# Innovation Process in the Engineering Curriculum in Peru

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***Abstract**: In this paper, first of all, let me remark on the correlation between the kind of technical education at the university and the different patterns of national development tried out in the last century; secondly, the process of diversification of the engineering careers in this country. Finally, other aspect that is of particular concern in the fact that we are presently witnessing the attempts or efforts oriented toward the innovations in curricula and the application of the most modern methods or technologies concerning continuing engineering education, and in improving the co-operation university-industry in Peru taking into account the significant changes taken place world wide in science, technology and economy.*

## INTRODUCTION

The peruvian university, since the creation of the National Major University of San Marcos (UNMSM), on May 12, 1551, has been subject to a slow process of growth, and, also, decentralized development which will briefly be outlined. For about three centuries the UNMSM has kept up a salmantin pattern which has served as a model for the creation of new National Universities as well as other universities of Latin America.

The central government, in passing the 13417 law of 1960 (specifically, on April 8, 1960) set up for the first time the interuniversitary council made up of the Rectors of each peruvian university, irrespective of the hierarchical status of each university and, therefore, the system of faculties, as basic units of each university's organization, was stablished. This system of faculties has been introduced again by the 23733 law, May 09, 1983; in place of the former system of academic departaments established by 174337 decree (February 8, 1969).

Over the past decades, with each government introducing periodic changes in the system of organization of the peruvian university, an inorganic process of creation of universities has taken place. However, such process, unfortunately, has been the result of political and electoral motives instead of being based on strategies oriented towards the goal of reaching the true needs for regional development. In 1959, eight public university and one private university had been created in our country and, furthermore, the Congress, in passing the 13417 act, in force during the period 1960-1969, achieved the approval of twenty one new universities, and ten private universities (seven in Lima and three in provincies). During this short period the universities increased more than three times when compared with former figures.

The creation of new universities gave rise to the diversification and new proffesional careers were founded. As result of the just described situation, the number of officially approved engineering specialities experienced an increase from 15 to 31, a fact that do not suit the true needs within the productive domestic sector. At the present day (as of February, 1998) there are 67 universities, that is, 28 public universities and 39 private universities and, there fore, it would seem obvious that such facts as could only be explained on the supposition that higher education is currently changing rapidly and is becoming increasingly part of the private sector.

The creation of new universities has had the effect of accelerating the increase in university student enrollment. Our university student enrollment experienced an increase from 110,000 (in 1970) to 350,000 (in 1985), and, at present, the total enrollment is moving towards a student population of 600,000. Furthermore, it is at the level of non-technical specialities that the majority of students are to be found. On the other hand, as regards the large number of universities, we can say that is consequence ascribable to a gradually deteriorating of peruvian economy as well due to a more scarse labor market. Likewise, such expansion stems to a large extent from the existing, ineffective policy imposed by each government in the sense that none of them has been able to suitably restucture the educational system, one alternative in the way of solution would be the creation of technically-oriented short careers.

## I. MODELS OF DEVELOPMENT, TECHNOLOGY, AND PERUVIAN UNIVERSITY.

It is a well recognized fact that the university is an institutional framework or, put in another way, the university is a fundamental part of the institutional structure of society that reflects the economical and social country's situation in different periods of time. In Peru, in the past century diverse models of development have been tried out; thus, to our view, there is a definite relationship between those models and the kind of applied technology in the productive sector as well as the technical training imparted by the universities in order that its graduate students may

meet the needs of the modern economies.

In looking back on past events concerning domestic realities, we can glimpse that during the latter part of the nineteenth century mining underwent a process of resurgence based upon pressing needs of our country in the sense that the payments of the foreing debt were subject to such serious economic difficulties as insufficient cash assets because of various motives, namely: the country, unfortunately, was exporting only guano and saltperter and owing to the fact that the dollar exchange obtained were insufficient on account of their relevance to our limited exports, the economic system was not able to pay public loans adequately; on the other hand, the country continued to experience significant worsening of their terms of trade and around that time "the war in the pacific" broke out and, because of this event, no longer could the peruvian government primarily rely on its exports (guano and saltpeter) for assistance as debt requirements continued to become heavier.

