THE ROAD TO THE SELF-RELIANCE
NEW PRODUCT DEVELOPMENT OF HYUNDAI MOTOR COMPANY

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ABSTRACT

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This paper traces the new product development of **Hyundai Motor Company, Korea,** which, since its foundation in 1967, has maintained the self reliance strategy, particularly in new product development. Business strategy of Hyundai contrasts sharply with other auto makers in developing countries as well as to other Korean makers. In spite of a late entrance to the auto business, this unique strategy has led Hyundai to becoming a market leader in Korea and to becoming the thirteenth producer in the world--recording an output of over one million in 1994. Hyundai Motor has a aggressive plan with a goal to be within the 10 top auto makers by 2000 (Global Top-10 plan) but the process of accumulating the technological resources the company needs is not yet well established.

The intent of this paper is to provide readers with a basic understanding of Hyundai's approach in new product development under internationally oligopolistic markets and how it has accumulated technological resource capability in relation with foreign alliances. The research method consists of literature reviews of published sources on firm's activities--including company history and interviews with development and management personnel. The work will first overview the history and development of Hyundai, then will produce case studies on Sonata (1988), New Grandeur (1992), Accent (1994) and the Alpha engine (1991).

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I. INTRODUCTION

The first international motor show was held by Korean Automobile Manufacturers Association (KAMA) from 4-10 May 1995 in Seoul, Korea. This symbolic event exhibited new models, concept cars, and electric cars developed during the 30 year history of the Korean Auto Industry.

The Korean economy has progressed very rapidly in the last three decades moving from an agricultural base to an industrial base achieving the status of having the twelfth largest GNP by 1994. The Korean economy has been led by a large group of business leaders (called "chaebol" in Korea) consisting of companies like Hyundai, Samsung, Daewoo, Lucky Goldstar (L-G) and Ssangyong--most of which have gone on to extensively diversify their companies. For example, Hyundai and Samsung are currently operating ventures in electronics, semi-conductor, construction, trading, machinery, automobile, shipbuilding, finance and insurance, newspapers--to name a few--over fifty independent firms. The auto industry also has progressed very rapidly during the last two or three decades and Korea has become the sixth largest auto-making country reaching a production level of 2.3 million vehicles in 1994. Among the many developing countries only Korea has exported an indigenous model of automobile since World War II.

Hyundai was founded in December, 1967 making in a late entrant as compared to Daewoo Motors, commercial vehicle maker, Kia, and Asia Motor producing the Fiat model at that time.

Table 1. Selected Information of Korean Auto Makers

	Hyundai Motor	Daewoo Motor	Kia Motor	Aaia Motor	Ssangyong Motor
Foundation	1967	1955	1944 (as bicycle maker)	1965	1954
Main Product	Accent Sonata Elantra Avante,Grandeur Marcia C.V	LeMans Espero Prince Cielo C.V	Aspire Concord Sephia Sportage C.V	Festiva C.V	Musso Korando C.V
Production (1994) 1,000	1,134	340	620	51	46
Export (1994) 1,000	393	100	210	18	8
Foreign Invol.	Mitsubishi from 1982 (15 %)	G. M from 1972 (50%) but ended in 1992	Ford (10%), Mazda(8%) Itozu (2%) from 1986	Kia's subsidiary firm	Benz 5 %

Remark: C.V : Commercial Vehicle ; truck and bus
Data: KAMA (Korea Automobile Manufacturers Association)

Hyundai Motor became the thirteenth ranked auto maker--1.1 million in production and 400,000 cars exported to over 170 countries. Hyundai added two new products in 1995 and currently offers a full line of automobiles--including seven indigenous models--ranging from sub-compact to large automobiles;

Accent 1,300-1,500 cc

Avante 1,500-1,800 cc

Sonata II 2,000 cc

New Grandeur 2,000-3,500 cc

Elantra 1,500-1800 cc

Stellar 1,800-2000 cc (for taxi only),

Marcia 2,500 cc

Production share of Hyundai rose to nearly 65% in 1985 but it maintains about 50% levels in the 90s. Total sales in 1994 were nearly 10 billion (U.S.$) with 200 million (U.S.$) profit realized after taxes. Hyundai plans to be counted within the global top 10 (GT-10 Plan) auto makers producing over

2 million automobiles yearly (including overseas production) by the turn of the century.

Table 2. Automobile Production and Export of Hyundai

	PRODUCTION			EXPORT		
year	Hyundai (A)	Industry (B)	% (A/B)	Hyundai (A)	Industry (B)	% (A/B)
1965	-	141		-	-	
1970	4,360	282,819	15.1	-	-	
1975	7,092	37,179	19.1	-	-	
1980	61,239	123,135	49.7	16,244	25,252	64.3
1985	240,755	378,162	63.7	120,041	123,107	97.6
1990	676,067	1,321,630	51.2	225,393	346,491	65.1
1993	960,057	2,048,905	46.8	349,579	638,480	54.8
1994	1,134,611	2,305,772	49.2	392,959	737,807	53.3

Source: KAICA. (Korea Auto Industries Cooperative Association)
KAMA (Korea Automobile Manufacturers Association)

Note: Hyundai was founded in Dec. 1967.

The case of Hyundai is a good example of how, in the automobile industry, an independent organization can successfully develop its product using locally trained professionals and technology. The first indigenous car was produced in the mid 1970s and the power train (engine and transmission) in the early 1990s.

2. HYUNDAI'S PHILOSOPHY IN NEW PRODUCT DEVELOPMENT (NPD)

The Road to the Technological Self-reliance

Hyundai is a NPD leader. While Kia Motors continued to produce a Mazda-designed model until 1992--the Sephia--and Daewoo produced G.M. model cars until 1991--the Espero--Hyundai began to produce a unique car in 1975. While Kia Motors as only produced 3 indigenous models and Daewoo only 1, Hyundai has led the way with 7 new products.

Let's overview the government policy as it is one of the most important macro business environments, particularly in the early stages of country development. In 1974, the Korean government laws for promotion of local automobile industries encouraging the production of indigenous models. This led to Hyundai production the "Pony" in 1975. By the end of the 1980s, the government assisted again by enactment of high tariffs to protect domestic automobile markets from advanced makers.

In addition to government assistance, Hyundai's aggressive approach to self-reliance has also had a major influence on the rapid development of the Korean auto industry during the past two decades. Hyundai leadership realized from the start if an auto-maker in a developing country wished to become an independent producer, it would have to grow while in direct competition with established auto makers in advanced countries.

The first strategic decision was related with Ford in the beginning. When Toyota pulled out of Korea to enter mainland China it left G.M. to a 50:50 joint venture with Daewoo in 1972. Hyundai, at that time in the infant stages, was pushed desperately as it had to compete with the combination of G.M./Daewoo. Three years of negotiation with Ford in trying to establish a similar partnership failed--mainly because of Hyundai's insistence on being

the managerial leader in the joint venture. Hyundai tried to form alliances with other advanced global auto manufacturers including Volkswagen of Germany. Each time, by being insistent on keeping managerial control local, these negotiations failed because it is against the policy of foreign auto makers under "world car" strategy. One successful agreement was with Mitsubishi in 1982 to facilitate technology import--by allowing Mitsubishi 15% equity involvement with Hyundai maintaining managerial control--even though in direct competition with Mitsubishi in foreign markets.

Therefore, Hyundai leadership has largely decided to "go it alone" acquiring the necessary technology through licensing agreements. The "Pony" was a high risk indigenous model that Hyundai finally succeeded in producing in 1975. Over the next ten years, the "Pony" would prove to be a smashing success catapulting Hyundai to market leader in the 1970s and was followed by other model developments in the 1980s and 1990s.

