NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
APPLIED ENGINEERING MANAGEMENT

EDUCATIONAL OBJECTIVES MARKET ANALYSIS

EDUCATIONAL OBJECTIVES OF THE SPECIALTY OF MECHATRONICS ENGINEERING OF THE COLLEGE OF MECHANICAL ENGINEERING OF THE NATIONAL UNIVERSITY OF ENGINEERING

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LIMA - PERU

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PROLOGUE

In this paper we document everything done to be able to raise the observed by ABET regarding the evaluation criteria No 2 referred to the educational objectives of the mechatronics engineering program.

This document consists of five chapters. In the first chapter is the introduction; In the second chapter the objectives are presented; The third chapter shows relevant definitions; The fourth chapter shows the educational objectives and the fifth chapter shows the synthesis of the background and the final check made to consistency in achieving the educational objectives of the mechatronics program of the College of Mechanical Engineering of the National University of Engineering.

Finally the conclusions and recommendations are shown.

CHAPTER I

INTRODUCTION

1. - INTRODUCTION

In December 2016, the College of Mechanical Engineering of the National Engineering University received a visit from an ABET Delegate to carry out a review of the Mechatronics Engineering Program.

There were several observations, one of which was related to Evaluation Criteria No 2 referred to the Goals of the Mechatronics Career Education Program.

The Direction of School of Mechatronics Engineering instructed the Academic Direction of Applied Engineering to document the way in which the educational objectives of the mechatronics engineering program in accordance with the form claimed by ABET are identified.

Through this report, the Academic Direction of Applied Engineering, presents the developed to meet the manager made by the School of Engineering Mechatronics.

CHAPTER II

OBJECTIVES

2. - OBJECTIVES OF THE PRESENT WORK

1º Present the way in which the educational objectives of the Mechatronics specialty of the College of Mechanical Engineering of the National University of Engineering.

2º Present how the educational objectives of the program are linked to the needs of the electors of the program.

3º Show the preliminary and final processes to identify the fulfillment of the educational objectives of the Mechatronics Program (PEO), of the College of Mechanical Engineering of the National University of Engineering.

4º Show conclusions.

5º Present the recommendations

CHAPTER III

DEFINITIONS

3. - DEFINITIONS

- EDUCATIONAL PROGRAM
  The Educational Program is a Curricular Instrument where teaching-learning activities are organized, which allows teachers to orient their practice with regard to the objectives to be achieved, the behaviors that the students must demonstrate, the activities and contents to be developed, as well as The strategies and resources to be used for this purpose.

- LAS PEO's (Professional Employer Organizations)
  They are organizations that play the role of business partners in a contractual or implicit way, to provide human resources with general and / or specialized training and general training, so that they can carry out their direct and operative activities in an effective and efficient manner.

- LOS PEO's (Educational Objectives of a Program)
  The program's educational objectives are defined as general statements that describe what graduates are expected to achieve within a few years after graduation.

- OCCUPATIONAL ANALYSIS
  Technique that is performed through a process of gathering, ordering and valuing the information related to the characteristics of a job in terms of tasks, procedures, skills, knowledge and attitudes required by a job for efficient performance

- OCCUPATIONAL AREA
  It is the potential space of employability that a given professional profile can follow according to the professional competences that it develops.

- ABILITIES
  The development of skills corresponds to the acquisition of a series of practices in methodologies and techniques that are specific to certain occupations, professional figures or occupational areas.

- SKILLS
  They are practical skills that are linked to a precise development of certain forms of specialized motor skills, visual acuity, auditory, physical effort, and balance, for example, fine motor acquisition for precision or detail work, precision in the use of certain tools to obtain certain results.

- PROFESSIONAL ACTION COMPETITION
  Professional competence is available to those who have the knowledge, skills and abilities necessary to practice a profession, can solve professional problems autonomously and flexibly, is able to collaborate in their professional environment and work organization.
  The integration of personal, social, technical and methodological competence gives rise to the competence of professional action.

CHAPTER IV

IDENTIFICATION OF EDUCATIONAL OBJECTIVES

4. - OCCUPATIONAL ANALYSIS

4.1 Methodology to identify the occupations of mechatronics engineering graduates.

To identify the occupations of a graduate of the mechatronics specificity of the College of Mechanical Engineering of the National Engineering University, the methodology DACUM

The DACUM methodology serves as a means of analyzing the necessary employment of a specialty and allows identifying the areas of work performance of the corresponding personnel and identifying their respective tasks. It also allows identifying the resources necessary to perform them, such as tools, machines, Softwares, and the necessary complementary equipment.

With the realization of Workshops and / or consultations to develop the DACUM methodology the Occupational Matrices are obtained, which constitute an excellent reference to identify the areas of employment of the workers, in this case of the graduates of mechatronics of the College of Mechanical Engineering of The National University of Engineering.

4.2 WORKSHOPS AND CONSULTATIONS

4.2.1 Workshops carried out

Workshops were held with the following groups:

- Group of graduates (1 workshop with 12 experienced graduates).
- Employers' group (1 workshop with 8 employers related to mechatronics).

4.2.2 Custom Queries:

- 16 consultations were made to highly specialized and experienced teachers and in professional practice in industry.
- There were 16 personalized consultations with executives of relevant companies related to mechatronics training and training in the specialties that comprise it ie mechanics, electronics and information technology.

4.2.3 Surveys:

- A survey was made on the perception of the quality of the learning obtained during their stay as students to 50 students of the promotions between 2014 and 2016.
- A survey of 120 mechatronics graduates has been carried out at the main Peruvian companies to identify the area in which they work.
- A survey of 60 employers has been conducted to identify the quality of work performance of mechatronics graduates in their care.
- A survey of 60 graduates of the promotions, between 2010 and 2016-1, was carried out to determine the income received and to be able to see their relative evolution.
- A survey of 278 people engaged in activities related to mechatronic was carried out in order to identify the correlate between the Profile of the graduates of the mechatronics program and the Competitive Employment in Metropolitan Lima.