The comments just made are directly relevant to the creation of the National School of Engineers (Now, National University of Engineering). This school was created with the only goal of carrying out the idea previously proposed and of having materialized, namely: to contributed to the necessary training of engineers qualified to be managers of enterprises; the establishment of mining engineering and civil engineering. About that time and, on account of these uncertainties, large amounts of american investment were mobilized and channeled to peruvian economic system through traditional lending and, as a result the english lending and investment in Peru were pushed aside, at the same time, the so-called "enclave economies", were created and oriented towards the only goal of carrying out the process of confluence of economics systems or sectors backed up by modern technology, but unfortunately, those sectors do not foster the development or progress at the local level and the native economic systems backed up by technologies based on craftsmanships.

Up to beginnings of decade of the 50's, in our country the basically primary export sector has acted in the way of prevailing model. The creation (1901) of the National School of Agriculture and Veterinary Medicine (Now, National Agricultural University) is owing to the fact that it was necessary to meet the requirements of the economic system of that time.

Furthermore, about by that time, the industry sector in a novel way started absorbing increasing amounts of monopolist foreing capital and, consequently, many branch factories were established with the goal of exerting a supremacy over such industries as food industry, mining industry and textile industry. The american engineers and proffesionals were given an adequate share of responsability for decision-making, control and management of existing new enterprises, where as the peruvian engineers were in charge of minor tasks involving a second level technology.

From 1960 to 1970 we have witnessed the advent of the called "inward development policy" with the result that imports were replaced by better alternatives, for, firstly, the manufacturing sector began enjoying special treatment by means of protectionist measures; secondly, the incorporated technology began experiencing a dismemberment process and the local producers of capital goods and peripheral technologies were given a greater opportunity to participate in the economic and comercial activities (installation, assembly, maintenance, adaptation, repair).

In this period, because of domestic private sector's failure to foster peruvian development, we have witnessed the intervention of the government, and that is why the government was referred to as "the manager-state". Likewise, the number of universities with traditional specialities, such as business administration and humanities, experienced an increase equivalent to more than three times the number of the universities in the former period, and such careers were regarded as devoid of priority from the standpoint of the demand of the productive sector.

At the end of the decade of the 70's, a number of models or mechanisms were tried out or instituted with the goal of fostering "outward development" by means of neo-liberal policies sponsored by the International Monetary Fund, with the result that such policies inmediately influenced demand for foreing technology in spite of the domestic production of technology.

By the middle of decade of the 80's, a new capitalist "heterodox model" was tried out in order to counteract the results achieved by the former government, and, according, the peruvian state reasonably placed exonerations and incentives at disposal of peruvian managers with a view to reactivating the economy and, eventually the subsequent profits would supposedly be invested again in the same economic system. This economic model produced the highest inflation in the last century in Peru (7,650 % per year), besides an hard stagnation. In this period the process of creation of new private universities was still going on.

In the middle of decade of the 90's, the present government adopted a neoliberal model in accordance with the international prevailing policies. This model calls for a reconversion of the national industry and, consequently, new and modern technologies must be applied in order to achieve an increase in the productivity and thus compete from a international viewpoint within a global and interdependent economy.

However, this innovating experiment poses challenges in the sense that investments must be made in capital-intensive technologies, but infortunately, such has being bloked because of shortage of funds at the national level and, in addition to that, is held in subjection to the so-called "foreing aid" from the international financial agencies; on the other hand, the multinational investments must be taken into account because of the financing conditions imposed by such institutions, besides the process of selling of the public o state enterprises.

The university again has to face the new challenges

involving the need of fulfilling the demand for increasingly qualified proffesionals, and, in particular, the proffesionals involved in engineering careers and related fields must prioritily be taken into account.