The second strategic decision came when the military government pushed to merge Saehan Motors (formerly Daewoo), owned 50% by GM, with Hyundai in 1980. Instead of merging, Hyundai insisted on pursuing free access to any market with indigenous models and products. This negotiation failed and Hyundai was forced to build a new plant to produce the newly developed and extremely popular front-wheel drive car. By persistently following their vision of independence, Hyundai once again proved its abilities by successfully entering the U.S. market in 1986 with the "Excel."

A third and most important factor contributing to Hyundai success has been the development of an indigenous power train. Auto industry specialists knew, and as former research director of IMVP MIT once commented in the late 1980s, that "to get the design technology in power train, engine and transmission, will be one of the last hurdles for Korean auto makers in

becoming an independent producer in the global automobile industry." In 1991, after five years of hard work, Korean automobile manufacturers successfully designed this critical component of the Korean-made automobile. No longer must Hyundai import a foreign-designed engine and transmission for their indigenous automobiles. This development has increased Hyundai and Korean auto manufacturers' power in maneuvering effectively product/marketing strategy.

A fourth strategic initiative is long range planning. Hyundai will increase production to 2.1 million vehicles per year and design and manufacturer a new indigenous model every year to compete in the domestic and foreign marketplace. To accomplish this goal, Hyundai has recently built a large research facility and international size proving ground on the west coast of Korea at Namyang. A commercial vehicle plant passenger car plant at Jeonju (100,000 annual capacity) and a second passenger car plant at Asan (300,000 annual capacity) are now under construction far from the large Ulsan plant. Another large plant will be finished in the south-west by 2000 at Yulchon (500,000 annual capacity). Together, the annual production capacity will increase to 2.1 million vehicles annually realizing nearly one million net gain the current 1.3 million.

In 1993, Hyundai stopped production at the Bromont plant in Canada but is actively globalizing production in Asia, Africa and other countries.

<Table 3> Hyundai Capacity Expansion Plans

location	plant	products	capacity by 2000	net gain	remark
South-east	Ulsan	passenger car,	1,260,000	0	current
West	Asan	passenger car	300,000	300,000	by 1996
West	Jeonju	C.V	100,000	100,000	by 1995
South-west	Yulchon	passenger car	500,000	500,000	by 2000
Total			2,160,000	900,000	

Data : Maeil Economic Daily, 5 August. 1994

3. KEY ROLE PERSONS IN NPD

Ju-yung Chung, 80, is founder and currently honor chairman of Hyundai Business group. He was born of a poor family in 1915 completed elementary school started a vehicle maintenance business in 1940 and established Hyundai construction company in 1950 just before the Korean war. After the war he successfully diversified the company business lines to over 50 firms related to the construction business. He preferred to establish new firms rather than merge or acquire existing companies, therefore, nearly all of firms related to Hyundai were created by him. Recalling his experiences with vehicle maintenance in the early days, he founded the Hyundai Motor Company with his younger brother Se-yung Chung in 1967. He elected to meet global competition head-on as he did in construction and ship-building businesses. His leadership has taken Hyundai into the U.S. personal computer market with its own brand name--unlike other Korean PC makers under the OEM brand.

In 1980 the Korean military forced Hyndai to select either the auto or power plant business--he chose the auto business saying that it was the business he started. An entrepreneur in the real sense, he has created the Hyundai business group from nothing and is a top businessman in Korea. His recognized leadership ability led to a presidential candidacy of Korea in 1991 but he was defeated. Immediately before the presidential election, he retired to be an honor chairman of the Hyundai group with the management of Hyundai Motor Company being passed to his younger brother Se-yung Chung.

Se-Yung Chung, 67, has been president of Hyundai Motor company from its foundation and has been chairman of Hyundai business group since 1990. He graduated from Korea University majoring in political science and has a master degree in political science from Miami University in Ohio, U.S.A. He has prior work experience at Hyundai Construction Co. and made major decisions of Hyundai Motor company, particularly in new product design, from the very beginning. He made the crucial decision to develop an indigenous model in 1974 and the result was the enormously successful "Pony." He remembers the moment saying "Not wanting to sacrifice our independence, and struggling to maintain our self-posture, we made the decision to build our own indigenous automobile, literally from the ground up, only five years after Hyundai was founded."

This posture of self-reliance has led him to enter U.S. markets through an exclusive independent marketing channel in 1986 and he has become one of six industrial heros selected by the New York Times in 1987 from sales of 260,000 "Excel" automobiles in the U.S. He made the decision to build a plant in Canada to produce the "Sonata" in 1989--the first offshore facility of a Korean auto maker. He has always been heavily involved in NPD as owner and professional manager of the auto industry.

Sung-won Chon, 62, is president of Hyundai Motor company. He graduated from the Military Academy of the Naval Forces in 1954 and earned his master degree in Industrial Administration, graduate school of Korea University in 1969. He has served for 15 years as an officer in Korean Naval Forces from 1954-1969. In 1969, at the foundation, he joined Hyundai Motor company planning department. He was promoted to director in 1976, managing director in 1978, vice-president in 1985 and president in 1990. He has spent

nearly all of his time at Hyundai corporate planning office (division) and contributed to corporate long range planning, government relations, technology licensing, and new product development. He has played a major role in NPD as well as professional manager.

Chung-goo Lee, 50, vice-president on charge of research and development, graduated from Seoul National University majoring in Automotive Engineering and joined Hyundai in 1969. He participated in product design from the very first with the "Pony" project and has also studied engineering design and product development in ITAL-DESIGN, Torino, Italy from 1973-1974.

He has participated in nearly all product design development since then and was project manager (PM) of "New Excel" in 1989. He was promoted to director of the Passenger Car Development Institute and to the head of Technical Development Center in charge of Passenger Car Development Institute and Central Res. Institute (former Maebuk Res. Institute) in 1987 then to vice-president of above Center. Currently, he is a top manager in R&D and as vice-president manages research and development division of Hyundai, five research institutes and three overseas research branches in the U.S.A., Japan, and Germany.

4. NPD STRATEGY

Hyundai started the auto business to assemble Ford models with technical assistance from Ford in the late 1960s. Then Hyundai added Mitsubishi Motor of Japan as another source of technology particularly on small-size cars as Japan was more competitive in this area during the 1970s.

<Table 4> New product Development of Hyundai Motor

---- indigenous model
==== foreign model

	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95
Sub-compact															
Pony					76	----------						89			
Excel										85	-----89				
new excel												89	----------94		
Scoupe												90	----------95		
Accent														94	--
Compact.															
cortina (F)	68	======71													
new cortina (F)		71	=========76												
Mark IV (F)					77	=======80									
Mark V (F)							80	====83							
Stellar									83	----------					
Elantra												90	----------		
Avante														95-	
Medium															
Sonata												88	-----92		
Sonata II														93	----
Marcia														95-	
Large															
Ford 20M (F)	69	========73													
Granada (F)					78	==========85									
Grandeur (M)										86	==========91				
New Grandeur													92	-----	
Engine															
foreign models(M)					75	==========	==========	==========	==========	==========					
Alpha engine (1,500cc)													91	-------	
Beta engine (1,800-2,00cc)														95-	

F : Ford model M : Mitsubishi model

Table 4 shows the new product development of Hyundai since its foundation to the present. After development of its first indigenous model with assistance of Mitsubishi in 1975, Hyundai continued to develop technical capability in new product development areas of styling, body design, chassis layout, and then power train. The following Table shows how Hyundai has gradually replaced the foreign model with an indigenous one.