4.3 RESULTS OF OCCUPATIONAL ANALYSIS

4.3.1 Areas of Performance

The performance areas occupied by mechatronics graduates who have been identified are as follows:

1º Labor fields related to mechanics and energy:

1.1 Mechanical Manufacturing.

1.2 Automation of mechanical manufacturing.

1.3 Electrical energy.

1.4 Thermal energy.

2º Fields related to Electronic Control:

1.5 Maintenance of electronic control of automatically guided and motorized vehicles.

1.6 Industrial automation.

3º Labor fields related to Informatics:

1.7 Monitoring, control and data acquisition.

4.3.2 Classification of tasks performed by mechatronics graduates

In each of the performance areas indicated in section 4.3.1, the tasks performed by mechatronics can be classified as follows:

1. Projects execution
2. Realization of facilities
3. Performing maintenance
4. Realization of commercial services
5. Teaching
6. Research

4.4 EDUCATIONAL OBJECTIVES RELATED TO THE REQUIREMENTS THAT THE COMPANIES DEMAND OF THE DEGREES IN TERMS OF THE PROFESSIONAL COMPETENCES

The requirements of the graduates that the companies demand in each field of work and in each area of performance can be expressed in terms of Educational Objectives described in the form of Professional Competences.

4.4.1 EDUCATIONAL OBJECTIVES EXPRESSED IN TERMS OF COMPETENCES

These are the competencies that the graduates must demonstrate in their professional performance (three to five years of graduation). For the specialty of Mechatronics Engineering has been identified the professional competence in terms of the competences that comprise it, that is the personal, social, technical and methodological competence. These educational objectives are as follows:

(A) GRADUATES HAVE PERSONAL COMPETENCE

Graduates of the mechatronics specialty must have the capacity to act in a self-reflexive way and under their own responsibility.

They must act with professionalism and must conduct themselves correctly respecting the codes, rules and regulations of the profession, assuming their ethical responsibilities.

(B) GRADUATES POSSES SOCIAL COMPETITION

Graduates of mechatronics must have the capacity to collaborate with others in a communicative and constructive way

They must be able to communicate properly and work in multidisciplinary teams by participating as leaders or as active members.

(C) GRADUATES POSSES TECHNICAL COMPETENCE

Graduates of the mechatronics specialty should have the ability to apply correctly the theoretical knowledge of the specialty of mechanics, energy, control of energy with electronic technology and computer science.

They must have the ability to correctly apply the practical knowledge of their specialty.

They must have the ability to develop skills necessary and related to their professional field.

They must have good work adaptability in different occupational environments so that they are entrepreneurs and innovators practicing the principles of sustainability.

They must develop the ability and attitude to be continuously updated to understand and adapt to new technologies and continuous learning environments to stay current and competitive so that they continue their studies.

(D) GRADUATES POSSES METHODOLOGICAL COMPETENCE

Graduates of the mechatronics specialty must be able to react by applying the appropriate procedure to the tasks set out in their professional work.

CHAPTER V

PRELIMINARY AND FINAL PROCESSES TO IDENTIFY THE FULFILLMENT OF THE EDUCATIONAL OBJECTIVES OF THE MECHATRONICS PROGRAM (PEO'S) OF THE COLLEGE OF MECHANICAL ENGINEERING OF THE NATIONAL UNIVERSITY OF ENGINEERING

5.1 Interpretation of the ABET requirement regarding Criteria No 2: Educational Objectives, referred to the **'processes to review and revise the PEO's'**

It is necessary to clarify and differentiate the meaning of the term **'review'** and **'revise'**. The following table shows the difference between the two terms:

Table No 5.1 Definition of terms **review** and **revise**

REVIEW **(Background checks)**	**REVISE** **(Final check)**
To review means to look back over something for evaluation or memory.	To revise means to alter o improve a preliminary draft of something, usually a text.

5.2 BACKGROUND RELATED TO THE EDUCATIONAL OBJECTIVES OF THE MECHATRONICS PROGRAM

5.2.1 Preliminary consideration

- The National Observatory of the Group of Education to the Future in its portal shows a work done by the Ministry of Education in coordination with IPAE (Peruvian Institute of Business Action, Ministry of Labor and Employment Promotion and the collaboration of SUNAT (National Superintendence of Administration Tax), whose reference is the following:

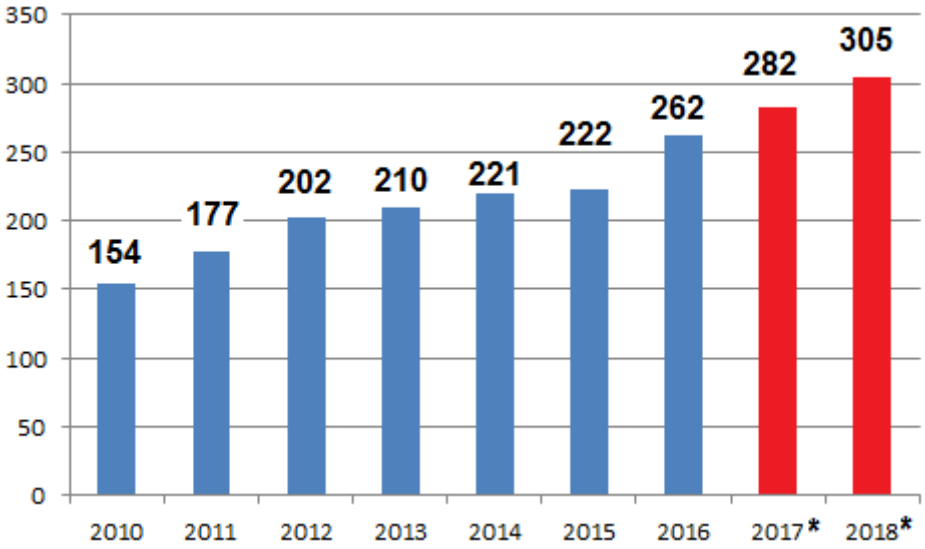
  http://educacionalfuturo.com/noticias/observatorio-laboral-sueldos-por-carrera/

  This portal shows an X-ray that allows to compare and to make a ranking of salaries of professionals of the same area or specialty in agreement with the educational institution

of origin, and it is observed that the graduates of the specialty of mechatronics of the National University of Engineering Are in the group that have the highest salaries in the Peruvian market.

- The Gross Domestic Product in Peru maintains its annual growth.

