individual connections as well as connection between exchange activities. The related activities of the lobbyist influence the people’s opinion, the gathering of information and current problem solving which is the object of the lobbyist’s efforts.

In the perspective of cultural differences ABB should consider the recruitment of qualified personnel who have been educated at both Korean and Swedish universities. The analysis of the characteristics of the Korean network environment can be carried out by combining two basic perspectives. Because of their Korean background and education the personnel could have a useful perspective for understanding and explaining the business behavioural pattern of the buyers’ and the competitors’ viewpoints. At the same time the personnel can consciously take the perspective of the Swedish firm. Thus, they can advice ABB Korea’s chief executives on the best corporate strategy for adapting the industrial applications and adjusting to the market requirements. They will be able to better understand ABB’s position, strategies and influence on the local networks. If the approach is developed by ABB Korea, it will have important strategic implications for the management of the firm’s position in the networks of electric power generation equipment.

The structure of the networks in the Korean market can be characterized as tightly structured turbine networks and loosely structured PFBC or IGCC system networks. The power industry networks have shown a high degree of contact intensity and versatility, and
ABB STAL, ABB Carbon and ABB Korea have pursued different lines of action in the establishment and acquisition of networks. In particular, the Korean government and KEPCO will perform repowering programme with IGCC system technology, ABB will have to attempt to acquire an American firm which has IGCC technology and business experience in order to build up a new subnetwork. Otherwise, the structure and strength of the network position will be dynamically changed in the future. There is also a high degree of stability, which allows technical co-operation involving both the individual and the organizational levels. The significant issue is the individual features which are required for developing a long-term stable relationship in the industrial networks.
APPENDIX 1

Information on the Empirical Study

The ABB CARBON Case

The Main Interview at ABB Carbon AB, ABB KOREA

<table>
<thead>
<tr>
<th>Company</th>
<th>Position</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB CARBON AB</td>
<td>Christer Tannander, Marketing Manager, Sales and Development</td>
<td>1992 07 08</td>
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<tr>
<td></td>
<td></td>
<td>1993 10 18</td>
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<tr>
<td>ABB KOREA</td>
<td>Kim Choong Myong, Vice President, Power Plant Division</td>
<td>1993 10 18</td>
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<td></td>
<td>Hakan Borin, Director, The Power Plant Division</td>
<td>1992 05 01</td>
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<td></td>
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<td>1993 11 08</td>
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<tr>
<td></td>
<td>Lee Bong Joo, Marketing Manager, Industrial Project &amp; Power Plants</td>
<td>1992 05 08 09</td>
</tr>
<tr>
<td></td>
<td>Han Yun Sok, Director, Planning &amp; Marketing Development</td>
<td>1992 05 13</td>
</tr>
<tr>
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<td></td>
<td>1993 10 27</td>
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<td></td>
<td>Oho Sai Young, Director, After Service</td>
<td>1992 05 13</td>
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<tr>
<td>KEPCO (Korea Electric Power Corporation)</td>
<td>Lee Soon Byoung, Deputy General Manager, Power Planning Dept</td>
<td>1993 10 28</td>
</tr>
<tr>
<td></td>
<td>Cho Chang Joo, Assistant Manager, Power Planning Dept. Planning &amp; Administration Division</td>
<td>1993 10 28</td>
</tr>
<tr>
<td></td>
<td>Chun Kwang Jong, General Manager, Construction Division</td>
<td>1993 11 02</td>
</tr>
<tr>
<td>KOPEC (Korea Power Engineering Company INC.)</td>
<td>Kim Nam Soo, Senior Mechanical Engineer, Mechanical Engineering Dept. Fossil Project Division</td>
<td>1993 11 09</td>
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<td>HHI (Hyundai Heavy Industries)</td>
<td>Chung Young Sup, Director, Turbine Engineering Dept. Engine &amp; Machinery Division</td>
<td>1992 05 19</td>
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<tr>
<td></td>
<td>Kim In So0, Senior Manager, Project Development Dept. Engine &amp; Machinery Division</td>
<td>1993 11 05</td>
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<td></td>
<td>Kim Yong Hee, Senior Manager, Engineering Dept. Boiler &amp; Power Plant, Industrial Plant Division</td>
<td>1993 11 06</td>
</tr>
<tr>
<td></td>
<td>Gwak Ho Young, Manager, Engine &amp; Machinery Division</td>
<td>1992 05 19</td>
</tr>
<tr>
<td></td>
<td>Kim Kyung Rul, Assistant Manager, Turbine Engineering Dept.</td>
<td>1992 05 19</td>
</tr>
<tr>
<td>KHIC (Korea Heavy Industries &amp; Constnction)</td>
<td>Lee Hyun Koo, Managing Director, Chief of Changwon Factory</td>
<td>1993 11 12</td>
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<tr>
<td>Daewoo (Shipbuilding &amp; Heavy Industries)</td>
<td>Ki Won Kwang, General Manager, Marketing Division</td>
<td>1993 11 10</td>
</tr>
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<td></td>
<td>Han Byung Hwan, Team Manager, Machinery Outfitting Design Team</td>
<td>1993 11 10</td>
</tr>
<tr>
<td>Ssangyong (Heavy Industries &amp; Engineering)</td>
<td>Chun Myung-Soo, Manager, Gas Turbine Business Team</td>
<td>1993 11 13</td>
</tr>
</tbody>
</table>
APPENDIX II

The Comparison of CFBC Boiler Systems Between Main Manufacturers

Explanation: Combustion Chamber
Cyclone
External Heat Exchanger

Note: The Figure is based on the comparison of Main CFBC Boilers which was analyzed by KEPCO.
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ABB Group, 1992. Facts & Figure, Zurich: Corporate Communications, ABB Asea BrownBoveri Ltd.


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