<Table 5> Characteristics NPD of Hyundai

model	Pony	Ste	Excel	Sonata	N-Exc	Scoupe	Elan	N-Gran	So-II	Acc	Mr Avante
yr.	75	83	85	88	89	90	90	92	93	94	95	95
styling	1	1	1	3	3	3	3	3	3	3	3	3
Body design	1	3	3	3	3	3	3	3	3	3	3	3
Power train	1	1	1	1	1	3	1	1	1	3	2	3
Chass.layout	1	2	2	2	2	2	2	1	2	3	3	3
Total	4	7	7	9	9	11	9	8	9	12	11	12

Remarks:
yr : year of commercial production
1 : completely import or licensing
2 : improve based on imported technology
3 : indigenous development

Data : based on Gyun Kim (1994) and revised based on additional interview

Accent and Avante are the new models with the indigenous platforms in the small car or subcompact segment. The platform of these two products is different from previous model with deviate of Mitsubishi's platform. The engine and transmission position of this Hyundai platform is East-West (engine: east transmission : west) type but Mitsubishi's model is as contrasting West-East type. Hyundai needs at least two or three additional platforms in medium and large car segment by 2000 to maneuver the product strategy more competitively.

<Table 6> Platform of Hyundai

Platform	small		medium		large
engine (cc)	1,500	1,600-1,800	1,800- 2,500		3,000 - 3,500
	Excel new Excel Scoupe	Elantra*	Sonata Sonata-II* Marcia*	Stellar*	Grandeur New Grandeur*
new base platform	Accent*	Avante*	?		?

* currently under production on May 1995

Stellar is rear wheel drive model

4. NPD OPERATIONS AND OUTPUTS

1) Inputs : R&D Investment and Manpower

Hyundai established the R&D institute in 1974 and since then has increased the R&D efforts in investment and manpower continuously, but the total amount of Korean auto industry is relatively small in contrast to U.S. Japan, and European makers. For example, R&D investment of G.M was 59.2 (100 million $ in 1992 and Hyundai 3.9 (100 million $) in 1993. But Hyundai has a aggressive plan to expand R&D investment to 6-7% of sales to accelerate technology development in the late 1990s. The R&D investment is projected to reach to 625 million U.S $ (500 billion won) in 1995 and 1.5 billion U.S $ (1,200 billion won) in 2000. The number of R&D is 3,800 persons nearly 10% of total employees in 1994 and the number will increase to 5,000 in 2000.

<Table 7> Number of R&D persons in Hyundai

	1975	1980	1985	1990	1993	1995 planned	2000 planned
# of R&D person	197	422	1,422	3,418	3,800	4,200	5,000

2) NPD Organization

In 1979 Hyundai established a new product development institute under the vice president in charge of manufacturing with only 4 departments on passenger car and commercial vehicle development and administration. The engine research department and design department was added in 1981 and in 1982

in succession. But the research function expanded rapidly to develop the front wheel drive car Excel appearing in 1985.

In 1990 the major functions of new car development were integrated into both the passenger car institute and central research institute and they began to report to general manager in charge of R&D but the C.V. institute continued to report to VP on manufacturing (head of Ulsan plant) as previously. In 1991, four major research institutes were operating--passenger car development, commercial vehicle development, central research institute and HATCI (Hyundai America Technical Center in Ann Arbor, U.S.A.) and they began to report a general manager on R&D decision under head of Ulsan plant (VP on manufacturing). HATCI was founded in 1986 to collect updated information on advanced technology, particularly on emission regulations, in the U.S A. The overseas research branches extended to Chino California (1987) and a styling studio in Los Angeles (1990). The styling studio in L.A has finished the styling works for concept car and sporty car, HCD-I, HCD-II and HCD-III appearing in Seoul international motor show.

<Table 8> R&D Institute of Hyundai (1991)

	passenger car Dev.Inst	C.V Dev.Inst	Central Res. Inst.	HATCI in U.S.A	Total
job	passenger car	C.V	power train new tech, CTM		
location	Ulsan	Ulsan	Maebuk	Detroit U.S.A	
# of person	1,658	549	902	20	3,192

Data : Company History of Hyundai Motor, 1992, PP. 845

In 1995, Hyundai streamlined the R&D organization to established R&D division in line with manufacturing division as there appear another plants and research institute in west coast area. Hyundai is no longer one site operation company as the commercial vehicle plant in Jeonju already started

production in April 1995 and another passenger car plant in Asan will appear in 1996.

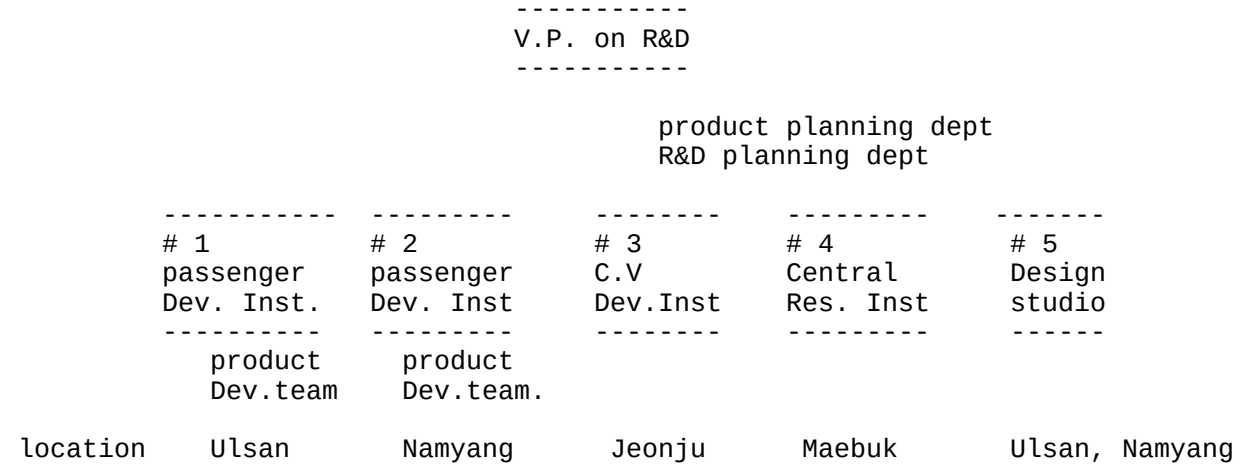
In April 1995, Hyundai finished building a new research center in Namyang, on west coast of the Korean peninsula--a ten year, 620 million $ investment. This research wing is very near to Hyundai's second passenger car plant in Asan currently under construction. Asan passenger car plant and Namyang research institute will be another production and research center of Hyundai Motor. The 60km long proving ground and research facilities for emission and safety standards of advanced markets, for example, testing for ABS and free-ways built for NPD.

This #2 passenger car development institute will concentrate on design, styling and development of passenger car in cooperations with the existing #1 passenger car development institute in Ulsan and central research institute and Design studio, which is recently separated as independent institute from passenger car development institute (Korea Economic Daily, 27 April 1995). Hyundai has also extended overseas branches of research center in Japan and Germany.

This dispersion of manufacturing and research site led Hyundai to integration of R&D divisions to strengthen the management leadership in NDP. The vice president on R&D is currently in charge of managing all research and development activities on passenger car, commercial vehicle, power train and design institute. This new organization is expected to empower the R&D coordinating functions, particularly on NPD, to establish product planning department (30 persons) and R&D planning department (25 persons) with the staff reporting directly to the VP on R&D. Hyundai also extended one existing product development team to two as staff reporting to the director in charge of #1 and #2 passenger car development institute. The

manager of this team as a chief engineer is exclusively in charge of project management.

<Table 9> R&D organization (1995)



3) Project Management

The project management organization in the 1980s of Hyundai was mixed of functional and project organization. But the increased number of new product development projects led Hyundai to be more project oriented and as a consequence, in 1990 Hyundai adjusted the NPD organization in order to empower the authority of PM, particularly on cost control, as it became one of the most important competitive edges in new product development. Hyundai also assigned the project development team in passenger car development institute to work exclusively on project management.

Under this system the project management process in the early 1990s can be summarized as following. At the concept development process, product planning team of corporate planning office (division) in headquarter undertakes coordinating function of the product concept from multiple sources as top management, marketing and manufacturing divisions through new product

planning committee by regular meetings. Then the product concept is transferred to the product planning department of R&D division.