Figure N° 5.1 Real GDP of Peru (in billions of US $)



(*) Estimated projection
Source: Central Reserve Bank of Peru, Ministry of Economy and Finance.

- From the growth shown it is deduced that the employment will not fall and therefore the labor supply will continue with its rate of growth.

- In Peru the university careers most demanded by the students are:

  Business Administration, Industrial Engineering, Accounting, Economics, International Business Administration, Law, Communication Sciences and Marketing.

- Engineering careers are relatively viewed as more demanding during the admission phase to the University, making them more selective. This makes the competition to enter the National University of Engineering is very demanding and deserves special preparation. For this reason the students who enter to study engineering macatrónica possess a good degree of knowledge to begin their formation and professional qualification. This is evidenced by the good performance during the classes and their theoretical and practical evaluations.

- SINEACE (National System of Evaluation, Accreditation and Certification of Educational Quality, Peru) last year (2016) announced that in Peru 300,000 technical professionals were demanded and only 98,000 graduated. This shows that the demand exceeds the supply and therefore the technical professionals and engineers are the most requested by the companies.
- It is necessary to point out that students of the last cycles of the mechatronics specialty, being in the last cycles are already required by the companies, mainly for their high degree of flexibility and adaptation to the different labor requirements and for the confidence that the employers have in the students of mechatronics of the National University of Engineering.
- The College of Mechanical Engineering has a permanent Advisory Board of external experts who are consulted on the relevance of the guidelines to be taken into account related to the following topics:

    a. Follow-up of graduates
    b. Evaluation and certification
    c. Teaching-learning
    d. Student participation in special events
    e. Implementation of resources
    f. Curriculum design and development
    g. Identification of competency profile

h. Elaboration of occupational profiles

i. Needs assessment

5.2.2 Training and evaluation of students

- Education, training and evaluation is made based on the current curriculum. The training is of an integral nature. It can be indicated that there are three stages during the development of the activities which are:

  ✓ Basic training:

  Humanist, ethics, mathematics, physics, chemistry and graphic expression

  ✓ Transversal technical training:

  It develops the capacity of study and analysis related to subjects of the engineering in general.

  ✓ Specialized training and training:

  It develops the capacity of study and analysis related to subjects of the most specialized engineering of mechatronics career.

- The Direction of Applied Engineering promotes both the development of the learning competences and that of professional competence and has as reference eight levels that are mentioned in the following table:

Table N° 5.2 Learning competence and professional competence categorized by levels

Nivel	**LEARNING COMPETITION**	**PROFESSIONAL COMPETENCE**
1	Accepts guidance during learning.	Demonstrates basic knowledge of troubleshooting procedures.
2	Look for guidance during learning.	Solve problems using the information provided.
3	Take responsibility for your own learning.	Solve problems using good sources of information known taking into account some social versions.
4	Demonstrates self-direction in learning.	It solves problems by integrating expert information from sources taking into account the relevant social and ethical context.

5	Evaluates their own learning and identifies needs to undertake future learning.	Formulate answers to abstract and concrete problems. Demonstrates experiences in operational interaction within the field. Make judgments based on relevant social and ethical knowledge.
6	It consistently self-assesses and identifies learning needs.	Collect and interpret relevant data in a problem-solving field. Demonstrates experience in personal interactions within a complex environment. It makes judgments based on social, ethical and technical aspects that are presented in the work or study. It can support a thesis related to its engineering specialty.
7	It demonstrates autonomy in directing learning and a high level of understanding of learning processes.	It solves problems by integrating a complex source of knowledge that is sometimes incomplete and unknown by others in certain contexts. Demonstrates experience in professional interaction in a change of management within a complex environment. Respond socially, scientifically and ethically to situations that are found in work or study.
8	Demonstrates the ability to sustain the mission of developing new ideas and processes. Demonstrates a high level understanding of learning processes.	It critically analyzes, evaluates and synthesizes new and complex ideas and makes strategic manufacturing decisions based on these processes. Demonstrate experience in operational interaction with strategic decision-making capacity within a complex environment. Promote social development, and ethical advancement with actions.

The goal of the training and training during the Undergraduate is that the student reaches level 6 and do the induction work so that later on to pursue his master's and doctorate degree can reach level 7 and 8.

5.2.3 Actual conditions

- Currently in Peru governs the new University Law that makes the Normative Direction of the University is in charge of the Ministry of Education and not in charge of the National Assembly of Rectors as it was before.
- The accreditation process is currently mandatory and it is imperative to adapt to the required changes and progressively raise quality in every sense.

- The allocation of resources by the state is annual and, of course, the resources allocated depend on the general budget of the republic, which is made with a much more dispersed time.
- The National Engineering University has many specialties and with which resources are shared. For example, mechatronics students in the development of the Physics course employ the properly equipped Laboratories that are of the College of Sciences.
- The College of Mechanical Engineering has laboratories for manufacturing materials, machine tools, metrology, thermal machines and turbo machinery, automation, electricity and computing. It has a photovoltaic power plant and a wind farm.
- There are also the Chemistry and Process Control laboratories that have the Faculty of Chemical Engineering and they have an excellent equipment.
- All teachers are permanently evaluated and currently required by the new University Law are continuing their studies of masters and doctorates.
- Teachers who are part-time work in the main companies of the country and the experience they have is very important during the development of their classes. The stringency required of them is similar to full-time teachers.