## II. DIVERSIFICATION OF ENGINEERING CAREERS IN PERU

Up to the latter part of nineteenth century, only five national universities offered careers closely related to academic fields referred to as humanities, legal profession and medicine.

When the primary exporting model of the national economy began to change, the inmediate consequense was the emergence of the technical professional: the engineer. Now we will describe how the engineering careers were diversified during the present century.

The process of evolution of engineering career during the first part of the present century has been closely related to existence and history of the National University of Engineering (UNI) which was created by law enacted on March 10,1876; this university was inaugurated on July 23, 1876; under the name of School of Engineers. We are stressing such relationship on the basis that, the UNI has, since its creation, been the main center of higher education of engineers both because of the considerable numbers of graduated engineers as well as owing to diversity of engineering speciaties imparted by the university, and furthermore, most of them were exclusively offered by the UNI.

On the other hand, up to decade 50 of the present century, in addition to UNI there were four universities which offered a few engineering careers: the National Agricultural University which has been training agriculture engineers and forestry engineers; the National Major University of San Marcos and the National University of Trujillo which have been training chemical engineers and geological engineers; and the Catholic Pontifical University of Peru which has been training civil engineers.

If we are to objetively understand how the engineering careers were diversified in Peru, then we will have to approach this problem from the historical point of view. Therefore, we will lay stress on the different periods, from the date of creation of the School of Engineers until the present period.

### Period 1876 - 1911

In the decade of the 70's of the past century, when the domestic comerce of saltpeter was on the decline, it became necesary in our country to orient the economic activity towards the minig and agriculture; consequently, the Peru had to resort to technical professionals, namely; the engineers, who, formerly, had to be hired abroad.

In order to supply the shortage of peruvian engineers, the School of Engineers had to be created with the inmediate goal of training engineers specialized in the management of enterprises; therefore, from that date, the two following careers were created: mining engineering and civil engineering. The french school predominantly influenced the curriculum.

En 1901, the National School of Agriculture and Veterinary Medicine (now, National Agriculture University) was created, which undertook the training of Agriculture Engineers.

### Period 1911 - 1930

In 1911 the curricula were restructured in the School of Engineers and, therefore the school laid greater stress on the practice or experimental side, with the goal of trainig professional specialized in certain phase of the productive activity, and therefore engineers and professionals brought in by the foreing enterprises were in charge of the management of enterprises.

In accordance with the curricular process, the common courses in political economy as well as formative courses related to management of enterprises were put out of the curriculum; on the other hand, new technical courses were ushered in. New specialties, namely, electro-mechanical engineering, industrial engineering and arquitecture, were created.

### Period 1930 - 1945

The School of Engineering took steps aimed at ignoring the social problems enviroment of that time and, instead, measures were taken to promote the industrial policy established at the initiative of each government. In keeping with the new curriculum, the school laid considerable stress on the teaching of mathematics, and consequently, the new trend was toward a rigorous specialization and, at the same time, there was in increase in the number of courses for each career, and, lastly, the american school remarkably influenced such curriculum.

In 1933, civil engineering Faculty was founded in the Catholic Pontifical University. About by this time, they first began introducing specialties related to chemical engineering both at the UNMSM as well as at the National University of Trujillo. At the UNI such spaciality was introduced as a branch of Industrial Engineering.

### Period 1945 - 1960

In 1945 the university reform took place, with the active participation of studentes of the School of Engineers, and, consequently, such reform has led to the appearance of a new speciality, namely: petroleum engineering and, at the same time, the aeronautical engineering was suppressed; therefore the american school strongly influenced the contents of the just conceived curriculum. In this period at the UNI following careers were created : sanitary engineering, geological engineering and metalurgical engineering. Furthermore, such specialities, except sanitary engineering, were succesively created both at the National Major Universidad of San Marcos as well as at San Agustin University of Arequipa.

