

〈招請學術論文〉

Korean Experience of Cooperative Education Pioneered at
Ulsan Institute of Technology*

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Summary: Ulsan Institute of Technology's ideal and unique location in the centre of South Korea's fastest growing and most diversified industrial area (petro-chemicals, shipbuilding, car manufacture, nuclear power plants etc.) has enabled it since establishment in 1970 to pioneer the introduction of the first organised planned field experience as part of university curriculum by evolving and adapting the sandwich system to meet the realities and requirements of Korean education and industry.

In addition, extended programmes in postgraduate courses have been offered for students from industry with emphasis placed on industry-oriented research. The affiliated Junior College, as part of UIT's continuing education of technicians, runs a nuclear technicians' course with the full cooperation of the Korea Electric Power Corporation as well as one-year technicians' courses and two-year engineers' courses for employees of the Hyundai motor-car company and Hyundai shipyards.

The motivation of students, teaching staff and cooperating industries has ensured the continuing success and upgrading of this Cooperative Education.

I. Introduction

The aftermath of the disastrous Korean War found Korea totally destroyed and divided, with the south cut off from its industrial base in the north, and most of its primary resources situated there. Nevertheless by the sixties there was a truly remarkable surge of industrial and economic growth in South Korea which has shared the problem with developing countries

of sustaining and furthering their growth with sufficient technical education and expertise.

From the outset of a series of five-year economic plans, it became obvious that the existing limited and sporadic cooperation between industry and educational institutions was unsatisfactory; there was some industrial training of students during vacations but there was insufficient overall and objective planning.

The Korean Government, cognizant of the importance of cooperative education, revised

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"the Promotional laws of industrial education" in 1973, 2 to 6 months of field experience during their course for all technical and engineering students becoming mandatory. Many universities have only been able to implement this in a casual manner.

But since its foundation in 1970, the Ulsan Institute of Technology has pioneered cooperative education working closely with surrounding industries providing an adaptation of the British sandwich system in structured field experience as an integral part of the curriculum (Kim, 1975) and (Lee, 1976).

II. Background

1. Ulsan Industrial Area

Ulsan on the southeast coast is located 400km southeast from Seoul and in proximity to the major port of Pusan.

Since the proclamation of the city of Ulsan as a special industrial complex by the Government on January 27, 1962, it has emerged as a fast developing industrial city, now the largest in Korea. The city alone has 161 large scale

Table-1 Industries in and around Ulsan

Industry	No.	Capacity
Thermal power		2,670 MW
Nuclear power		1,916 MW
		*1,900 MW
Oil refinery	2	360,000 B1/day
Fertilizer	3	890,000 ton/year
Petrochemical product	17	1,270,400 ton/year
Synthesized textile	2	112,800 ton/year
Iron and steel	1	6,920,000 ton/year
Aluminium refinery	1	17,000 ton/year
Copper refinery	1	80,000 ton/year
Copper alloy	1	120,000 ton/year
Shipbuilding	17	500,000 DWT/year
Marine engine	130	000HP × 40/year
Car manufacturing	1	150,000 ca/year
Others	220	

*under construction

plants now in operation and 10 more are under construction. Major industries located in and around Ulsan are as shown in Table-1.

2. Ulsan Institute of Technology

Ulsan Institute of Technology (UIT) was established in 1970 in the centre of this area to offer four year bachelor of science degree courses with the aim of educating engineers for and with the close cooperation of the surrounding industries. At the present, the number of courses offered at UIT are 11 in science and engineering faculty and 7 in liberal arts and business faculty.

It is in itself a unique example of cooperative education for it was set up jointly by an agreement of the governments of Republic of Korea and Great Britain and a leading Korean industrialist. The main supportive financial foundation is that of the large Hyundai group of companies with interests in shipbuilding, construction, car manufacture etc. Student scholarships are donated by industries every year and in 1982 altogether US\$ 150,000 worth of scholarships have been given by 60 companies.

In addition to the sandwich courses for UIT students in various industries, arrangements are made for a large number of industrial employes to take evening courses in the Institute and joint research is carried out. Various types of off-campus programmes are also sponsored by UIT. Ties between UIT and industries are further cemented by joint sports and social events.