5.3 REVIEW OF THE ACHIEVEMENT OF THE EDUCATIONAL OBJECTIVES OF THE MECHATRONICS PROGRAM

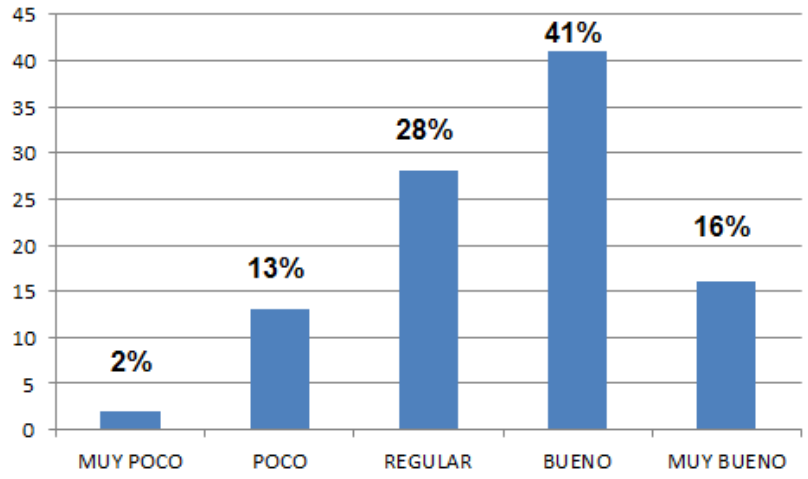
In addition to the theoretical, practical, compulsory, participation in project competitions that are made respectively during the development of academic activities, the Applied Engineering Academic Direction performs different types of analysis that allows collateral verification of the achievement of the educational objectives of the Mechatronics program of the College of Mechanical Engineering of the National University of Engineering. The following are the most significant ways to monitor the achievement of educational goals:

5.3.1 Perception of the degree of learning obtained by the graduates of the last five semesters:

- It has been monitored the degree of perception of the quality of knowledge that mechatronics students have had when leaving the University.

The result of the indicated monitoring of a random sample of graduates is presented in the following figure:

Figure N° 5.1 Average perception of mechatronics students of the degree of learning obtained upon leaving university



Sample: Sample of 10 graduates from each promotion: 2014-2, 2015-1, 2015-2, 2016-1, 2016-2
Date: March 2017
Source: Survey conducted

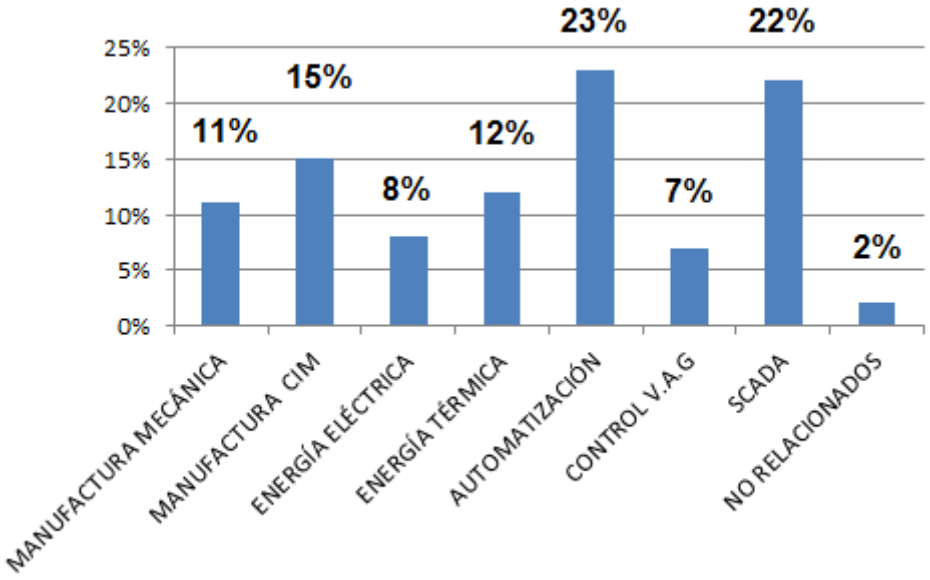
It can be observed that 57% of the graduates interviewed perceive that the knowledge with which they leave the University are acceptable.

It can be observed that 15% of the graduates interviewed perceived that the knowledge with which they leave the University are not enough.

5.3.2 Distribution of the employment of Mechatronics graduates of the College of Mechanical Engineering of the National University of Engineering

After performing a detailed analysis (see Annex 1) of the occupations in which mechatronics graduates perform, it is possible to classify them as shown in the following graph.

Figure 5.2 Areas where Mechatronics graduates work



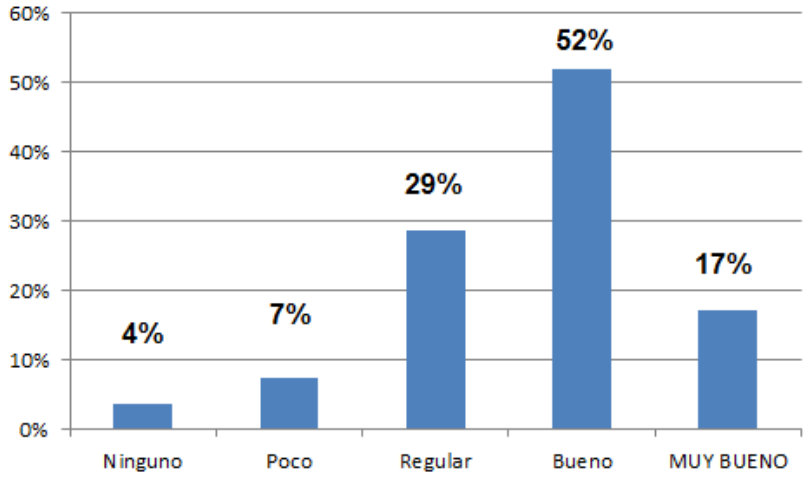
Sample: 120 graduates working in the main Peruvian companies
Date: March 2017
Source: Survey conducted

5.3.3 Degree of appreciation of employers (Adapted according to the criteria provided by the Accreditation Office)

The degree of appreciation of the employers, adapted according to the criteria provided by the Accreditation Office of the College of Mechanical Engineering of the National Engineering University (see Annex 2).

Monitoring in the field related to the degree of appreciation of employers regarding the efficiency and effectiveness of mechatronics graduates during the development of their activities according to the criteria provided by the College Accreditation Office is summarized in the following figure:

Figura Nº 5.3 Perception of the quality of the work performance of mechatronics graduates appreciated by the employers.



Sample: 60 Graduates work in the main Peruvian companies
Date: March 2017
Source: Survey conducted

5.3.5 GROSS INCOME OF GRADUATES, IN PERCENTAGE TERMS CLASSIFIED BY INTERVALS

A study was carried out on a sample of 60 graduates of the mechatronics specialty referred to the level of remuneration perceived in their work activity.

The relative scale used was as follows:

If the remuneration exceeds S/. 6000 is considered very high remuneration.

If the remuneration exceeds the S/. 4000 is considered high remuneration.