**Period 1961 - 1968**

In 1963, at the UNI the was created: Economical Engineering career, and, around the begining of the period 1961-69 a new sub-specialty referred to as "Hydraulic Engineering" was created and regulared by the faculty of civil engineering; likewise, electronic engineering was created as a branch of the faculty of electromechanical engineering, and, in the latter part of this period, textile engineering and chemical engineering were created as branches of industrial engineering.

**Period 1969 - 1996**

Owing to frequent turning in the university policy in the last 25 years, period during which four university statutes were enacted, the critical situation became increasingly worse, and the outcome has been an inorganic growth with no real planning of the peruvian university; the foregoing discussion leads us to such conclusions as claiming that university careers have gradually been hard hit, and as regards the career of engineer the prospect for the future becomes increasingly incertain because of the fact that there is not a definite relationship between the prevailing number of specialities (30) of engineering and the oportunities of job made available by the demand. At present, the specialities of engineering officialy recognized are:

- Civil
- Electronics
- Industrial
- Food industries
- Fishing
- Environmental
- Mining
- Mechatronics
- Fluid mechanics
- Petrochemical
- Chemical
- Industrial biochemical
- Geophysics
- Informatics
- Agricultural
- Electrical
- Mechanical
- Electro-Mechanical
- Metallurgical
- Management
- Petroleum
- Geographical
- Economics
- Naval
- Systems
- Textile
- Aeronautical
- Industrialsafety
- Agroindustrial
- Forestal
- Geological

## III. PROCESS OF CURRICULAR INNOVATION IN THE ELECTRONICS ENGINEERING SCHOOL.

The problems related to changes or curricular study reform within the electronics engineering are closely linked to goals and aims inherent at the academic institution awarding titles and academic degrees in electronics engineering, the planning of process of reform should consider such institutional model.

Below we are exposing the basic, preliminary stages with regard to the writing of the electronics engineering's curricular plan within process of elaboration of the new curriculum.

### 3.1 GENERAL INSTITUTIONAL POLICIES

**Professional Formation Engineering**

The engineer by profession educated at the UNMSM must be qualified for the retrieval, adaptation, operation and creation of technologies oriented towards the country's integral and self-supporting growth.

The UNMSM graduate must be trained to lead the transformation process necesary for the country.

The professional formation is an answer to the fact that it is necesary to train and reorganize scientifical-technological graduates qualified to create and lead the necessary growth for the country.

Such mission (post-graduate and second specialization studies, academic recycling, professional perfection and updating, and so forth).

**Teaching/Learning**

The UNMSM regards teaching/learning as a process oriented towards the formation of integral men, as well as oriented towards professional formation and specialization; in addition, such process is an answer to the fact that it is necesary to be abreast with the country's problems and, lastly, to agree to seek to obtain suitable solutions.

The teaching/learning approvall must be subject to following criteria:

a) Development of critical and creatives abilities.

b) Development of working ability both in size and quality.

c) Development of understanding and commitment to national problems.

d) Permanent interaction between theory and practice, the latter being regarded not only as experimentation but as process of participating in the production work and technical innovation as well as the assimilation of technological transformation.

e) Development of the capability for optimizing the use of technologies in accordance with social and economic criteria as well as in accordance with the possibilities found in the natural resources.

f) Suitable relationship between teaching/learning approach and research.

g) Permanent evaluation of teaching/learning approach, and assessment according to right and objetive criteria.

The trasmission and asimilation of knowledges and skills should be handled by both proffesional graduates and students.

Accordingly, it becomes necesary to promote the research and the pedagogical training and preparation and training regarding elaboration of curricular methods as well as educational assessment.

By making such transmission/asimilation more efficient it becomes necesary to introduce the modern educational technology and the instruction aids.

h) Training and information on the national reality.
i) Basic training.
j) Professional training, oriented towards the goal of providing student with the knowledges and skills inherent in his profession.
k) Specialized information, prepared in the way of activities package (courses, seminars, papers, researches, an so foth) which train student in specific subject within the same professional area.

