

ideas

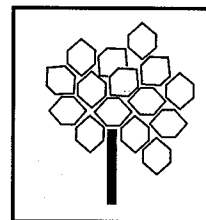
FOR BETTER
EDUCATION
& TRAINING
FOR ENGINEERS

DISTANCE LEARNING IN ENGINEERING

NUMBER 1
NOVEMBER 1993



COMMITTEE ON EDUCATION AND TRAINING
WORLD FEDERATION OF ENGINEERING ORGANIZATIONS



PURPOSE OF THIS PUBLICATION

The World Federation of Engineering Organizations (WFEO) has performed a permanent activity in the field of formation and training of engineers since its foundation in 1968. In 1975 a Technical Committee was created to analyze new ideas, ways and methods to improve engineering education all over the world and to propose to WFEO and other international, regional and national organizations the necessary actions to be taken.

The WFEO Committee on Education and training is formed by prestigious educators from different countries of the world. It meets annually to discuss subjects related to the formation of engineers that are proposed by the WFEO Assembly or by the Executive Council, and to in turn propose plans of solution for these subjects. At these meetings joint programs with UNESCO and other institutions are elaborated and the status of engineering education in countries and regions is put forward and analyzed by means of papers submitted by its members.

The documents that this first issue of IDEAS contains were submitted by their authors at the 1993 Annual Meeting of the Committee, held in Paris.

**PROF. MIGUEL ANGEL YADAROLA - PRESIDENT
WFEO COMMITTEE ON EDUCATION AND TRAINING**

IDEAS is a publication of the WFEO Committee on Education and Training, addressed to engineering educators, educational officers at Universities and leaders responsible for establishing educational policies for engineering in each country. The articles it contains reflect the concern of people and institutions linked to WFEO, to provide ideas and proposals with the object of improving formation of engineers.

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INTERNATIONALIZATION OF ENGINEERING EDUCATION

RESOLUTION

Approved by the WFEO General Assembly - Havana, Cuba, October 22, 1993
Approved by the WFEO Committee on Education and training - Paris, June 26, 1993

CONSIDERING That engineers and their works provide a significant component to the economy and social progress of each country and of all countries combined, regionally and internationally;

That education and training, particularly of engineers and their assistants, is a vital component of their preparation for participation in the national and global scenario, where they will face the challenge to work for the sustainable development of their countries;

That it is recognized that several problem areas exist in effecting useful international educational exchange programs: the most significant of these being funding for exchange programs, and the easy transfer of credit from a host institution to a sending institution;

That in providing for the freedom of opportunity for engineers to practice across international boundaries, some kind of basic equivalency of educational systems on both sides of the boundary must be pursued and recognized;

The 14th WFEO GENERAL ASSEMBLY meeting in Havana Cuba, on October 22-23, 1993, following a proposal of the Committee on Education and Training, **RESOLVES:**

To state its support of further internationalization of engineering education, including the following specific steps:

- 1) National Members are urged to further encourage cooperation in international education by the engineering schools in their countries, including good-faith efforts to reduce and eliminate impediments to the successful implementation of the programs on international educational exchange. These steps should include the effecting of the easy transfer of credit between institutions internationally and nationally and the recognition of exchange students as being desirable residents on each other's campuses and therefore could be, according to the different national modalities, worthy of preferential financial treatment.
- 2) National members are urged to recommend to industries in their countries that they assist in the identification of sufficient working internships to satisfy the needs of the exchange programs in their countries and that they analyze the convenience of assisting in the funding of international programs.
- 3) National members are urged to impress on their governmental and professional bodies that recognition of the educational equivalency of engineering programs in all countries with the necessary adaptation to better considering the particular local environments is a precursor to the successful implementation of future agreements for world-wide engineering practice, as well as regional common markets and free trade agreements, and similar international initiatives.



JOURNAL IDEAS N° 1

November 1993

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**DISTANCE LEARNING (E.A.D.)*
in CONSERVATOIRE DES ARTS ET MÉTIERS (CNAM - France)**

WFEO Committee on Education & Training

by Nicole du Vignaux

INTRODUCTION

Several regional, national, public and private actions of "Enseignement à distance" (EAD) exist in France. Unfortunately, there is no census about this subject.

Recently, an official organism "ORAVEP"*** was in charge to establish a catalog of EAD possibilities in France: this directory will be available at the end of 1993.

Therefore, it is now possible to give an information about the important action conducted by CNAM in the field of EAD.