If the remuneration exceeds the S/. 2000 it is considered average remuneration.

If the remuneration is lower than S/. 2000 it is considered low remuneration.

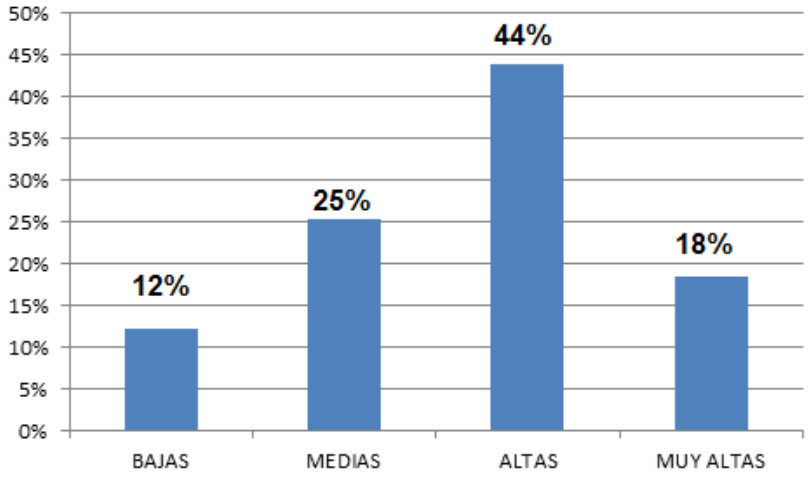
The results are presented in the following table and figure:

Table 5.3 Percentage distribution of income of a sample between 2010 and 2016 of 60 graduates

GROSS INCOME INTERVAL	YEAR							AVERAGE (%)
	2010	2011	2012	2013	2014	2015	2016-1	
Low				7%	14%	29%	35%	12%
Average		7%	6%	30%	37%	43%	55%	25%
High	71%	70%	71%	45%	32%	13%	6%	44%
Very high	29%	23%	23%	18%	17%	15%	4%	18%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Sample: 60 graduates from the year 2010 to 2016-1
Source: Survey conducted

Figure 5.4 Percentage distribution of income of a sample between 2010 and 2016-1



Sample: 60 graduates from the year 2010 to 2016-1
Source: Survey conducted

5.3.6 Statistical monitoring of the correlate between the profile of graduates of the specialty of Mechatronics and competitive employment

In this statistical work the following has been done:

- The variables have been identified:
  Independent variable: The profile of mechatronics engineering graduates.
  Dependent variable: Competitive employment in Metropolitan Lima.
- The alternative and null hypotheses have been identified:
  H1: The profile of graduates of Mechatronics Engineering facilitates competitive employment in Metropolitan Lima.
  Ho: The profile of graduates in Mechatronics Engineering does not facilitate competitive employment in Metropolitan Lima:
- The mean and standard deviation were obtained with the following results:

Table N° 5.4 Statistics table

STATISTICS		PROFILE OF MECHATRONIC ENGINEERING GRADUATES	COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA
Sample	Valid	278	278
	Lost	0	0
Mean		74,86%	76,20%
Typical deviation		4,39%	4,13%

Source: Survey conducted

- The following analysis was made based on the results shown in the statistics table:

The table shows the most important statistics.

The average value of the independent variable PROFILE OF MECHATRONICS ENGINEERING GRADUATES is 74.86%, while the average of the dependent variable COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA is 76.20%. These indicators are significant and the greater of the dependent variable supports the research model carried out.

The standard deviation measures the degree of deviation of the values in relation to the average value, in this case it results to be 4.39% for the independent variable PROFILE OF MECHATRONICS ENGINEERING GRADUATES and 4.13% for the dependent variable COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA. This means that there is a high concentration in the results obtained, being better this concentration in the dependent variable, which favors the proposed research model.

- The accepted margin of error was allowed to 5% in order to apply the fundamental criteria of the test generally accepted in the methodological tasks.

After estimating the correlations between the variables using the SPSS software, the following results were obtained:

Table N° 5.5 Correlation table between the variables.

VARIABLES OF RESEARCH	STATISTICAL INDICATORS	PROFILE OF MECHATRONICS ENGINEERING GRADUATES	COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA
PROFILE OF MECHATRONICS ENGINEERING GRADUATES	Pearson's Correlation	100%	100%
	Sig. (Bilateral)		4,30%
	Sample	278	278
COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA	Pearson's Correlation	65,40%	100%
	Sig. (Bilateral)	4,30%	
	Sample	278	278

Source: Survey conducted

- The analysis of the results obtained in the correlation table between the variables was performed:

The value of the Pearson correlation is equal to 65.40%, which indicates a regular positive direct correlation, therefore it can be considered that there is a correlation between the acceptable variables.

The significance value [sig. (Bilateral)], it turned out to be 4.30% therefore less than the proposed error margin of 5%. This, according to the generally accepted statistical theory, allows to reject the null hypothesis and to accept the alternative hypothesis, from the point of view of the correlation of the variables.

It is inferred that the correlation obtained for the sample is significant and is not due to chance but to the logic and meaning of the formulated research model.

- The regression table of the model is shown below:

Table N° 5.6 Model regression table and research model summary

VARIABLE INTRODUCED / ELIMINATED

MODEL	INTRODUCED VARIABLES	ELIMINATED VARIABLES	METHOD
1	Profile of Mechatronics Engineering Graduates Competitive employment in Metropolitan Lima	0	Statistical

Source: Survey conducted

SUMMARY OF THE INVESTIGATION MODEL

Model	R	R square	R square corrected	Typical estimation error
1	69,40%	65,10%	65,70%	2,95%

Fuente: encuesta realizada

- The following analysis of the results are shown in Table N° 5.6:

The coefficient of linear determination (R square) is equal to 65.10%. This coefficient explains that 65.10% of the total variation is due to the independent variable *Profile of Mechatronics Engineering graduates* and the rest to other factors.