Studies curricula should place emphasis on the goal of devoting more time to go deep into basic concepts of formative subjects, so avoiding crowd the course programs, and the same can be true about the creation of numerous courses in a same area o discipline.

### 3.2 INSTITUTIONAL GOALS

As a leading institution by contributing towards the organization of a national system of science and technology aimed at integral development of country and in the service of the national interests.

By doing research into scientific and technological areas in order to promote the national growth inasmuch as the research is regarded as a effort of the highest priority as well as a centerpiece for the professional training and post-professional; such research can also be regarded as a source of proposals of solutions to national sectorial, regional and local problems.

Setting up a strong relationship and excellent cooperation among the differents Faculties and promoting the joint elaboration of programs and plans which are multidisciplinaries in nature and useful for the country.

Training change-minded individuals who are to be able to be leaders in their field of competence or speciality and who, likewise, are to be aware of their responsabilities towards society and country.

### 3.3 GENERAL AIMS CONCERNING REFORM PLAN OF CURRICULA WITHIN THE ELECTRONICS ENGINEERING SCHOOL (EES)

Within the framework of outline regarding policy and basic aims of the reform plan of curricula concerning EES, we have the following goals:

The training of chanse-minded electronics engineers who are to be able to be leaders in their field of speciality, willing to undertake challenges pertaining to managerial issues, and, likewise, willing to create things within the technological field.

By training a integral engineer, widely aware of national, international reality; such engineer will be aware of his duties towards society and country and, likewise, of his role in the future.

By training engineers of electronics in accordance with outlines drawn up for engineers who are to be educated in the EES.

### 3.4 DEFINITION OF THE PROFESSIONAL SCHEME

**General Aim**

Definition of professional outline of electronics engineer, for the training of a integral engineer througthly aware of national reality, thus promoting the country's social and economic growth.

**Particular Aims**

Defining special development features of the individual as a person, reing the latter regarded as integral member and, at the same time, being in joint relationship with the society.

Defining the professional features of the electronics engineer, features that will train him to be an agent for the change in the country's social and economic development.

## PROFILE OF THE ELECTRONICS ENGINEER

The profile states the relevant features to be met by the electronics professional trained within the EES's professional school. Therefore, the EES's new studies curriculum, wil be worded in accordance with the model that takes professional development into account [personal profile], the technical and scientific knowledge [knowledge profile] and, likewise, such model should take the society's needs as well as national production sector's needs into account [employment profile]. Thus, the electronics engineer will be trained from the integral stand point, main goal or cornerstone upon which FIE's curricular reorganization is based.

From the above, the following outstanding aspects are to be considered:

A. Personal Profile (what he should be as a person).
B. Knowledge Profile (what he should know).
C. Employment Profile (tha ability of the engineer at the moment of practicing engineering).

**A. Personal Profile.**

Develop his personal actions and professional activities according to ethics based on respect towards his community's members and their representative institutions.
Be qualified to handle analysis, criticism and self-criticism.
Adop lasting teaching disposition.
Be aware of his social duty or responsability as engineer as well as be aware of his leading role in the future.
Exhibit and prove his responsability and honesty in all his actions.
Exhibit responsability, strong social commitment translted into desires o willingness for contributing to the welfare of the community.
Exhibit creativity and resourcefullnes.
Be willing to be leader, that is, be qualified to organizate, initiate and make strategical decisions.
Be willing to consider adaptations and be qualified to work in team.
Cultivate self-learning and group-learning.
Cultivate the high spititual values within the universal culture.