During the product engineering process, the chief engineer as a head of product development team usually coordinates product engineering functions in body styling, chassis, trim, and electric parts. The PM with assistant to him is in charge of overall coordinating functions on budget, cost and schedule control as dual not exclusive job on NPD and he is usually selected seven months before freezing the clay model. He usually begins a project management job after finishing the product engineering phase. PM, assistant to PM, liaison engineer of each function are all part time workers on project except chief engineer but the power of chief engineer as head of product development team is usually relatively weak but he is in charge of project management--particularly in the product engineering process. As a consequence, the project management leadership in Hyundai is dispersed and is not so strong in comparison with Japanese auto makers, in which PM has strong authority and responsibility on the overall NPD process.

In 1995 Hyundai again tried to empower the leadership in NPD to stream the R&D division as aforementioned. The #1, #2 passenger car development institutes are in charge of passenger car as well as 1 ton-level small bus development. But C.V development institute is in charge of the large commercial vehicle development separately. Hyundai also extended one existing project development team to two in #1 and #2 passenger car development institute respectively. Each chief engineer as the head of this team development team with 30-40 persons usually undertakes 3-4 projects including minor changes projects but one distinctive new product. 6 projects are under the management of these two chief engineers as of April

1995. As a consequence, the chief engineer has more projects to manage in addition to one distinctive new product development project.

There are about 2,500 people in #1, #2 passenger car development institute and design studio for these projects. In addition, Hyundai has a central research institute located at Maebuk-ri, 30 KM south to Seoul. This has about 1200 additional people on power train and advanced research. Commercial vehicle development institute has additional 700 people separately. Other Korean auto makers recently reformed the NPD organization to empower the project leadership for example, one maker transformed the functional organization to project oriented matrix organization in 1994 and another maker introduced leading PM. system in 1995 to strengthen the leadership in NPD.

<Table 10> NPD Organization (1995)

		product engineering Div. (Passenger car dev. inst.)				process eng. Div.	material supply Div.
		product dev. team	body	chas.	Trim elec.		part dev.
		FM	FM	FM	FM	FM	FM
Project I							
PM	chief engineer*	L	L	L	L	L	L
A	(team 1)						
project II							
PM	chief engineer	L	L	L	L	L	L
A	(team 2)						
project III							
PM	chief engineer*	L	L	L	L	L	L
A	(team 1)						

PM : project manager (part time)
FM : functional manger
Chief engineer : on a specific NPD project (full time)
A : assistant to PM (part time)

L : liaison engineer working level (part time)
Project I, II : project of distinctive new product
Project III IV, , , : project for major or minor change

The NPD organization of Hyundai in the early 1990s designed to meet a demanding commercial production time schedule. Occasionally, the project manager will come from the senior level (for example, managing director of manufacturing/process engineering functions). The major objective of this system is to work fast enough to meet the target commercial production time. As a consequence, Hyundai, due to time compression, must, at the expense of quality design and design for manufacturability to meet the demand explosion in domestic market. Prof. Fujimoto at Tokyo university once commented

during the Korean plant visit on July 1994 that the Japanese faced a similar situation in the late 1960s and early 1970s; auto makers were eager to increase the number of new products by compressing the product development time to 2 years in order to meet the demand explosion in domestic markets..

Most Korean auto makers are in the beginning stage of develop new platform and the success or failure of a new product fundamentally impacts overall corporate performance. As a consequence CEO and top management always pay a great attention to NPD process. They sometimes interfere in NDP process regardless authority of formal project manager. For example, a CEO ordered a revision of the finished styling design at the later stage and leading to a three month delay of commercial production. This may be one of the reasons that the power of PM is relatively weak formally or informally in Korea.

4) Corporate Culture

The corporate culture of Hyundai business group influenced the managers of Hyundai Motor to have relatively superior ability in project management. Hyundai business group is based on construction company policy and the most important job in construction business is project management--meeting the project completion time. Several senior managers including CEO of Hyundai Motor company have prior experiences in Hyundai Construction company. The corporate culture of Hyundai demands superior capability in time scheduling and flexibility to adapt to unexpected events. The time compression is well known as one of the most important competitive weapons of Korean business--particularly in the construction business in Middle East countries during the 1970s. Korean growth in economy is sometimes termed "time compressed growth."

A manager of Hyundai Motor, in charge of new product development for 15

years with experience of assistant to PM of New Grandeur and at HATCI, and I agreed, during an interview, that the corporate culture based on construction business seems to be diffused to NPD process of Hyundai Motor. But he is optimistic to the future of Hyundai Motor in NPD as it has shown to be highly flexible in adapting to new environments so far.

5) NPD Outputs

The number of new product with different wheel base introduced was only one in the 1970s but increased to three in 1980s and then to five in 1995 as shown in the following table. Hyundai NPD was under a heavy load as it developed Accent in 1994, Avante and Marcia in 1995--three new products in two years. This proves the capability of Hyundai NPD to develop multiple projects simultaneously, and Hyundai's models have met with success following production quantity in the markets per model in 1994 ; Elantra (262,157), Sonata (235,344), Accent (187,021) and Excel (126,298).

<Table 11> New Product Introduction by Hyundai

	1970s	1980s	1990s
new product	Pony	Stellar Excel Sonata	Elantra, New Grandeur Sonata-II, Accent Avante, (Marcia)

Remarks: Marcia has same wheel base as the Sonata-II.

I tried to extended Nobeoka's definition to check change point from 3 point (0,1,2) grading to 4 point (0,1,2,3) grading system and add the changes in the body suitable to Korean situation as most of new product are closely related with foreign models in the initial stage. The following Table shows the changes and product development type based on the published data and additional in-depth interview.

<Table 12> New Product Development Type

Model Name	year	Base	Change Point				Strategy. Type
			fl.	panel	susp.	Body	total	
Sub-compact								
Pony	76	Lancer (M)	2	2	2	6	1
Pony-II	82	Pony	1	0	1	2	4
Excel	85	new	2	2	2	6	1
new Excel	89	Excel	0	0	1	1	3
Scoupe	90	New Excel	0	0	2	2	2
Accent	94	new	3	3	3	9	1
Compact.								
cortina	68	Foreign	0	0	0	0	0
new cortina	71	Foreign	0	0	0	0	0
Mark IV	77	Foreign	0	0	0	0	0
Mark V	80	Foreign	0	0	0	0	0
Stellar	83	Mark V	0	2	2	4	1
Elantra	90	new	2	2	2	6	1
Avante	95	new	3	3	3	9	1
Medium								
Sonata	88	Grandeur(M)	2	2	2	6	1
Sonata-II	93	new	3	1	3	7	1
Marcia	95	Sonata-II	1	1	1	3	2
Large								
Ford 20M	69	Foreign	0	0	0	0	0
Granada	78	Foreign	0	0	0	0	0
Grandeur	86	Foreign	0	0	0	0	0
New Grabdeur	92	new	3	1	3	7	1

Remarks : M ; Mitsubishi

change point

floor panel

0 same. both wheel and track are unchanged
1 partially new. either wheel base or track are new
2 new--Both wheelbase and track are new
3 totally new, indigenous platform different from previous foreign one

Suspension system and Body

0 same as previous model
1 partially new
2 new
3 totally different from the previous foreign model

Type of inter-project strategy

0 : simple assembly of foreign model
1 : new design
2 : rapid design transfer
3 : sequential design
4 : design modification

We can find only 2 examples of rapid design transfer case (Scoupe and Marcia) among 20 new product development for 1967-1995 as Hyundai has just begun to develop its own base platform. Most of new product were developed by simple assembly of foreign model in 1960 and 1970s but by new design in 1980s and 1990s. Nobeoka found that the rapid design transfer is the most efficient way of new product development.