III. Undergraduate Programme of Cooperative Education

1. UIT Sandwich Programme

Such close ties between UIT and industries facilitated the implementation of cooperative education at UIT. In 1972, UIT introduced the sandwich system which incorporates planned

industrial experience with lecture-on-campus. UIT's sandwich system was the first of its kind in the nation and has become a land mark for cooperative education in Korea.

At the very inception of the sandwich system in 1972, all engineering students underwent industrial training during the second term (16 -17 weeks) of the third year. The training was preceded by three week introductory course (see Table-2).

The aim of the course is to let students prepare for an entirely new industrial environment and give a general picture of current Korean industry, aspects of management and other relevant topics of importance. Most of these subjects are lectured by plant managers or managerial staff in order to give students

Table-2 Introductory Course for Sandwich Students

Subject	Hour
Introduction	1
Cooperative education	1
Personnel management	2
Cost control	8
Safety control	4
Industrial engineering	2
PERT/CPM	4
Industrial site	2
Industrial water treatment	2
Polution	2
Induction of technology and foreign capital	2
Shipbuilding industry	1
Iron & steel industry	1
Automobile industry	1
Fertilizer industry	1
Petro-chemical industry	1
Construction	1
Energy	2
Work relations	2
Report writing	3
Introduction to student's major field industry	8
Total	51

a broad basic understanding of the industry.

In the training, three types of tutors are involved; the UIT major area professor, the industrial tutor and various field tutors. The home professor imparts basic knowledge relating to the training programme, briefs the students fully on what is expected of them for the coming weeks and examines the daily log books students are expected to keep. The industrial tutor cooperates closely with UIT in guiding the student work and seeking constant improvement of programmes. The field tutors act as field instructors and they check student attendance and set oral or written tests.

Students are required to write a progress report and a final report. These along with the project report which is assigned to each student in the beginning of their industrial training will be submitted to UIT through industrial tutors.

In order to ensure the quality of the programme, an advisory committee is formed. The members of the University-Industry Cooperation Advisory Committee include the President of UIT, the Mayor of Ulsan and representatives of various industries. The Laboratory Management Department of UIT acts as a coordinator between UIT and the industries.

UIT sandwich system evolved continuously

Table-3 Number of Sandwich Students Placed in Industries(1972-1981)

Department	No. of Students
Mechanical Engineering	459
Electrical/Electronic Engineering	236
Materials Science	243
Industrial Chemistry	187
Civil Engineering	194
Architecture	199
Computer Science	50
Naval Architecture and Shipbuilding	149
Industrial Engineering	52
Total	1,769

in the last 10 years since its implementation in 1972. At the present, UIT sandwich system is classified as "block out-training scheme" and "one day per week out-training scheme". Table-3 shows the number of sandwich students placed between 1972 and 1981.

2. Block Out-training Scheme

UIT found it necessary to readjust the period of the industrial training part of the sandwich scheme through inflexibility of the length of study set for Korean higher educational institutions.

At the present, block out-training scheme takes place in the second half of the second term (8 weeks) of the third year and includes the normal winter vacation time (8 weeks) for the Department of Architecture, Industrial Engineering, Computer Science and Chemistry, and the second half of the first term and the summer vacation time for the Department of Civil Engineering. The sites of the civil engineering training in 1982 are as shown in Fig.1.

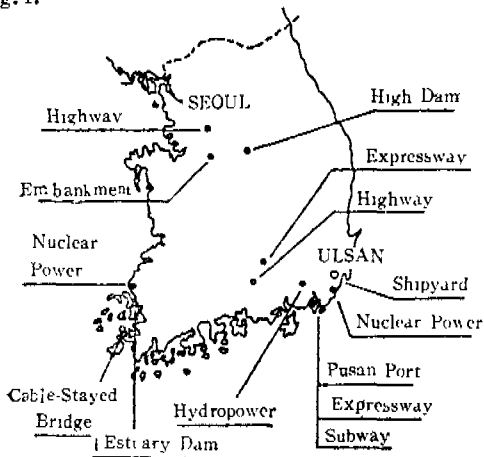


Fig.1 Sites of civil eng. training (1982)

3. One Day Per Week Out-training Scheme

One day per week out-training scheme is an innovative attempt by UIT and the Naval Architecture and Shipbuilding Department was

the first to try out this new scheme in 1976.