- Finally based on the statistical study and the model used it can be concluded that:

"The profile of graduates of Mechatronics Engineering facilitates competitive employment in Metropolitan Lima"

CONCLUSIONS

The order received from the Professional School of Mechatronics Engineering of the College of Mechanical Engineering of the National University of Engineering has been fulfilled:

1. It has been presented how the educational objectives of the Mechatronics specialty of the College of Mechanical Engineering of the National University of Engineering are identified.
2. It has been presented how the educational objectives of the program are linked to the needs of the electors of the program being these electors the students who adopt to follow studies of mechatronics and the employers that use their services.
3. The preliminary and final processes have been shown to identify the fulfillment of the educational objectives of the Mechatronics Program (PEO), of the College Mechanical Engineering of the National University of Engineering.
4. This work also serves as an instrument of recommendation to realize the continuous improvements that the mechatronics program demands.

RECOMMENDATIONS THAT CONSTITUTE A CONTRIBUTION TO IMPLEMENT CONTINUOUS IMPROVEMENT

Carry out an individualized monitoring work to identify the reasons why there is a percentage of graduates perceived to be leaving the university with insufficient knowledge.

Continue improving the monitoring system for the fulfillment of the educational objectives of the Mechatronics program of the College of Mechanical Engineering of the National University of Engineering.

Consider that there is a growing labor demand in the occupational area of automated manufacturing and in the area of supervision with SCADA systems, so it is necessary to redouble efforts to continue improving services in these areas.

To maintain in time the practice of the evaluation model practiced by ABET.

ANNEXES

ANNEX 1

OCCUPATIONAL MATRICES

DIRECTORATE OF THE ACADEMIC DEPARTMENT OF APPLIED ENGINEERING

RESULT OF THE APPLICATION OF THE DACUM TECHNIQUE TO IDENTIFY THE AREAS OF RESPONSIBILITY AND THE TASKS OF THE CAREER OF MECHATRONICS ENGINEERING

OCCUPATIONAL MATRICES OF MECHATRONICS

Developing a Curriculum (DACUM) is a process that incorporates the use of a focus group in a facilitated storyboarding process to capture the major duties and related tasks included in an occupation, as well as, the necessary knowledge, skills, and traits. This method provides a quick and thorough analysis of any job.

In the process known as DACUM (curriculum development), a specialized group is involved that helps to graphically focus the main tasks (or areas of responsibility) and related tasks that are included in an occupation. It also allows identifying the relevant knowledge, skills and traits. This method allows a quick and exhaustive analysis of any work.

SUGGESTED AREAS OF RESPONSIBILITY

SPECIALTY
Mechatronics Engineering

1.- AREAS OF SUGGESTED RESPONSIBILITIES

1.1	Mechanical Manufacturing
1.2	Automation of mechanical manufacturing
1.3	Control of electrical energy
1.4	Thermal energy control
1.5	Maintenance of electronic control of automatically guided and motorized vehicles
1.6	Industrial automation
1.7	Monitoring, control and acquisition of data

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (1)	
Nº	Mechanical Manufacturing
1	

TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
1.1	Perform mechanical design	☐	√
1.2	Identifies and applies manufacturing standards	☐	√
1.3	Identifies and enforces industrial safety standards	☐	√
1.4	Identifies and applies environmental standards	☐	√
1.5	Defines manufacturing processes	☐	√
1.6	Optimizes Manufacturing Procedures	☐	√
1.7	Identifies characteristics of the materials to be used	☐	√
1.8	Identifies the necessary machines	☐	√
1.9	Identifies the necessary tooling (devices)	☐	√
1.10	Identifies the necessary tools	☐	√
1.11	Identifies the necessary operating conditions of the machines	☐	√

1.12	Interprets technical drawings	☐	√
1.13	Identify the necessary adjustments of the machines to be used	☐	√
1.14	Operates conventional manufacturing machinery during initial adjustments	☐	√
1.15	Supervises the realization of mechanical manufacturing	☐	√
1.16	Measures the products obtained	☐	√
1.17	Identifies mechanical failures of machine tools	☐	√
1.18	Plan maintenance of machines	☐	√
1.19	Performs maintenance of machines	☐	√
1.20	Estimate Manufacturing Costs	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (2)	
Nº	Automation of mechanical manufacturing
2	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
2.1	Identifies characteristics of CNC machines	☐	√
2.2	Configure AS / RS cells	☐	√
2.3	Set up manufacturing cells	☐	√
2.4	Set up flexible manufacturing system	☐	√
2.5	Set up automatically guided vehicles	☐	√
2.6	Configure industrial process modules	☐	√
2.7	Configures drag-and-drop modules	☐	√
2.8	Set up quality control cells	☐	√
2.9	Set Assembly Cells	☐	√
2.10	Configure packing cells	☐	√
2.11	Configures control and communication systems	☐	√

2.12	Configures CIM systems	☐	√
2.13	Performs projects related to the automation of mechanical manufacturing	☐	√
2.14	Installs subsystems and computer-integrated manufacturing systems	☐	√
2.15	Plans system maintenance	☐	√
2.16	Automated manufacturing	☐	√
2.17	Performs systems maintenance	☐	√
2.18	Automated manufacturing	☐	√
2.19	Identifies and applies technical standards related to equipment to perform manufacturing automatically	☐	√
2.20	Identifies and enforces safety standards	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (3)	
Nº	Control of electrical energy
3	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
3.1	dentifies the operating systems of the controllers of power generation plants	☐	√
3.2	Identifies the operational status of the controllers of the power generation plants	☐	√
3.3	Identifies the operating systems of the controllers of the electrical transmission equipment	☐	√
3.4	Identifies the operational status of the drivers of the electrical transmission equipment	☐	√
3.5	Identifies the operating systems of the controllers of the electrical distribution equipment	☐	√
3.6	Identifies the operational status of the electrical distribution equipment controllers	☐	√
3.7	Identifies electrical characteristics of loads	☐	√
3.8	Configures transformers	☐	√