CNAM Institution

CNAM is a very famous french institution, which has been created for almost two hundred years, in 1794. The main vocation of CNAM is to provide higher technical education opportunities for adults who wish to study while they already have an employment. The need to have possibilities to study in their home (or sometimes in their work), in their own time and to obtain certificates or diplomas attesting their new qualification.

In accordance with this goal, education was in 1992, given to 100.000 students:

- 70,000 have a HTO*** formation (out of working time) - (1/3 at CNAM in Paris, 2/3 in the 52 Regional Associated Centers).
- 30,000 receive an initial or continuing education in CNAM institutes.

Among the 70,000 HTO students, we find:

- 46% technicians
- 25% executives ("cadres")
- 11% students

We also note that 77% have an employment, and that 85% are less than 35 years old.

EAD Organization in CNAM

Three possibilities exist:

1. Education at home or at work place. Means are mainly: duplicated lecture notes, with correspondence and "télématique" corrections.
Regular meetings and the use of radio links complete that organization which concerns about 15,000 students each year.
2. Regional Networks based on tele-learning antennas.
A good experience is that of "Pays de la Loire" since 1987.
Details will be given in the next pages.
3. Distant interactive courses:
A particular communication process gives the possibility of a dialogue between one professor and several students, at the same moment in different places. It allows also transfer of documents, instructions, instantaneous corrections and so on ...

The example of:

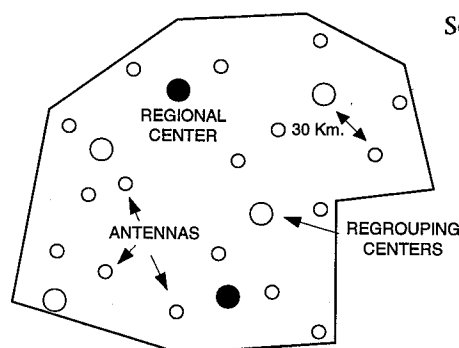
A REGIONAL NETWORK

BASED ON TELE-LEARNING ANTENNAS

France is divided in 22 "Regions".

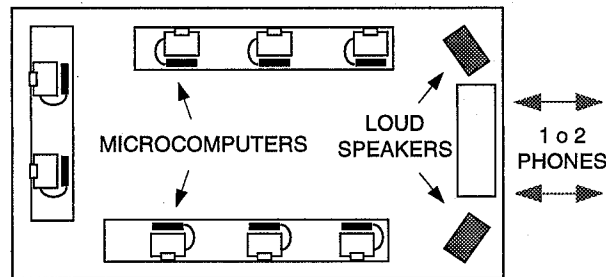
Each regional network is organized around antennas located in little towns (10,000 to 20,000 inhabitants). Technical and logistic means are neither very important nor expensive so each little town can become an antenna as soon as the need of a formation is expressed.

1. Geographical implementation:
Numerically the good size for a regional center is evaluated about 10 to 30 antennas, organized as follows:

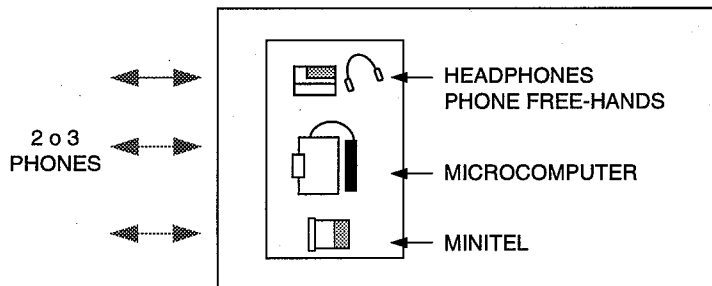


Scheme of a regional network

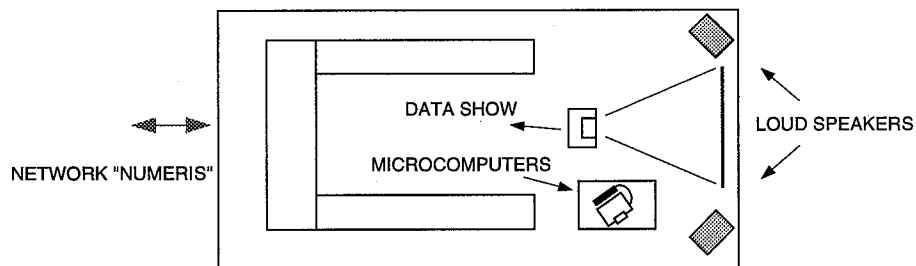
Antennas are located in towns of 10,000 to 20,000 inhabitants. Theoretically, a student does not live 30 km far from one antenna. These antennas are the place of weekly meetings, for "Travaux dirigés" (laboratory works).