**B. Knowledge Profile.**

Master the general laws governing the nature and the society.
Have sound background in sciences and engineering as an element of support for his continued professional updating or improvement as well as for the development of the scientific-technical research work.
Have multidisciplinary background enough to work in team.
Be suitably qualified to all (what) has to do will iniciative and corporative management so that he will be able to create new jobs in his own specialized field.
Be qualified to deal with oral and written communication efficiently and accurately.
Identify and know how to get scientific and technological information resources, oriented towards accomplishment of projects, studies and researchs.
Be abreast with the recent technologies dealing with electronic and computer engineering's specialities, taking country's needs into account.
Be abreast with industrial environment's working at both methods level and at procedure level.

**C. Employment Profile.**

The works or activities electronic engineer can perform from the professional stand point are, according to priority, the following :

Project, design and technological adjustment process.
Construction, erection and service operational.
Operation, planning and construction management.
Advising and technical assistance.
Research and development.
Undergraduate instruction (technical higher education).

In addition, the engineer should have a suitable background in an engineering discipline so that he will be able to participate in programs within the productive and services sector (it will produce, market, and apply the modern electronics technologies as well as communication and data processing) and accordingly, with expertise in one or more of the following:

Management, business management, economics management, and also, financial management and staff management.
Quality control and technical inspection (or technology assessment).
Expert work and technical qualification for the asimilation of technology.
Writing of engineering standars.

## V. ORGANIZACION OF CURRICULAR MODEL

In order to attain the objetives worded for the EES's plan of curricular reform, the organization of the new curricular model will have to meet the following requirements (or parameters) :

The curricula will necesarily require that university studies be established which will include three sequential cycles, namely : basic cycle, transition cycle and professional cycle which to a given degree will present superposition, depending upon general and particular objetives.
The plan of studies will feature a diagonal structure, that is, basic sciences area will provide the student with the background in physical-mathematical sciences, social sciences and humanities (economics, history of evolution of sciences and technology, social, economic and environmental impact of technology, and so forth). Structure where the greater stress is laid on studies for freshman and sophomore. The engineering sciences area will include courses from the gradual stand point starting from the first or second university studies year until the third university studies year is completed; its contribution being decreased in the fourth university studies year on the other hand, technological area courses will be introduced in the fourth university studies year and its contribution o presence is increased in the last studies year.
In the last studies year, the students can choose, through obligatory and elective courses, the following specialities : control and systems of communications, or electronics.

Promote a tendency towards a reduction in the teaching hours within the classroom and per course, as well as the posibility of introducing a separation of theory courses and laboratory courses, so avoiding the unnecessary and unyielding aproach, and at same time not overlooking the academic rigor.

The curriculum should include advent of new and modern teaching methods (computer science and simulation models) particularly in those purely theorical subjects not backed by laboratory practices. In that way, the teaching-research link will be attained.

Define a academic valuation system for a course or group of courses in accordance with its priority, significance and degree of difficulty in the academic integral student formation or education so surmouting or removing the existing system (one class hour igual one credit, etc.).

In accordance with a estimate prepared for the minimun curriculum of 3,600 total teaching hours comprising five years studies with 32 actual weeks per year, the FIE's curricular structure will have to adopt a reference percentual distribution per academic area, according to :

Basic Sciences :
30% (Physical-Mathematical)
7% (Social Sciences and Humanities)
Engineering Sciences : 30%
Technological or Professional : 33%

Likewise, it will become necessary, as a proposal to be debated, consider the following hour distribution (with regard to 3,600 hours) :

Percentual theory hours : 50%
Percentual laboratory hours : 15%
Percentual hours for practices/seminars : 25%
Percentual computing hours : 10%

Adoption of new academic evaluation systems or methods, which will make it easier for professors and students to get rid of such unnecessary obligations as extensiveness, over repetition and (over) strain inherent in the present (day) systems.

## IV. CONTINUING ENGINEERING EDUCATION IN PERU

The continuing training of engineer closely involved in productive activity and in services activity in the different regions of country, poses a challenge because of complex geography of the peruvian lands with ecological floors going up to 5,000 mt. altitude with respect to sea level, with desert and snow-covered highlands and tropical regions.