3.9	Set up control panels	☐	√
3.10	Set up electrical networks	☐	√
3.11	Perform electrical installations	☐	√
3.12	Supervises the realization of electrical installations	☐	√
3.13	It realizes projects related to the control systems of the electrical energy	☐	√
3.14	Conducts maintenance planning of electric power control systems	☐	√
3.15	Maintains the maintenance of electric power control systems	☐	√
3.16	Supervises the maintenance of the systems of control of the electric energy	☐	√
3.17	Identifies and applies technical standards related to equipment to control electrical energy	☐	√
3.18	Identifies and enforces safety standards	☐	√
3.19	Identifies and applies standards of environmental protection	☐	√
3.20	Identifies and applies occupational health standards	☐	√
3.21	High costs related to electrical installations	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (4)	
Nº	Thermal energy control
4	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
4.1	Identifies the thermodynamic cycles corresponding to thermal machines	☐	√
4.2	Performs calculations related to thermal loads	☐	√
4.3	Identifies the functions of the components that make up the thermal systems	☐	√
4.4	Identifies the technical specifications of the components of thermal systems	☐	√
4.5	Configure thermal systems	☐	√
4.6	Install thermal equipment	☐	√
4.7	Supervises the installation of thermal equipment	☐	√
4.8	Measures the efficiency of thermal equipment	☐	√
4.9	Performs projects related to thermal equipment	☐	√

4.10	Plans the maintenance of thermal systems	☐	√
4.11	Performs thermal system maintenance	☐	√
4.12	Identifies and applies technical standards related to the control of thermal energy	☐	√
4.13	Identifies and enforces safety standards	☐	√
4.14	Identifies and applies standards of environmental protection	☐	√
4.15	Identifies and applies occupational health standards	☐	√
4.16	Estimate maintenance costs	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (5)	
Nº	Maintenance of electronic control of automatically guided and motorized vehicles
5	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
5.1	Identifies electronic control systems for motor vehicles	☐	√
5.2	Identifies the electronic control structure of the driving system	☐	√
5.3	Identifies the electronic control system of the driving system	☐	√
5.4	Plans maintenance of the electronic drive control system	☐	√
5.5	Maintain the electronic drive control system	☐	√
5.6	Identifies the structure of the electronic control system for suspension, steering and brakes	☐	√
5.7	Identifies the operating system of the electronic suspension, steering and braking control system	☐	√
5.8	Plans the maintenance of the electronic control system of the suspension, steering and brakes	☐	√
5.9	Maintain electronic suspension, steering and brake control system	☐	√

5.10	Identifies the structure of the electronic control system for electric lighting, safety and accessories	☐	√
5.11	Identifies the operating system of the electronic control system of electric lighting, safety and accessories	☐	√
5.12	Plans the maintenance of electronic control system of electric lighting, security and accessories	☐	√
5.13	Perform maintenance of electronic control system of electric lighting, security and accessories	☐	√
5.14	Perform fault diagnostics	☐	√
5.15	Configure maintenance procedures	☐	√
5.16	Estimate maintenance costs	☐	√
5.17	Supervises maintenance	☐	√
5.18	Identifies and applies technical standards related to the maintenance of motor vehicles	☐	√
5.19	Identifies and enforces safety standards	☐	√
5.20	Identifies and applies standards of environmental protection	☐	√
5.21	Identifies and applies occupational health standards	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (6)	
Nº	Industrial automation
6	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
6.1	Identifies the structure of the plants and their respective operating units	☐	√
6.2	Identifies the operating system of the plants	☐	√
6.3	Identify the properties to measure	☐	√
6.4	Select sensors	☐	√
6.5	Identify the necessary signal conditioning of the non-standardized sensors	☐	√
6.6	Identify properties to control	☐	√
6.7	Identify actuators	☐	√
6.8	Identify the power interfaces	☐	√
6.9	Design control algorithms	☐	√

6.10	Digital controllers program	☐	√
6.11	Perform control by computer (PC)	☐	√
6.12	Performs control through programmable logic controllers (PLC)	☐	√
6.13	Performs control through human-machine interfaces (HMI)	☐	√
6.14	Performs control through embedded controllers	☐	√
6.15	Performs control through dedicated controllers	☐	√
6.16	Identifies data communication needs	☐	√
6.17	Configures data communication networks	☐	√
6.18	Install communication networks	☐	√
6.19	Plans the maintenance of automation systems	☐	√
6.20	Performs maintenance of automation systems	☐	√
6.21	Performs projects related to automation systems	☐	√
6.22	Identifies and applies technical standards related to industrial automation	☐	√
6.23	Identifies and enforces safety standards	☐	√
6.24	Identifies and enforces safety standards	☐	√
6.25	Identifies and applies environmental protection standards	☐	√
6.26	Identifies and applies occupational health standards	☐	√

SUGGESTED TASKS CORRESPONDING TO EACH AREA OF RESPONSIBILITY

AREA OF RESPONSIBILITY (7)	
Nº	Monitoring, control and acquisition of data
7	

SUGGESTED AREA TASKS

Nº	TASK PERFORMED	TYPE OF TRAINING REQUIRED	
		BASIC	SPECIALIZED
7.1	Identifies the structure of level 1 (level of data acquisition and field performance): Sensors, actuators, complementary I / O components, field instruments, HMI, hardware, sofwares and communication networks corresponding to level 1	☐	√
7.2	Identifies the structure of level 2 (direct control level): PLCs, DCS, RTUs, HMI, SCADA, hardware, software and communication and automation networks corresponding to level 2	☐	√
7.3	Identifies the structure of level 3 (SCADA Level): DCS, Control Centers, HMI, power management systems, asset management systems, hardware, software and information level operation networks corresponding to level 3	☐	√
7.4	Identifies the structure of level 4 (ERP level): Enterprise resource planning, hardware, software, and information networks related to business processes at level 4	☐	√
7.5	Configure Integrated Management-Scada system (level 1+ level 2 + level 3 + level 4)	☐	√

7.6	Performs projects related to the configuration of Integrated Management-Scada systems	☐	√
7.7	Plans the maintenance of Integrated Management-Scada systems	☐	√
7.8	Perform maintenance of Integrated Management-Scada systems	☐	√
7.9	Identifies and applies technical standards related to integrated systems	☐	√
7.10	Identifies and enforces safety standards	☐	√
7.11	Identifies and enforces safety standards	☐	√
7.12	Identifies and applies environmental protection standards	☐	√
7.13	Identifies and applies occupational health standards	☐	√