Regional Centers (i.e. teaching centers): they are transmitting centers and centers of tutorial. These transmitting centers are 2 or 3 in each "Region". From these centers, teachers-tutors can supervise, help and guide the work of 30 to 60 students distributed in the whole "Region". This activity is done from an office of CNAM or from the teacher's home if he has the good equipment (which in fact is quite simple).



Regrouping Centers: they have a role of relay between antennas and teaching centers. They could use "audiographic" process on Numeris network.



2. Courses Organizations: Each "teaching unit" for the student is composed of about 220 hours of work distributed as follows:
60 to 70 hours of "T.D." in antennas, distributed between 20 to 25 sessions of three hours, once a week.

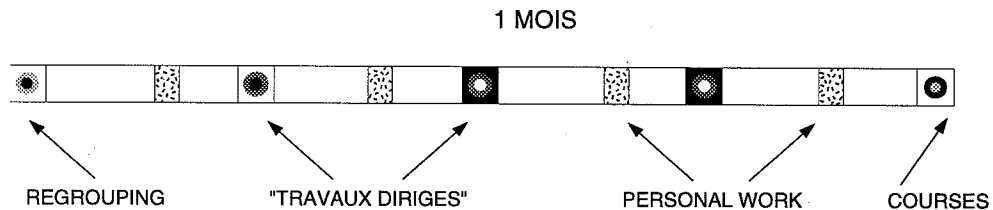
15 hours of regrouping, distributed in 5 sessions once a month.

25 hours of personal work guided at home.

More personal work must be necessary for revisions, documentation, and so on ...

Therefore 110 hours should be considered as a minimum.

Scheme of s student's work for a month



The examinations: they are traditional, written and oral.

CONCLUSION

Such a regional network was created in the region "Pays de la Loire" in 1987 and has had a real success.

It is why four new centers will be created in 1992-1993 in other regions, with the final goal to cover the whole territory of France.

* EAD - Distance Learning Education

** ORAVEP - Observatory for Audio-Visual Resources for Continuing Education

*** HTO - out of working time

DISTANCE EDUCATION IN JAPAN

WFEO Committee on Education & Training

by Kaneichiro Imai

I. INTRODUCTION

Distance education is a type of education in which the teacher instructs the student who is at a distance. There are several ways to send the information of lectures as shown in Fig. 1 (1).

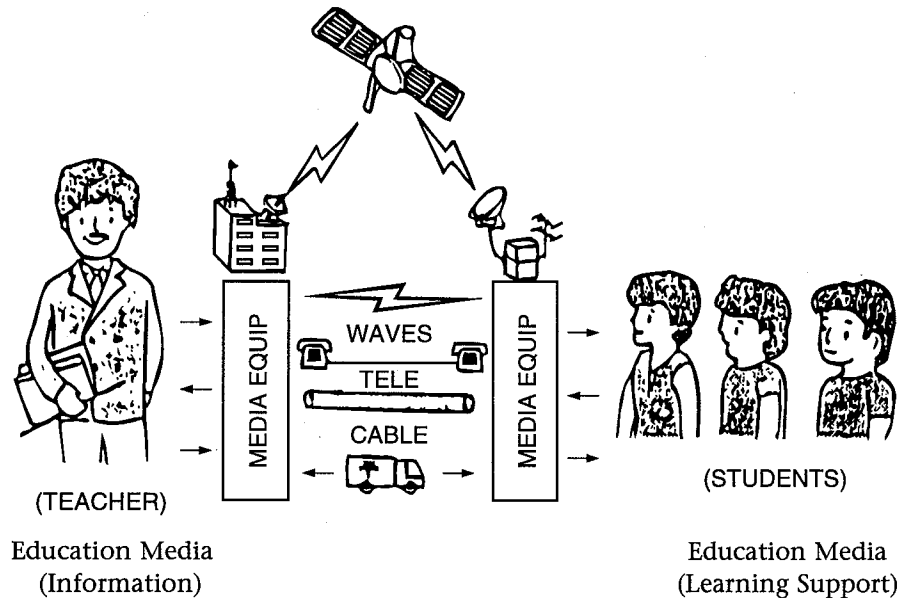


Fig. 1. Distance Education

Position of Distance Education is shown in Fig. 2 (2)

Except for the University of the Air, although the number of participants is large, the number of students who are studying engineering oriented courses might be a rather small portion of this number. Usually experience or training in practice is required to study engineering courses, so in Japan very few schools have opened the correspondence courses on Engineering.