The challenge of continuing engineering education is shared, in accordance with resources and capabilities, by universities, college of engineers and other filial colleges all over the country, the institutes and peruvian professional associations involved in engineering careers. The modern technologies must be brought up to date specially concerning industrial sectors or enterprises:

Agricultural-Alimentary sector.
Agricultural-Industrial sector.
Petrochemical and non-metallic minerals sector.
Fishing sector.

The just indicated industrial sectors are regarded as leading industries, and, furthermore, such industries require modern technologies in accordance with how complex the industrial process may be, the trend being towards automation and a more economic use of labour force; on the other hand, the small-scale industry sector requires a greater numbers of man-hours of labor per unit product. The CAD systems (computer-aided design) have been introduced, and, likewise, the CAM system (computer aided manufacture) includes: machines of numeric control, automatic manufacturing systems, qualify control systems and industrial robots. Lately, the services sector (banking, commerce, communications, transports) in their attempt to move towards the goal of modernization, has significantly derived its high momentum essentially from the introduction of such modern technologies as teleinformatics, optical fibre, via-satellite systems.

In Peru, in the past three decades because of migratory movement of labour from diverse regions of high lands toward coastal regions, the so-called urban informal sector has made its appearance, and the total labour force of this sector is accounting for about 30 % of economically active population (PEA) at domestic level and about 46% with respect to Metropolitan Lima; this informal sector would be yielding about 38% of gross domestic product (PBI), where as the industrial sector provides about 23% of PBI, and it has absorbed about 10% of the PEA, according to certain studies, about 70 % of informal sector is composed of people engaged in activities with the only goal of meeting their basic requirements; and the remaining group (about 30%) is made up of miners and small-scale industries which usually make use of technologies and methods closely linked with the craftsmanship.

Summing up, within the peruvian economic system we are witnessing the joint establishment of three productive sectors, namely: a modern sector (leading industry) and the traditional sector (small-scale industry) and, lastly a marginal sector (informal sector) with different technological requirements.

The technological updating and training of engineer is usually carried out in the capital in virtue of that the more reputable and qualified universities and higher academic institutions are located in Metropolitan Lima, in the universities UNMSM and UNI are offering short courses aimed at professional updating undergraduate major programs and postgraduate programs, teaching highly complex recent

technologies covering diverse engineering branches aplying the following teaching aids:

The multimedia projection, with the goal of displaying specific topics of the programmed course, in virtue of that on the basis of such topics the stages of experimentation and assembly of the real devices or system will be carried out.

Digital simulation (at Informatics Laboratory) of dynamical phenomens, and, in addition, the digital simulation can be used in the way of tool essential for the design of physical (or real) devices.

Interconnection with Internet.

Linking via Hispasat Satellite with the Iberoamerican Educational Television.

Similarly, at the Peruvian College of Engineers has been introduced the Professional Qualifying Center aimed to certify the professional level and updating of engineers.

Begining 1995 the public universities UNMSM and UNI, supported by de National Science and Technology Council and the collaboration of a multinational high technology company, presented to the Peruvian Government the project "The Engineering Excellence Program (EEP)". The EEP Program is oriented to :

Encouraging peruvian universities to work with the local electronic industry;

Modernizing and improving the teaching of electronic engineering;

Fostering and disseminating high technology to the local industry;

Shortening Peru's electronic technology gap.

**FINAL REMARKS**

In recent years, significant changes have taken place worldwide with the result that the nations are closely interrelated, consequently, the historical and cultural characteristics which are common to the latinoamercian countries provide the basis for a greater scientific, technical and cultural and commercial cooperation among such nations and the developed countries.