<Table 13> Type of inter-project strategy

inter-project strategy	number of project	%
simple assembly of foreign model	7	35
new design	9	45
rapid design transfer	2	10
sequential design	1	5
design modification	1	5
Total	20	100

An in-depth interview with the expert in new product development of Hyundai confirmed this fact that the rapid design transfer (for example, Scoupe 1990 after New Excel and Marcia 1995 after Sonata-II 1993) saved about a third the time in engineering man-hours. Hyundai is now under development of Avante wagon ('Nextone') by rapid design transfer and it is expected to reduce to about 30% total engineering man-hours. This fact might confirm the research findings of Nobeoka and it also implies that Korean auto maker will be able to reduce the development lead time by rapid design transfer. But the number of basic platform of Hyundai is 4 while G.M 13, Ford 12. This implies that Korean auto makers need to wait to take advantage of carry over effect of common part and rapid design transfer strategy in new product development until they extend the number of indigenous platform.

6) NPD Performance: International Bench Marking

New product development performance in auto industry: 1990s updated study (Ellison, Clark, Fujimoto and Young-suk Hyun) included three Korean new products developed in the early 1990s. one product for Hyundai, Kia and Daewoo motor respectively but this research did not include the new products appearing in the following case study. Let us overview of the results for international bench-marking. The lead time of 54.5 months and 2.1 million of engineering man-hours of Korean auto makers is very similar to Japan and U.S.A but the new product quality is below of theirs. Korean auto makers seems to achieve the development efficiency at the expense of quality of new product. Ellison et. al (1995) explained it that Korean makers lack a large base of engineering talent and as it is only beginning to develop in-house capabilities in new product development. The degree of innovation of Korean

new products measured by new components ratio is highest, common part ratio is lowest and the scope of engineering works done by maker is the highest as the low technological capability of parts supplier. This implies that it is the difficult hurdle for Korean auto maker to compete with established advance makers. This Table also shows that the power for project manager in Korean auto makers is relatively weak as for the project management structure as similar to Hyundai organization.

<Table 14> New product development performance in auto industry: the 1990s update (adjustment)

	Japan	U.S	Europe	Korea	Average
engineering MH (1,000 hour)	2,093	2,297	2,777	2,127	2,438
lead time (months)	54.4	51.6	56.1	54.5	54.7
overall quality	62	42	59	21	52
degree of innovation (4 point scale)	2.35	2.20	2.35	2.52	2.34
process change (4 point scale)	2.15	2.48	2.39	2.27	2.32
common part ratio (%)	28	25	32	13	28
supplier proprietary	6	12	12	13	10
black box part	55	30	24	36	35
detailed control part	39	58	64	51	55
scope	48	64	64	68	63
project management structure overall integration index	18.9	19.2	17.7	13.3	17.8

scope : function of engineering effort done by makers

Data : Ellison, Clark, Fujimoto and Young-suk Hyun, "New product development Performance in Auto Industry : 1990s updated" Harvard Business School, Working Paper, 1995.

5. BRIEF PROJECT HISTORY

Case I : SONATA (1988)

Sonata was suggested as a next model of Stellar immediately after the appearance of Stellar in 1983. Initially, Hyundai planned "Sonata" as a rear wheel drive model and negotiated a contract to import styling from ITAL DESIGN for 720 thousands US dollar in March 1984. But Hyundai began to realize the importance of mid-sized car in export market particularly in North America in the late 1980s. In 1985, one year after styling job order to Ital Design, Hyundai changed basic product concept to front wheel drive as it might be to be competitive in export market.

At the planning stage it targeted 35 year old college graduated person with 35,000 US $ annual income. The target price was 8,800 US $, with 2,000-2,400 engine displacement, one hundred horse power and a 5-speed manual transmission or 4-speed automatic transmission. Design targets was Toyota Camry, Honda Accord and Mazda-626, which were the popular models in American markets but the Grandeur under production form 1986 was actually preferred in design process as a "less bulky, more roomy" car.

In August 1986 when the project was under die manufacturing works after finishing the basic design, the basic dimension of the product was changed to meet the export markets in overall length from 4,732 m/m to 4,680 m/m and overall height from 1,421 to 1,411 m/m. This led to much confusion to project management but Hyundai proved that it could absorb these difficulties. Hyundai met such trial and error processes because of few prior experiences in new product development at the early stage but these might be regarded as a learning process to accumulate technological capabilities. The experiences

developing Pony (1976), Pony-II (1982), Stellar (1983) and Excel (1985) enabled Hyundai to work out styling features independently though Hyundai referred Ital Design's output for rear wheel drive. The styling experience Sonata enabled Hyundai to be more active in styling work in other projects.

The project manager of Sonata came from manufacturing/ process engineering divisions. The target time to finish styling was Feb. 1986 but Hyundai could finish it by November 1985, three months ahead of planed time as thanks to the CAD as Hyundai began to use CAM and computer simulation from Sonata styling job. Hyundai spent nearly 17 months, one million Km driving for testing this new model particularly for export market. Xenoy, new material, developed by General Electric was used as Sonata's bumper for the first time in the world automobile industry (Company History of Hyundai Motor, 1992, PP. 644). A prototype car appeared in April 1986 and two years after Hyundai began commercial production (June 1988). Costs and time range up to 375 million U.S $, and 67 months from the initial product concept and 38 months after restyling for front drive car in April 1985.

<Table 15> Sonata Development Schedule

	83	84	85	86	87	88
concept dev	11/83	---------->	5/85			
concept change (to front drive)			4/85			
styling			4/85-->11/85			
engineering product and process				12/85-->12/86		
pilot production					10/86 ---> 10/87	
test					2/87 --->	2/88
#1 production						
domestic						6/88
export						8/88

Data : Hyundai Motor Company History, 1992. PP.642

The #1 production for domestic and export market began on 1 June 1988 and 1 August 1988, 40 and 80 days ahead of initial planned time. Sonata became best seller in domestic market in mid-sized segment for the long time and it began to be exported to U.S market from November 1988 to add export product with existing Excel. This model was also in production on July 1989 in North American plant at Bromont, Canada, the first transplant of Korea's auto industry but the sales performance in U.S market was below expectation as this segment is the most competitive in U.S market. The New car initial quality of Sonata was 224 and 249 (number of defects per 100 cars), which was far below that of the average of 133 and 124 in 1991 and 1992 respectively. Hyundai developed a completely new model, Sonata-II in 1993 to replace Sonata.

<Table 16> Specification of Medium and Large car

model	Sonata	Sonata-II	Grandeur	New Grandeur
Dev. year	1988	1993	1986	1992
engine displacement(cc)	1,800, 2,000	1,800, 2,000	2,400-3,000	2,400-3,000
wheel base (mm)	2,469	2,700	2,735	2,745
track (mm)				
front	1,455	1,515	1,455	1,545
rear	1,440	1,505	1,405	1,550

Case II. NEW GRANDEUR (1992)

Product Development Alliance with Mitsubishi

After developing Sonata in 1988 Hyundai established to develop another indigenous model in large car segment independently but Mitsubishi requested to develop a large car. and finally in July, 1985, Hyundai and Mitusubishi agreed to develop large sized passenger car with front wheel drive.

New Grandeur is the product of joint development of Hyundai with Mitsubishi. The major development work of Grandeur was done by Mitsubishi but the development process of New-Grandeur contrasts the Grandeur developed by Mitsubishi exclusively. All development activities from concept development to pilot production were carried out in Korea and Japan as jointly by Hyundai and Mitsubishi. Hyundai was responsible for body, trim design and Mitusbishi's for power train.