Every week, four days of lectures at the university were followed by one day of industrial training at the Hyundai Shipyard during the second term of the third year of the four year bachelor degree course. Although in-depth industrial experience is somewhat sacrificed in this scheme, students would gain a wider overall picture since the shipbuilding industry, by nature, has to deal with a complexity and variety of work undertaken. In this scheme, a series of lectures very closely links the experiential learning and students are able, due to the proximity of the shipyard, to consolidate their observations every week back at university under their professors.

One day per week out training scheme will last 19 weeks and the details of the type and the place of training are as shown in Table-4 and an example of the daily plan at the shipyard are shown in Table-5. After a day's training, students must submit their log book to the university tutor.

On the other hand, Mechanical Engineering Department concentrates on case studies in

Table-4 One Day Per Week Out-training Scheme (Dept. of Naval Arch. & Shipbuilding)

Type of training	Week	Place
Introductory session	1	Training Centre
Design	2	Basic Design Department
	3~4	Structural and Functional Design Dept.
Shipyard practice	5~6	Steel Storage Yard, Steel Preparation Shop
	7~10	Minor Assembly Shop
	11	Major Assembly Shop, Dockyard
	12~14	Outfitting Shop, Painting Shop
	15	Testing and Sea-trial Dept.
Management	16~18	Management Division
Concluding session	19	Training Centre

Table-5 Example of Daily Plan for One Day Per Week Out-training Scheme

Hour	Activities at major assembly shop
08:30-10:00	Lecture by the industrial tutor: 1. Introduction of the day's training, 2. 1) Building large blocks (fore and after part blocks, engine room block, house block, pre-outfitting etc.) 2) Transportation of blocks 3) Production & fitting of rudder to stock 4) Estimation of man-hours
10:00-12:00	On-site observation
12:00-13:00	Lunch
13:00-16:30	Learning how to handle various equipment
16:30-17:30	Review and test

their one day per week out-training scheme. A group of students of less than five is given case study subjects by the industrial tutor and these subjects are either from the projects completed or underway in the industries. These are selected from various fields such as metal cutting, process design, jig and tool design, metal forming, equipment design, optimal design of chemical process equipment etc. Background of the projects and some basic data and information are given by industrial tutors, while basic calculation and the collection of additional information will be made by students with the help of the university tutor.

Students of the Materials Science Department and Electrical and Electronics Engineering Department also have industrial training under this scheme.

IV. Postgraduate Programme of Cooperative Education

Many of the engineers serving the Ulsan

Industrial Complex wanted facilities for further studies, while on the job. As a result, UIT started part-time postgraduate courses in mechanical, electrical, metallurgical, civil engineering, chemistry, architecture and naval architecture in 1980 with a present total enrolment of 28 students.

Admissions to the programme are made through written and oral examination from those who have more than two years of industrial experience. The courses are of two and half-year duration as against two years for regular masters' degree programme and the lectures are given in the afternoon twice a week.

In addition to the competency examination in the major field of study and foreign language, students are required to submit a thesis as a degree requirement. A most important feature of UIT postgraduate programme is its approach in incorporation of off-campus or industrial situations with research project. A great effort has gone into the creation of research projects which are relevant to the

Table-6 Firms Sending Students to Part-time Postgraduate Courses and Student Numbers

Organisation	No. of Students
Hyundai Motor Company	1
Hyundai Heavy Industries Co.	6
Hyundai Electrical Engineering Co.	1
Hyundai Engine Mfg. Co.	2
Hyundai Construction Co.	1
Hyundai Precision & Industry Co.	1
Korea Electric Power Corporation	2
Poong San Metal Corporation	1
Onsan Copper Refinery Co.	2
Ordnance Depot	1
Korea Synthetic Rubber Ind. Co.	2
Yukong Limited	2
Yongnam Chemical Co.	1
Korean Fertilizer Co.	2
Technical High School	3
Total	28

pressing needs of the industries.

Although the course structure is designed to build firm foundation of basic knowledge necessary to prepare for a rapidly changing technology, special consideration was given so that computer science and management elements would be included as a part of the course.

Table-6 shows that students are drawn from various industries in and around Ulsan Industrial Complex. The job responsibilities of the students are middle and low level management.