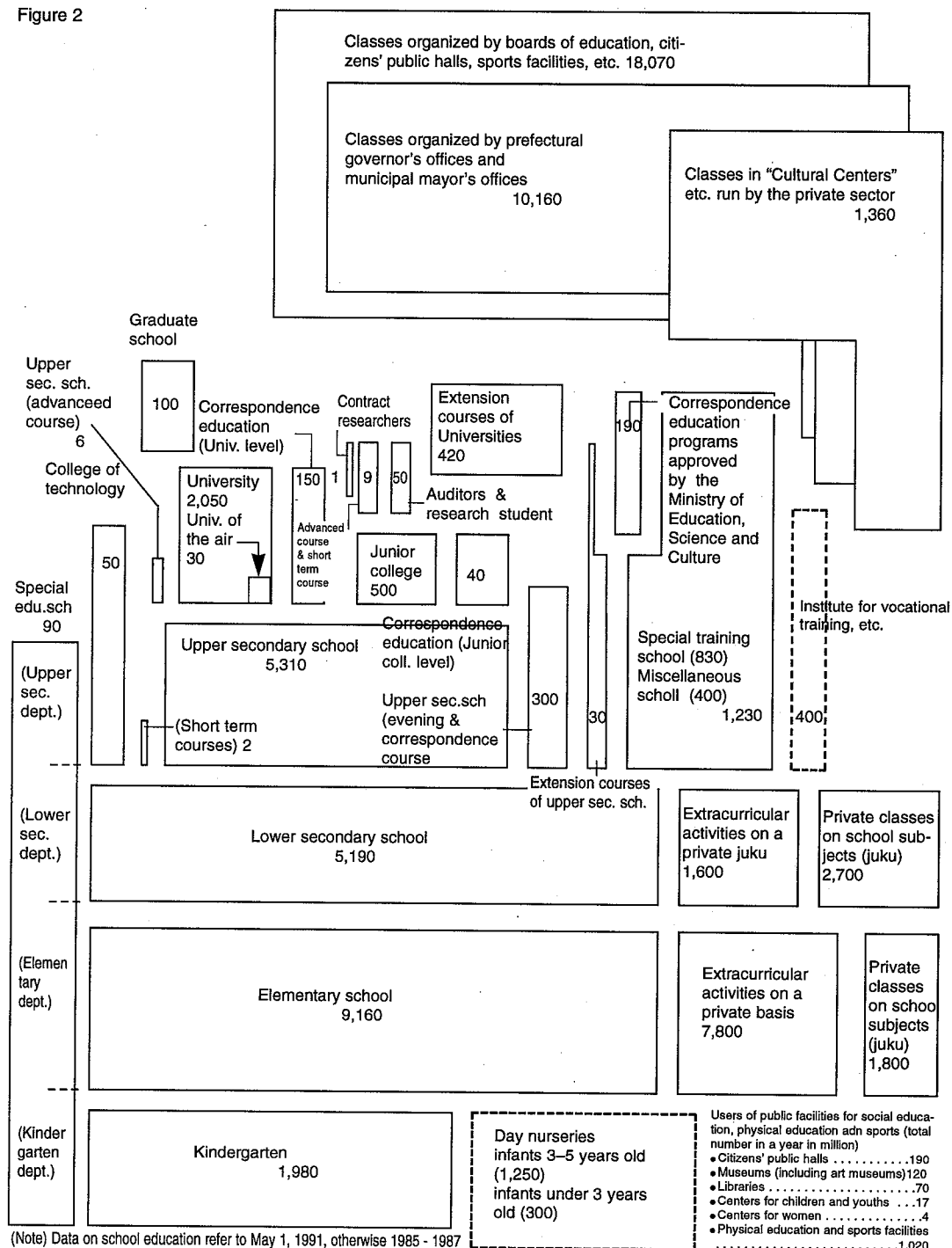
The contributions made by the recent progress of the information media and information systems to promote distance education are surprisingly fast and remarkable.

I will take up this distance education method by method.