During the development process, the verbal product concept (key words describing planned vehicle) were created by senior manager, CEO. The product concept approved first and styling developed given concept. Layout was determined first then styling was selected to the given layout. As for the engine, it was selected first and styling was determined by the given engine as New Grandeur is designed to use Mitsubishi designed-Sigma engine. Design targets of this model was Toyota Lexus, Nissan Infiniti, Benz S class and BMW 7 series. The styling work done by Hyundai independently but this model used Mitsubishi's chassis and Mitsubishi supplied necessary technological information on chassis and engine.

The newly designed parts of New Grandeur were about 90% which is far above of Japanese (72%), U.S (75%), and European (68%) cases in 1990s (Ellison et al 1995) as New Grandeur is first model of Hyundai in large sized segment.

As for the involvement of suppliers in NDP, 25% of supplier proprietary parts, 35% of black box parts, and 40% of detailed controlled parts were used in new Grandeur development.

The project manager of new Grandeur came from passenger development institute in product engineering function with following background: 48 years old with 23 years work experience and an engineering background. He has 11 years experience on 1 completely new product, 5 new products developed based on platform and 3 facelifts. The PM reports that he had relatively weak influence particularly on marketing research, finance, basic research and supplier relations but strong influence on engineering related activities such as styling, body, chassis engineering and testing. As a consequence, he allocated 50 % of his time on development work in design and prototype evaluation. It takes 42 months and 200 million $ development budget as the following schedule shows.

<Table 17> New Grandeur Development Schedule

	89	90	91	92
concept development	2/89 --> 8/89			
advanced engineering			10/90 --------> 6/91	
product engineering		12/89 ------------> 1/91		
process engineering			6/90 ------------>10/91	
pilot production				10/91---> 8/92
#1 production				9/92

Particularly for Hyundai the simultaneous engineering in NDP is active contrasting to other Korean makers as the development schedule of New Grandeur shows that 7 months overlap (simultaneous engineering) between product engineering and process engineering job among 33 months of cumulative lead time in these two functions.

When Hyundai developed Excel in the early of 1980s, the engineering staff of Mitsubishi were very reluctant to show an engineering design and blueprint as that provided technology to develop first front wheel drive car in Korea and Hyundai was in inferior bargaining power to share the technological information. But in development of New Grandeur in 1990s, the role and contribution of Hyundai increased drastically as partner. After finishing this project successfully, Hyundai as similar bargaining power in technological problem solving. Ten years has changed Hyundai from technology receiver from Mitsubishi to technological partner in new product development. The top manager of Mitsubishi began to admit the capability of Hyundai in styling after Hyundai succeeded in the styling of the New Grandeur. Hyundai proved it could gain experience of developing large sized-car through the cooperative spirit of foreign alliance. Hyundai's experience in New Grandeur development was transferred to Sonata appeared one year later in 1993. This might be called the advantage of rapid of design transfer not in development time but in product quality and resource capability building in NPD, which is more important to current Korean automobile industry.

Case III. ACCENT (1994)

Excel was the first model exported to US market in 1986 and became a hot seller to sell over 260 thousand in 1987, 1988 but sales fell to 10 thousand in 1990 because of relatively low quality. The mass production of Excel enabled Hyundai to take advantage of the economies of scale but Hyundai began to recognize the importance of quality--particularly in export markets.

Hyundai planned to develop another model to replace it. Hyundai used

the Japanese Mitsubishi platform in Excel but developed a completely new platform in Accent equipped with the alpha engine.

<Table 18> Specifications of Small Car

model	Excel	Accent
Dev. year	1985	1994
Engine	Mitsubishi	Hyundai alpha
displacement (cc)	1,300, 1,500	1,500 DODC
wheel base (mm)	2,380	2,400
tack (mm)		
front	1,375	1,420
rear	1,340	1,410
Chassis	Mitsubishi	Hyundai
Platform type	West-East	East-West

Remarks: Platform type : engine and transmission location

Data : Hyundai Motor Company

Hyundai slightly changed the project management system to empower the project manager additional cost control in Accent development. The plant PM for Accent project came from the product engineering division. The authority of PM increased particularly in product engineering functions and it could contribute to improve the product quality from the product design stage. The experience of Excel in export market is reflected in the development of Accent particularly on quality as this small car is equipped with ABS and air bag as option. The process of developing Accent took 52 months, 430 million U.S $ to develop Accent. The sales performance of Accent is good enough to be a best seller in small car segment in domestic market to produce 187,021 in 1994. The foreign newspapers recently reported that the quality of Accent has been improved much and Hyundai is now waiting for the favorable consumer reputation in export market.

Case IV : ALPHA ENGINE (1991)

Hyundai succeeded to develop its own models of engine and transmission as the first case in developing country and sixteenth case in the world in 1991 after 5.5 years of R&D. The technology mastery of power train might be regarded as one of the most difficulty hurdles to be an independent auto making company. In September 1983, Hyundai planned to develop indigenous model power train and established engine development team in Seoul and this team moved to Mabuk-ri, about 40 Km south to Seoul, a separate research center, in November, 1984, with 98 persons. The number of persons in this central research institute reached to 252 in end of 1986, 442 in 1988 and increased to 902 in 1991 including 14 Ph.Ds and 171 masters.

Strong support of top management of Hyundai led to the successful development of an 1,500cc alpha engine in 1991 and a 1,800 - 2,000cc beta engine in 1995. The other projects to develop other size engines are now on-going. Se-yung Chung, CEO of Hyundai Motor has supported this project continuously and consistently regardless of financial performance Hyundai Motor as owner and professional manager. It is very similar logic applied to the recent success of Korea in the semi-conductor industry.

At the concept development stage for an engine in 1984, some engineering staff-persons insisted on developing a carburetor-type engine with consideration of the technological capability of Hyundai but others argued to develop an advanced injection type engine. There were two demands on these alternatives-- fuel economy and engine performance (speed) as the corporate planning department demanded high performance but export marketing department requested fuel economy. Top management, however, finally made aggressive decision to take a risk by selecting fuel injection type, high performance

engine to show the technological capability of Hyundai. This was a high risk as there was no prior experience to develop 12 valve engine (3 valve per cylinder) with turbo charger in the world automobile industry. The chairman of Mitsubishi, Kubo, commented on this decision, "I don't know why Hyundai tries to develop engine as Mitsubishi Is always ready to fully assist Hyundai as partner and anyhow if Hyundai could succeed in engine development it might be limited to only low level"

<Table 19> Alpha engine development schedule

	83	84	85	86	87	88	89	90	91
concept development	9/83 ->	6/84							
product engineering		7/84	-->8/85						
pilot product			4/85	-->10/85					
engine test				10/85	--->	12/87			
vehicle test					7/87	--------->	12/89		
prod. preparation						7/88	--------->		3/91
#1 Production									3/91

Data : Korea Productivity Center, Case, "Hyundai Motor Company, Alpha Engine Development"
Hyundai Motor Company, Company History of Hyundai Motor, 1992 PP.340

Hyundai has imported technologies from Ricardo Engineering in 1970 for the noise control in diesel engine. Hyundai also tried to convert gasoline engine to diesel to meet the high gasoline price in 1980 because of second oil crisis with imported technologies from ElKo company in Germany. Hyundai could not meet success in this attempt but the engineers on charge of this project have accumulated important technological capabilities to develop a Hyundai-designed engine in 1990s. Hyundai made a contract to import the necessary technology to develop 1,500 cc gasoline engine with Ricardo Engineering, U.K. on June 1984.