In countries belonging to andean sub-region, a strategy must be adopted with the goal of achieving both a reduced technological dependence as well as a establishment and strengthening of a system of science and technology, predominally oriented toward definite development objetives; furthermore, such system must rescue and update autochthonous technologies; this system must give rise to domestic technologies by solving problems peculiars to geographical regions and productive systems, but it, at the same time, will be in keeping with protection of environment as well as the exhaustible natural resources.

The process of curricular innovation must be carried out gradually without leaving out stages or starting new stages without having completed the foregoing stages, so avoiding the academic disorder and ensuing setbacks.

Every university, according its intrinsic features, will provide its new curriculum with the relevant academic trend and status.

The essential feature for the attainment of a successfull curricular reform program will be embodied by the suitable faculty members.

Continuing specialization and training of the engineer in developing countries will be subject to requirements of a productive sector which, in turn, will be restructured in accordance with genuine national and regional development requirements.

Lima, February 1998.

## ANNEX

## PERUVIAN UNIVERSITIES

### NORTHERN REGION

U. N. de Tumbes, Tumbes.
V. César Vallejo, Trujillo.
W. N. de Piura, Piura.
U. Privada del Norte, Trujillo.
U. de Piura, Piura.
U. N. de Cajamarca, Cajamarca.
U. N. Pedro Ruíz Gallo, Chiclayo.
U. N. Santiago Antúnez de Mayolo, Huaraz.
U. Privada de Chiclayo, Chiclayo.
U. N. Del Santa, Chimbote.
U. N. de la Libertad, Trujillo.
U. P. Los Angeles, Chimbote.
U. P. Antenor Orrego, Trujillo.
U. San Pedro, Chimbote.
U. P. Juan XXIII, Chepén.
U. Privada de Jaen.

### LIMA REGION

U. N. Mayor de San Marcos.
U. Inca Garcilazo de la Vega.
P. U. Católica del Perú.
U. Ricardo Palma.
U. N. Agraria.
U. Marcelino Champagnat.
U. Peruana Cayetano Heredia.
U. Peruana de Ciencias Aplicadas.
U. del Pacífico.
U. N. del Callao.
U. de Lima.
U. N. José F. Sánchez Carrión.
U. de San Martín de Porres.
U. N. Enrique Guzmán y Valle.
U. Femenina del Sagrado Corazón.
U. Peruana Unión.
U. N. Federico Villarreal.
U. P. San Juan Bautista.

U.  N. de Ingeniería.
U. Norbert Wienner.
U.  Alas Peruanas.
U. San Ignacio de Loyola.
U.  María Inmaculada.
U. Tecnológica del Perú.
U.  Científica del Sur.

## CENTRAL REGION

U.  N. Herminio Valdizán, Huánuco.
U. Peruana Los Andes, Huancayo.
U.  Privada de Huánuco, Huánuco.
U. N. San Cristóbal de Huamanga, Ayacucho.
U.  N. Agraria de la Selva, Tingo María.
U. N. de Huancavelica, Huancavelica.
U.  N. Daniel A. Carrión, Cerro de Pasco.
U. Tecnológica de los Andes, Abancay.
U. N. del Centro del Perú, Huancayo.

## SOUTHERN REGION

U.  N. San Antonio de Abad, Cuzco.
U. Andina Néstor Cáceres V., Juliaca.
U.  N. Gran Padre San Agustín, Arequipa.
U. Andina del Cuzco, Cuzco.
U.  N. San Luis Gonzaga, Ica.
U. Privada de Tacna, Tacna.
U.  N. del Altiplano, Puno.
U. Privada de Moquegua, Moquegua.
U.  Católica Santa María, Arequipa.
U. Privada de Ciencias y Tecnología, Ica.
U.  N. Jorge Basadre Grohmann, Tacna.
U. Privada Abraham Valdelomar, Ica.
U. P. San Pablo, Arequipa.

## EASTERN REGION

U.  N. de la Amazonía Peruana, Iquitos.
U. Privada de Iquitos.
U.  N. de San Martín, Tarapoto.
U. N. de Ucayali, Pucallpa.