Participation of Distance Education in Learning Opportunities in Japan

(thousands of persons)

Figure 2



II. DISTANCE EDUCATION BY USUAL DELIVERY METHOD

In case of education by correspondence, usually the texts and other printed material are sent by ordinary delivery system. An open university/university of the air also used to send their material by ordinary delivery systems.

II.1 DISTANCE EDUCATION BY BROADCASTING MEDIA

(1) Educational Program on the air.

NHK (National Broadcasting Co.) is broadcasting the educational programs; the detail is as follows:

- (Radio 2) 92 hours and 10 minutes
- (FM Channel) 6 hours and 45 minutes
- (TV Channel 3) 97 hours and 10 minutes
- (Satellite TV N° 1) 24 hours and 35 minutes
- (Satellite TV N° 2) 51 hours and 15 minutes

(1)-1 Besides these programs many special educational programs are broadcasted from NHK, in the case of TV programs

- Kindergarten: nearly 10,000 (65.8 %)
- Nursery School: 17,000 (77.0%)
- Primary School: 23,000 (95.1%)
- Middle School: 4,500 (40.1%)
- High School: 3,000 (57.4%)

are using the programs for their education. However, utilization of radio programs is less than 10%.

(2) University of the Air/Open University

This university transmits on a television system which is used only for education, and as for the text book, the printed text book is delivered to the audience by the usual mailing system.

In Japan, the University of the Air began its trial broadcast in 1984 and started enrollment in 1985; the first graduation ceremony was held in April 1989 (Budget for 1993 is 100 M\$).

This university is a 4-year course university. Total number of students registered for a selective subject is 21,000, so the total number of students in 1993 is 46,900. For Kanto area, the program is transmitted from the special television station, and for the other areas students have to use eighteen local video centers, spread all over Japan, until 1997 when the satellite channel becomes available. Then the number of students will increase to 325,000. In order to meet the diversified needs of the Japanese people, the University of the Air has established a Faculty of Liberal Arts which offers courses in three areas of study, each of which has two major subjects. The detail of its activities are well explained in "The Universities of the Air, 1992".

The Ministry of Education, Science and Culture started The National Institute of Multimedia Education as from 1978 (Total budget for 1992 was 19,6 M\$).

III. DISTANCE EDUCATION BY SATELLITE COMMUNICATION

- (1) The Japanese Management Society started a distance education program (Tele-learning) for engineers and workers in the companies using the tele-conference system of NTT (National Telephone and Telegram) as from June 1986.
- (2) Voice and Figures on the Electronic Board are sent by the usual telephone lines to the students and the questions from the students are sent back to the lecturer and are also sent to all the participants, simultaneously.

Although the results of this tele-learning system had been good and also cost effective, it was replaced by the satellite for distance teaching for industries, using audio-visual presentations and the telephone line feed back system as from 1991.

"Practice for new products and new business development" was the first course and was watched by 160 persons in 14 different companies.

Curriculum

6 courses have been provided in the field of artificial intelligence, mechanisms, digital control, electronics, CAD/CAM, expert system, and four courses in the field of management, such as Management staff training, Practice for exploring new products and new business, Practice for facility maintenance, Practice for strategic accounting. Ordinary courses consist of 12 sessions of 90 minutes per week. Approximately 5 lecturers cooperate in the implementation of each course.

Though this system has proved its effectiveness in education for engineers and managers for small to medium sized industries, unfortunately, due to the sluggish business atmosphere, the program had to be suspended as from April this year (1993).

III-1 MOI

MOI has started a new program to use a satellite for the master course program to exchange classroom lectures between several universities; it is still at an experimental stage. They made demonstrations twice in one year.

III.2 OTHER APPLICATIONS OF THE SATELLITE

- Several preparatory schools for the universities are using the satellite for distance education. The earliest case is in 1988 from Tokyo and Nagoya School, one of the largest preparatory schools sent 2 to 3 courses every day to the over one hundred and thirty classrooms all over Japan. In some cases over six thousand students receive the lesson at one time. Total of students participating in this program was over 150,000 last year.