<Table 20> Technology import for power train development
(78 1.1 - 92. 12. 31)

No.	date	tech. supplier	period	technology
1	78 5.19	Ricardo	3	engine design (diesel engine
2	78 6.14	Ricardo	2	engine design noise control)
3	78 7.13	Ricardo	2	engine design
4	80 3.10	Elko	1.5	convert gas. -> diesel engine
5	84 7.25	Ricardo	3.4	alpha engine dev.
6	84 10.22	Mr. Daeun Lee	5	CAD for diesel engine dev
7	85 7.25	Mr. C Mears	3	alpha engine dev.
8.	85 9.20	Ricardo	1	saturn engine(mid sized engine)
9	85 10.16	AVL	1	cirius engine improvement
10	87 6.30	AVL	3	Gamma (2,400 cc) engine dev.
11	87 9.24	Ricardo	2	alpha engine 2nd
12	88 2.26	Mr. J.W Holdman	1	T/M dev.
13	88 4.11	Mitsubishi	2	E-W type auto T/M production
14	88 12.24	AVL	3.4	Delta engine(3,000cc DOHC) dev.
15.	89 7.26	Mr. C.H. Suh	3.4	employment, advisor for T/M dev.
16.	89 7.26	Mr. Fukushima	3.4	employment, gear for T/M
17.	90 12.27	AVL	4.5	Jetta engine (small diesel) dev.
18	91 1.16	F.F.D	5	automatic T/M
19	91 2. 5	F.F.D	5	4 wheel drive T/M

Data : K Kim, 1994, Ph.D dissertation, Seoul National University and Hyundai Motor company

Hyundai has imported technologies from multiple sources since 1970s to maintain the bargain power in the selection of foreign technology. The managerial independence strategy enabled Hyundai to maintain this policy giving Hyundai a more favorable condition in technology transfer and competitive price. Furthermore, it could prevent technological dependency on a specific source. For example, Hyundai imported engine design technologies from dual sources; Ricardo and AVL as shown in the Table 20. As another example, as for the engine management system, Hyundai tried to acquire technology from the dual sources Bosch and Bendix by competitive bargaining but in the initial bargain process, Bosch was very reluctant to transfer technologies of EMS to Hyundai under the circumstances, Hyundai invited Bendix to the competition and it finally led Bosch to transfer favorably. Bosch supplied necessary specifications and technology to accommodate its EMS to Hyundai alpha engine,

which was invaluable to Hyundai (Gyun Kim, 1994). It is consistent strategy of Hyundai to acquire necessary technologies from the multiple sources on competitive bargaining process.

The choice of appropriating technology on good terms has been regarded as one of the most essential elements for developing countries to develop an indigenous technology. In the early of 1980s, Hyundai's technologies could hardly follow the state of art of advanced engine technologies. However, the foreign and Korean experts have played a major role in searching for good sources of advanced technologies on engines. Two Korean experts, Dr. Daeun Lee, 50, and Dr. Hyun-soon Lee, who has prior experiences in engine development at Chrysler and G.M, respectively, after earning his Ph.D. in mechanical engineering in the U.S.A, have provided decisive leadership in alpha engine development. Mr. Clions of Ricardo engineering U.K was hired for three years from 1985. He has also made a great contribution in the process of alpha engine development as a guider. Such key role persons were scouted from foreign sources as they were in developing the Pony in the 1970s. Hyundai hired Mr Turnbull, a former managing director of BLMC of England as vice president for three years and six other English auto experts were also employed to develop Pony in the mid-1970s.

Director In-soo Cho at central research institute was in charge of developing the transmission in cooperation with alpha engine development team. He used Nitsubishi transmission as a reference to design a new transmission adapted to Hyundai's alpha engine. But it was very difficult to find out which was at fault-the transmission or alpha engine--when the transmission broken out during the testing process because both are under development in unapproved status. It was learning process by trial and error to accumulate necessary technologies. Hyundai has also been active to technological

training to dispatch a number of engineers to overseas training ; 83 in 1982, 141 in 1983, 166 in 1984, 276 in 1985 and 351 in 1986.

During the development process of alpha engine, there were 288 engineering changes--particularly, 156 changes in 1986 at the peak of development. This project costs 125 million U.S $ with 300 engines, 200 transmissions, 150 vehicles used for testing and improving performance.

On September 1985, the trial product appeared and the following multiple test were undertaken:

1. an emission test in Maebuk research institute in 1985;
2. a durability test with 83 engines for 21,000 hours and vehicle test in Phoenix, Arizona desert in July-September 1987;
3. a summer test by Bosch Co. in Germany;
4. a winter test at under 30-40 below zero Centigrade at Opasatika, Ontario, Canada, January 1988;
5. a high altitude test at Denver Colorado in July, 1989.

During the emission testing process in Maebuk institute, 11 test engines were broken at very high to costs--25 thousands U.S $ value each. The development of an indigenous engine has no small meaning to Hyundai as it enabled Hyundai to save much in royalties (90 $ royalty per one Mitsubishi designed-engine). Hyundai estimates that it would be able to save 43 million U.S $ in royalty only for Scoupe production by 1995. The reduction of royalty for Accent production only, in 1994, is estimated 17 million $ (90 $ x 186,000). Beside solving the royalty payment problem, the experience of engine development in Hyundai has stimulated other makers to develop an engine. Kia and Daewoo have both succeeded to develop engines in the early 1990s.

The pilot car, Scoupe, equipped with alpha engine, was finally into production in November, 1990. Scoupe for domestic market and for export market was also into production on April 1991 and July 1992 respectively.

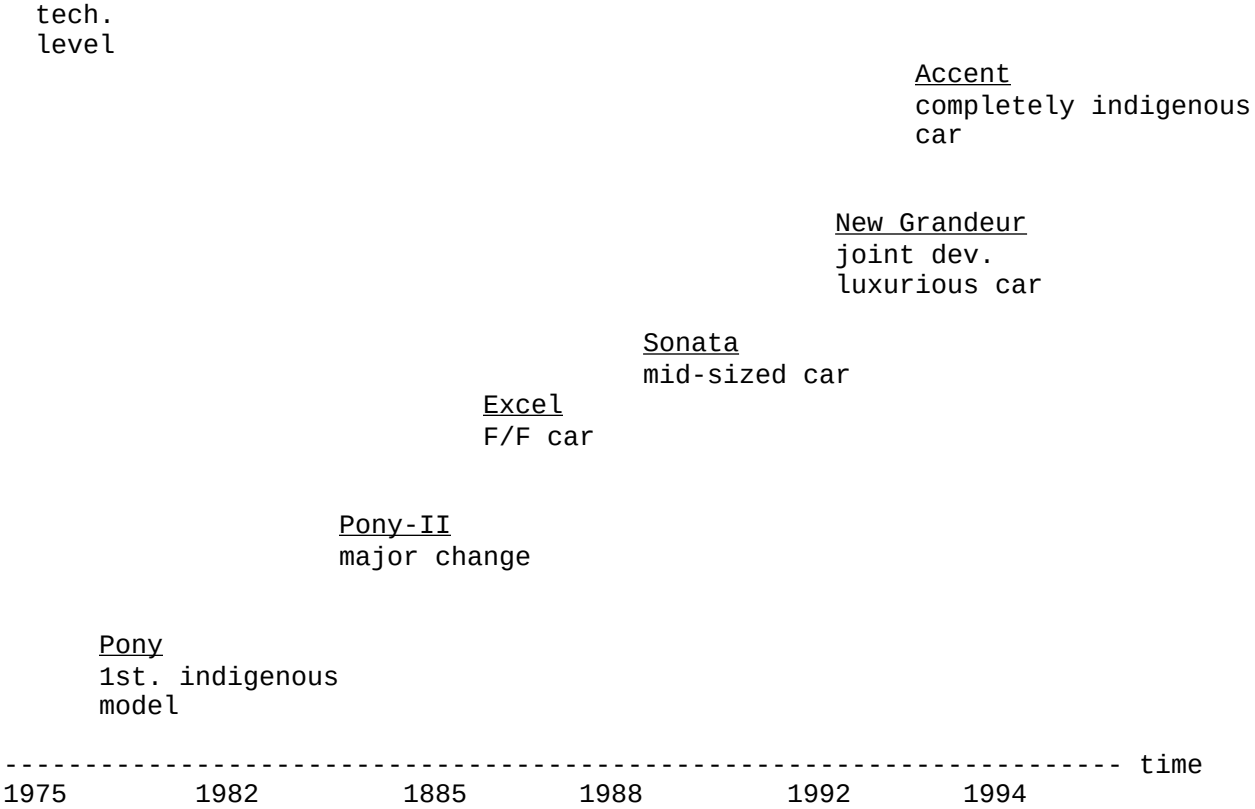
Hyundai also began to load the improved alpha engine to the newly developed car, Accent, from April, 1994.