V. Junior College Programme of Cooperative Education

UIT operates affiliated 2 year course of Ulsan Junior College of Technology (UJCT) for technician training. The UJCT's Nuclear Technician Course is an example of the ideal education-industry cooperation. Cognizant of the need of the nuclear technicians for the operation and maintenance of the nuclear power reactors, which are emerging as a significant source of electricity in Korea, the UJCT opened a nuclear technician course in 1981 with complete cooperation between UJCT and the Korea Electric Power Corporation (KEPCO).

Students for courses are recruited from two sources; recommended school leavers from Sudo Electrical Technical High School run directly by KEPCO and technicians with minimum of two years industrial experience at KEPCO power plant. Agreed KEPCO support includes \$300,000 worth of laboratory equipment, provision of industrial training facilities, industrial tutors and lecturers. Every student of the course is provided with tuition and textbook along with salaries from KEPCO. KEPCO also ensures placement for students at their power plants after the graduation.

The course work requires 16 weeks of field training at two different types of nuclear power plant, that is, PWR type and CANDU

type. The training is performed in 4 steps; 3 weeks each during two summer vacations and 5 weeks each during two winter vacations at Kori Training Centre, Kori Nuclear Power Station and Wolsung Nuclear Power Station. The outline of the programme is as shown in Table-7.

Table-7 Field Training Programme(Nuclear Technician Course)

Year Term	No. of Weeks	Training Site	Activities
I-1	3	Kori Training Centre	PWR power reactor construction
I-2	5	Kori Station Kori Training Centre	PWR power reactor operation
II-1	3	Kori Station Wolsung Training Centre	CANDU power reactor
II-2	5	Wolsung Station Kori Training Centre Kori Station	Construction & Operation Reactor operation Test operation

VI. UIT Off-campus Programme

Industry's interest in having their technicians or engineers participate in continuing education activities is usually motivated because of the inherent belief that further education will increase their employees' productivity(DeBrito, 1979). Hyundai Group of Companies firmly endorse this principle.

1. Technicians' Course

In 1977, UIT, UJCT and Hyundai Motor Car Co., Ltd. implemented one-year advanced technicians' course for the junior technicians of the company. The trainees were selected among junior technicians who have been employed by

the company for more than three years with high school diploma. Although the course duration is only one year, it was intended to cover the major theoretical subjects of the mechanical technician course of the two-year junior technical college through a series of 960-hour lectures. The average size of the classes was 43.

Even though the certificate awarded after the completion of the training is independent from the Korean educational system, it was recognised as equivalent to the diploma from the junior technical colleges within Hyundai Motor Co., Ltd., the largest of its kind in Korea. So far 130 technicians have completed the training.

2. Engineers' Course

Hyundai Heavy Industries Co. Ltd. also has started similar courses in 1981 except that the course duration is two years as against one year for the motor car company. Altogether 384 hours of lectures in basic science and engineering subjects of the four-year degree course are being given by UIT teaching staff on-site. This programme was enthusiastically received by the trainees, since this will give them a chance to assure themselves that they can compete with new college graduates. It also increases their opportunity for job mobility, promotion and overall career development. The courses and the number of trainees is as shown in Table-8.

Table-8 Off-campus Programme(Hyundai Shipyard)

Course	No. of Trainees
Shipbuilding Technology	30
Mechanical Engineering	40
Mechanical-Electrical Engineering	15
Total	85

VII. Conclusion

As mentioned earlier, cooperative education

programmes of UIT are in themselves innovative efforts. In Korea, they are the first and only form of cooperative education incorporating field experience as an integral part of the regular curriculum. Reasonably active participation of industry in cooperative education has been achieved.

However, the last ten years of experience leads us to conclude that the success or the failure of the implementation of cooperative education in developing countries depends largely upon dedication and enthusiasm on the part of faculty and well defined and carefully prepared plans of the training programme.

Cooperative education involved independent study and exposed the student to self-education and it may contribute to the maturation process of the future engineers. In addition to this, it provided students with experiences, interpersonal-interactions and communication lacking in an academic setting. It is only fair to say that cooperative education is one form of life-long learning consideration which should be incorporated in the engineering and technical education.

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