- Pine Net

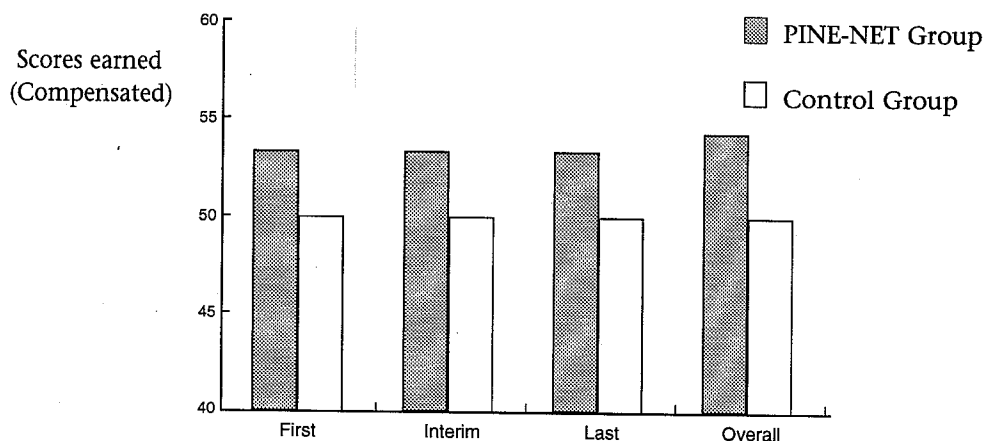
The group of private schools concerned with information oriented education, structured a private special educational network using the satellite.

This system is used by the university which has been allowed to issue an academic degree.

They have their own institute to improve their system continuously and curricula effectiveness is measured by a group of outside consultants and experts.

In the case of Pine Net they transmit from the Institute in Hokaido, in the northern part of Japan, five days a week, over 600 hours in one year, by satellite to nearly ten locations in Japan. One of the effectiveness they measured is shown in the following figure:

Comparison of scores earned by PINE-NET/CAI and control groups



More detailed information may be obtained from their document (4).

** NEC (Nippon Electric Company). One of the largest electronic companies in Japan uses the satellite communication for in-house education [1]

V. GENERAL VIEW OF ACTIVITIES IN ASIA

In Asia, India, Indonesia, Japan, Korea, Pakistan, Sri Lanka and Thailand have organized the Asian Association of Open University and year by year member countries are increasing as shown in the attached chart [5].

VI. CLOSING

In Japan, the future of distance education is bright not only as a measure of refreshment education, recurrent education and continuing education, but also as the media for the basic ordinary education system.

In the case of Engineering Education, experience and training in practice is essential, so schooling seems to be mandatory.

In the era of information systems or satellite systems, the funding allocation by the Government to encourage the university level of engineering education, is strongly and urgently desired to enhance the improvement of the quality of life of people.

References:

- [1] Media Technology and Distance Education, 1968, Vol. 71, N° 1. J. JEIC Y. Shimizu.
- [2] Japanese Government Policies in Education, Science and Culture. 1991 pp. 113
- [3] Distance Learning for Industry in Japan. 1992. T. Sakamoto et al. Industry and Higher Education. Dec. 1992
- [4] Software Consultant Corporation
- [5] Research Conference Report. Asian Association of Open University. 1987

Nation	India	Indonesia	Korea
Member of Fulltime /Part-Time Faculty	53/269	3.000 (Including tutors)	130/13,154
Number of Fulltime/ Part-time	320/53	450	194/0
Name of Degrees Offered	B.A.B.of Commerce B.Sc. Diploma in Management. Diploma in Distance Education	Diploma I, II, II and First Degree (Sarjana)	Bachelor's Degree in 8 denominations and Diploma in Early Childhood Education.
Annual Current Expenses	R.S. 130 million	US\$ 2.75 million	US\$ 18.480.750
Objectives of Establishment	<p>1) To advance and diffuse learning and knowledge by a diversity of means, including the use of communication technology</p> <p>2) To provide opportunities for higher education to a large segment of the population</p> <p>3) To promote the educational well being of the community.</p> <p>4) To encourage the open university and distance education system in the educational pattern of the country</p>	<p>1) To provide more opportunities for access to higher education, using distance means.</p> <p>2) To produce high level manpower for various sectors of development</p> <p>3) To upgrade people working in various professional jobs.</p>	<p>1) To raise the general education level of the people by providing opportunities of higher education for those high school graduates who, for various reasons cannot pursue ordinary college education.</p> <p>2) To improve the academic and professional qualities of the people engaged in the professional fields covered by the twelve major areas of study in order to contribute to the national welfare through higher education.</p>
N° of Universities participating (1990)	5	1	1

CHART N° 5(1)