The success of alpha engine development enabled Hyundai to follow with the beta engine 1,600cc, 1,800cc, and 2,000cc displacement with 16 valves DOHC in 1995. In the 5 years since February 1992, with 120 million U.S.$ R&D investment, the Hyundai Beta engine--2,000cc DOHC, 152 HP, 19.5 KG/M maximum torque--is expected to be competitive with Toyota's Corolla engine. This engine is designed to meet the environmental regulation of 1996 California as recyclable plastics are widely used for weight reduction in cylinder head cover, water pump impeller, air cleaner etc. (Korea Economic Daily, 7 March 1995). This beta engine is now equipped with newly designed car Avante (1995). The central research institute established "10-year Engine Development Plan" to develop two stroke engine, a hydrogen engine, five-gear automatic transmission and continuous variable transmission to meet the year 2000.

7. CONCLUSIONS

The unique strategy of Hyundai reaching toward self-reliance might be a major step for Hyundai in new product development, as we have discussed. The development of technological capability of Hyundai Motor in NPD could be plotted as the following Table. The capability in NDP has increased gradually step by step as Hyundai repeated new products development since the mid-1970s. Pony (1975), Pony-II (1982), Excel(1985), Sonata (1988), New Grandeur (1992) and Accent (1994) were all stepping stones for Hyundai to improve its NPD technologies.

<Table 21> General Technology Development



Hyundai has succeeded in NPD by imitative learning process of imported technologies. The experience of Hyundai in NPD is a great inspiration to how auto maker in developing country can grow to be a large exporter. We can find very similar logic as following in the development critical products as Pony in 1970s, Excel in 1980s and Alpha engine in 1990s.

First, full and consistent support and trust of top management on the capability of engineering staffs to encourage the dynamic technological learning process.

Second, technology licensing from the multiple sources on the competitive bargaining for the effective technology transfer. The independence in managerial control enabled Hyundai to maintain this kind of technology licensing policy. Third, hiring of foreign experts and scouting experts working overseas in specialized areas to supplement the technological gap within short time. That is logic based on the 'technology utilization' rater than 'technology possession'

Fourth, continuous R&D investment and full delegation of authority to engineers in technological problem solving.

But Hyundai is to meet multiple challenges in NPD. The international comparative bench marking shows the new product development performance of Korean auto makers, particularly in quality, is below the average. How to improve quality of new product with competitive cost from the designing stage might be one of the most challenges to Hyundai. Hyundai has been more competitive in low cost small car segment but other advanced makers Ford, G.M., Toyota, and European makers are now racing to develop low cost high value small car with advance technologies. Hyundai also meets the advanced maker in domestic market as the government has lifted all of the import regulation in 1995. Various questions remain to Hyundai.

First, How to manage the heavy engineering load to extend distinctive platform products in larger car segment with limited resource of technological capabilities in NPD by 2000 ? But Hyundai must get over this transition period to be an independent auto maker in the world.

Second, How to improve the quality of new product rapidly from the design stage. Hyundai must consider the design for quality and design for manufacturability instead of time compression in new product development.

Third, How to compete in cost reduction in new product development under relatively inferior condition to increase new parts inevitably as there is limited number of existing base platforms?

Fourth, How to manage the project management organization for the effective NPD and how to manage multi-project management in the future? That is how to manage product portfolio and product integrity as Hyundai will soon diversify the new products. Toyota already reformed NPD organization to center 1,2,3,4 system to strengthen the leadership in mutli-project development it might give some policy implications to Hyundai despite the current situation and contexts of Hyundai in NPD is different to those of Toyota.

Fifth, How will Hyundai meet the competition in more advanced product technologies, for example, electric vehicle, safety and smart car etc in the future?

This reminds us of the aforementioned comment of Prof. Fujimoto that efficiency at the expense of quality in new product development of Korean auto industry in 1990s is very similar to Japanese auto industry in the late 1960s and early 1970s. At that time, the Japanese auto industry selected efficiency in new product development to increase the number of new products to supply the over-demand in domestic market but the quality of that product was not

good. It took 20-30 years for Japanese auto industry to become world class. The history of Japanese automobile industry might give some implications to Hyundai. The competitive strength of new product development in world industry is shifting from japan to U.S.A but Hyundai must pay attention what is behind of recent dynamic process of mutual learning in new product development in Japanese and American auto industry.

The current project management system of Hyundai has been relatively light weight. The recent mild changes in R&D division to strengthen the leadership in NPD towards the more heavy weight project management system could be a one of reasonable responses to improve product quality from the designing process but the reality whether Hyundai is to meet the best practice to effectively coordinate the dispersed NPD functions in the #1, #2 Passenger Car Development Institute, Central Research Institute and Design studio awaits for the completion of coming new projects. But project management system is one of the necessary conditions to competitive new product development particularly to Hyundai and Korean auto makers and as a consequence, the technological capability in basic functions such as design, product engineering, process engineering, die manufacturing, power train and advanced engineering might be more important in NPD.

Overall, Hyundai has been ahead of its Korean competitor in new product development, it has benefited more from the first mover's advantage in new product development but other makers are also on the rapid racing in new product development. Hyundai is also on the world racing to be world Top 10 maker in 2000 and the effective NPD is at the heart of Hyundai's success to get the target.

REFERENCES

Automobile Life, Oct. 1992, "Development History of Hyundai's New Grandeur" Monthly Journal, PP 176-181.

David Ellison, Kim B Clark, Takahiro Fujimoto and Young-suk Hyun, "New product Development Performance in Auto Industry : 1990s updated" Working Paper 1995

Gyun Kim, "A study of the Development of Technological Capability of Korea in the 1980s", Ph.D dissertation, Dept. of Economics, Seoul National University 1994

Hyundai Motor Company, Company History of Hyundai Motor, 1992

Hyundai Motor Company, Journal of Automotive Industry, Spring 1995

Hyundai Motor Company, Automotive Industry of Korea 1993, 1994, 1995.

Young-suk Hyun and Jinjoo Lee,"Can Hyundai go it alone ?" Long Range Planning Planning 1989, Vol. 22 No.4

Young-suk Hyun and Jinjoo Lee, "Hyundai Motor Company: Self-reliance Strategy and Growing Challenges" edited by Dong-ki Kim and Linsu Kim Management Behind Industrialization :Readings In Korean Business, Korea University Press 1989.PP. 616-539.

Young-suk Hyun, "Systematic Analysis on the Technological Development of Korean Automobile Industry 1962-1986" Ph.D Dissertation, KAIST(Korea Advanced Institute of Science and Technology) 1988

KAICA (Korea Auto Industries Cooperative Association) Data Book

KAMA (Korea Automobile Manufacturers Association) Data Book

Kentaro Nobeoka and Michael A. Cusumano, "Multi-project Strategy, Design Transfer, and Project performance: A survey of Automobile Development Projects in the U.S and Japan" MIT IMVP 1994

Korea Economic Daily, 7 March 1995, 24 April 1995, 14 March 1995

Korea Productivity Center, "Technology Development of Hyundai Motor, Alpha Engine_case" Case III, 1991

Kia Economic Research Institute, 1994 Korean Automobile Industry, 1994.

Kia Motors Company, 50 Years History of Kia Motor, 1994

Maeil Economic Daily, 5 August 1994, 27 April 1995,