Pakistan	Sri Lanka	Thailand	Japan
70	155	200/3.000	67/525
861/1,608	508/1,000	600	194/40
Bachelor of Arts Master of Arts (EPM) Master of Science Master of Business Administration M.A. in TEFL	Diploma in Technology. Bachelor's Degree in Science, Law, Post-Graduate Diploma in Education, M.Phil.	Bachelor - 9 Certificate - 5	Bachelor of Liberal Arts
RS 33 million	RS 34 million	US\$ 23.281.000	US\$ 51.000.000
<p>1) To provide facilities to people who cannot leave their homes and jobs.</p> <p>2) To provide such facilities to the masses for their education uplift.</p> <p>3) To provide facilities for the training of teachers.</p> <p>4) To provide for instruction in such branches of learning technology or vocation, and to make provision for research and for advancement and diffusion of knowledge.</p> <p>5) To hold examinations to award and confer degrees, diplomas, certificates and other academic distinctions.</p>	<p>It is essentially a home based University offering its own programmes of study leading to certificates, diplomas and degrees and Post-Graduate Diplomas and Degrees, to provide educational opportunities for upgrading of those employed and an avenue of higher education for those who are desirous but unable to obtain same at other conventional universities.</p>	<p>1) To provide and promote university and professional education so as to enable people to raise their educational standard in response to the needs of society.</p> <p>2) To promote research so as to generate new knowledge and to national development.</p> <p>3) To render public service to society by disseminating knowledge so as to promote personal development and professional competence.</p> <p>4) To preserve and develop national culture.</p>	<p>1) To provide working people and housewives with the chance of life-long university level education.</p> <p>2) To provide an innovative and flexible system of university level education which is open to all high school graduates.</p> <p>3) To cooperate with existing universities and make full use of the latest knowledge and newest educational technology in order to offer a system of higher education which meets contemporary needs.</p>
1	1	1	1

CHART N° 5(1)

DISTANCE LEARNING IN ENGINEERING THE "OPEN UNIVERSITY" (BRITAIN)

WFEO Committee on Education and Training

by J. C. Levy

1. INTRODUCTION

The Open University (OU) was established in 1969 to provide higher educational opportunities for adults who wish to study in their own homes and in their own time. Like all UK universities it can grant degrees and other qualifications. It also has a special responsibility to further the educational well-being of the community as a whole. Over a million people have studied with this University to date.

This year 1993 about 150.000 students are enrolled. Most will be working towards a degree or a higher degree, others will be taking single courses, diplomas or study packs as associate students.

The OU also uses its internationally recognised expertise in open learning to produce a series of quality training courses for industry and commerce. These courses are continuously updated to reflect technological advances and the needs of a widening industrial and commercial audience. Two programmes of particular note are "Manufacturing: Management and Technology" and "Computing for Commerce and Industry".

The OU operates from a campus near Cranfield in central England, but there are not many students there at any time. The campus mainly provides facilities for academic staff and for a production unit of the British Broadcasting Corporation (BBC) which prepares high quality instructional programmes for radio or television transmission.

2. TUITION AT THE OU

Tuition is mainly by instructional packs (which may also include experimental kits) posted to students' homes. These packs link with the radio or TV transmissions which many students will record for future reference.

Newly enrolled students receive a package of preparatory material before the course begins. Each is assigned to a member of the tutorial staff who is responsible for counselling the student throughout the course.

Students' regular contacts are with their regional centre, each of which is headed by a Regional Director. Within the 13 regions are some 250 study centres placed to match the distribution of the student population. They are usually in full-time educational institutions and are available to OU students on week-day evenings and Saturdays.

The main purpose of these study centres is to enable OU students to meet their tutors and other students.

Summer schools are held which entail six days in residence at a conventional university, where the OU brings students and tutors together for intensive full-time study, which may include lectures, seminars and laboratory work. Examinations are generally by a combination of continuous assessment and formal written examinations. The continuous assessment element is on the basis of assignments which are either tutor-marked or computer marked. At the end of the year each degree level course has a written examination, usually lasting three hours, which has to be taken under supervision at a study centre.

Courses are organised into four progressively more advanced levels: Foundation, Second, Third and Fourth levels. To obtain a Bachelors degree, six credits are needed, which can usually be obtained at the rate of two per year. For an honours degree an additional two units are needed, making eight in all and probably covering four years of study.

Hundreds of separate course units are available in the following Faculties:

- Arts
- Social sciences
- Education
- Mathematics
- Science
- Technology
- Health and Social Welfare
- University-wide, Interdisciplinary

3. ENGINEERING AT THE OPEN UNIVERSITY

Within the various faculties, courses are offered in the following subjects relevant to engineering:

- Chemistry
- Computing and Computers
- Earth Sciences
- Economics
- Electronics
- Engineering Design
- Engineering Mechanics
- Environment
- Geology
- History of Science and Technology
- Materials
- Pure Mathematics
- Applied Mathematics

Mathematical Physics
Physics
Production Engineering
Statistics
Technological Systems
Town Planning

4. PROFESSIONAL ENGINEERS AND THE OU

To qualify as a professional (Chartered) Engineer in the UK there are four components which have to be satisfied. These are:

- i) The academic requirements by means of a recognised (accredited) engineering degree;
- ii) Training, covering specified knowledge and skills;
- iii) Experience, including some of a responsible nature;
- iv) A professional review in which the candidate is interviewed by senior engineers.

For the mainstream route to CEng., full-time students take a minimum of seven years to satisfy all these requirements. The minimum age for CEng. is 25 and the average about 28.

The standards for all four components are set by The Engineering Council in its publication "Standards and Routes to Registration" (SARTOR) and it is The Engineering Council which awards the title of Chartered Engineer (CEng.). In its work the Council works with and through a number of Engineering Institutions (eg the Institution of Mechanical Engineers) and a candidate for CEng has to be accepted for membership by one of these Institutions before being proposed to The Engineering Council for the CEng title.

Students at the OU can satisfy the academic requirement for Chartered Engineer (see 4(i) above) if:

- a) They hold an OU honours degree for which eight credits are required;
- b) Seven of the eight credits have an engineering content acceptable to the relevant engineering institution;
- c) Of the eight credits at least two must be at level 3 and one must be the fourth level project (see below).

An example is given in the Annex of the requirements of the Institution of Electrical Engineers.

The eight units of credit satisfy only the academic part of the requirements for Chartered Engineer. Candidates still have to fulfill the training, experience and professional review components (4(ii), (iii) and (iv) above).

However, it is possible that, as many of the OU students are in full-time employment while studying for their degrees, that they may fulfill part of the training and experience requirements concurrently with their academic studies.

The T-401 project, which is compulsory for all OU students wishing to qualify as Chartered Engineers, offers an opportunity to carry out a supervised project in any area or combination of areas covered by the Faculty of Technology. By the end of the T-401 course each student is expected to:

- a) Organise work to achieve a specified goal in strict time limits;
- b) Gather, analyse and evaluate material to increase understanding and awareness and the generation of ideas;
- c) Produce a written report which clearly and concisely communicates the context of the project to others.

Projects may result in design proposals or specifications for a system or artefact. Each student has a personal tutor and there is a minimum of eight hours of tutorial time allocated during the year, plus informal communication by telephone between the student and the tutor throughout the year. In many cases, employers cooperate in providing facilities for project work.

The final report is assessed by the tutor and another internal examiner and then there is an oral examination. Finally, a panel of external examiners considers all the submitted projects to act as a final check that the standards reached are comparable to those achieved at conventional universities.

About 100 students per year submit T-401 projects and are therefore in route to becoming Chartered Engineers.

ANNEX

The Institution of Electrical Engineers had adopted the following profile of courses for students wishing to become professional electronic engineers and proceed to the CEng title.

Foundation-Level

Credit Value

<u>One of T-</u> 102 - Technology	1
S- 102 - Science	1
M - 101 - Mathematics (note (i))	1

Second Level

T-202 - Analogue and Digital Electronics	1
DT-200 -An Introduction to Information Technology	1
M-205 - Fundamentals of Computing	1

Third Level

Two Credits from:

T-322 - Digital Communications	1/2
T-301 - Complexity, Management and Change	1
T-362 - Design and Innovation	1/2
T-363 - Computer Aided Design	1/2
T-393 - Electronic Materials and Devices	1/2
T-394 - Control Engineering	1/2
(M-353 - Programming and Programming Languages	1/2
(or	
(M-355 - Topics in Software Engineering	1/2
(or	
(M-357 - Data models and data bases	1/2
- Computational Mathematics	1/2

Fourth Level

T-401 - Technology Project	1
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- Notes:
- i) 101 must be taken unless evidence is produced of equivalent mathematics knowledge
 - ii) The above totals seven of the eight required credits. The eighth is a free choice from any of the OU courses.

1