IDENTIFY TOOLS NEEDED

N°	TOOLS NEEDED (DESCRIPTION)
1	Set of pressure, cutting and combination pliers
2	Set of flat screwdrivers and phillips
3	Perilleros
4	Set of clips
5	Scissors Set
6	Set of hammers
7	Set of wrenches
8	Set of wrenches
9	Allen wrench set
10	Indoor and outdoor calibrators and micrometers
11	Set of torque wrenches, levers, rathchets, extensions and dice
12	Saw blades and arcs
13	Set of blades
14	Tape measure
15	Set of metal squares
16	Metal tips for metal branding
17	Presses
18	Screws
19	Hand drills
20	Set of drills for various types of metals
21	Electric Saws

22	Grinders
23	Bolt and holder
24	Males and Taps
25	Thread Count
26	Set of metal compasses
27	Fileset
28	Set of square files
29	Set of metal punches
30	Stripper pliers

IDENTIFY TOOLS NEEDED

Nº	TOOLS NEEDED (DESCRIPTION)
1	Electronic meters
2	Regulated sources
3	Multitesters
4	Oscilloscopes
5	Function generators
6	Computers
7	Data Acquisition Cards
8	PLCs
9	HMI
10	Engine Control Modules
11	Embedded system programming modules
12	Pneumatic and electropneumatic modules including silent compressors
13	Modules of hydraulics and electrohydraulics that include their switchboards
14	Modules of proportional hydraulics that include their switchboards
15	Process control modules: temperature, flow, pressure and height control
16	Process control plants
17	Modules of industrial networks
18	Communication Modules
19	Motor set
20	Interfaces to control motors
21	Modules of electrical measurements

22	Turbomachinery modules
23	Refrigeration modules
24	Air Conditioning Modules
25	Modules of heat exchangers
26	Generation plant for compressed air and distribution network

IDENTIFYING NECESSARY MACHINES

Nº	NECESSARY MACHINES (DESCRIPTION)
1	Bench grinding machines
2	Lathes with tooling and tools
3	Milling machines with tools and tools
4	Brushes with tools and tools (optional)
5	Column drills with tooling and tools
6	Three-dimensional measuring machines
7	Numerical control lathes with tooling and tools
8	Machining centers with tooling and tools
9	Grinding machine with tooling and grinding stones
10	Erosion eraser with tooling and electrodes
11	Computer Integrated Manufacturing System (CIM)
12	Equipped Robot Set
13	Equipped dams
14	Equipped bending machines
15	Equipped cutters
16	Autogenous welding equipment
17	Electrical welding equipment
18	Spot Welding Equipment
19	Roller
20	Tables for mechanical adjustment

NECESSARY SOFTWARE

Nº	SOFTWARE (DESCRIPTION)
1	Drawing and design software: Autotcad, Inventor, solidwork
2	Design programs: Corel Draw, Photoshop
3	Three-Dimensional Drawing: Siemens PLM Software
4	Structural Calculation: Nastran, SAP 2000
5	Software NX-Nastran: NX-Nastran Basic, NX NASTRAN Avanced, NX Nastran Basic - Thermal , NX NASTRAN Basic Nonlinear, NX Nastran Dynamic Response, NX NASTRAN Superelements, NX NASTRAN Aeroelasticity
6	Software for robotic use consistent with selected robots
7	Computer-integrated manufacturing software matching CIM selected
8	Pneumatics: Fluidsim-Pneumatic, Automation
9	Hydraulics: Fluidsim-hydraulic
10	PLC software: Festo from Festo, Logo Soft, Simatic step 7, TIA Portal and utility programs to configure interfaces with components of control systems as selected.
11	Labview
12	Wonderware Intouch
13	Electrical design software: CIEBTWIN, ECODESIGN ELEC, ESQUEMALEC, SCHÉMA, or ELECTRICAL DESIGNER
14	Orcad, Pspice, Proteus, Workbench
15	PICkit Programmer Software, Arduino software
16	DSP Software
17	Programming languages: Assembler, C, C ++, C #, Java, Python, PHP, Visual Basic, Perl, JavaScript, Delphi / Object Pascal
18	Programs to plan.

19	ERP SAP Software
20	Oracle

MATERIALS (M) AND INPUTS (I) NECESSARY THAT ARE FREQUENTLY USED

Nº	MATERIALS AND INPUTS NECESSARY	M	I
1	Steel	√	
2	Aluminum	√	
3	Bolts	√	
4	Screws	√	
5	Standard aluminum profiles	√	
6	Stainless Steel Profiles	√	
7	Melamine	√	
8	Oil		√
9	Grase		√
10	Thiner		√
11	Metal markers		√
12	Adhesives		√
13	Putty		√
14	Cleaning products		√
15	Acceptance Products		√

IDENTIFYING NECESSARY INFRASTRUCTURE:
Classrooms, Laboratories, Auditorium, Rooms, Offices

No	TYPE OF INFRASTRUCTURE NECESSARY	EQUIPMENT REQUIRED
1	Computer class	Computers and Engineering Software
2	Mechatronics Design Laboratory (CAD)	Computers equipped with CAD-CAM software
3	Workshop of bank mechanics	Equipped with workbenches, screws and tools for Bank work.
5	Workshop of machining with conventional machines	Equipped with industrial machines of small size (not of table) properly equipped with tools and tools.
6	Conventional and computerized metrology workshop	Equipped mainly with a three-dimensional measuring machine.
7	Welding shop	Equipment of electrical welding, autogenous, MIG, TIG, of points.
8	Computer lab	Equipped with high speed computers and resolution.
9	Electronics Laboratory	Conventional equipment.
10	Mechanical Testing Laboratory	Equipment for mechanical testing of tension, fatigue, cutting, impact.
11	Metallography Laboratory	Equipment for conventional metallographic analysis, x-ray, magnetic. Equipped with ovens for heat treatment.
12	Automation laboratory	Equipped with sensors, actuators, computers, data acquisition cards, PLC, embedded controllers.
13	Laboratory of thermal machines	Equipped with heat exchangers, refrigeration, air conditioning, thermal motors, dryers, heaters.
14	Laboratory of hydraulic machines	Equipped with pumps, turbines and equipment for reading hydraulic parameters.
15	Laboratory of pneumatics and electropneumatics	Equipped with complete pneumatic and electropneumatic equipment.

16	Laboratory of hydraulic oil and electro-hydraulic oil	Equipped with complete equipment of basic and advance Oleohidraulic.
17	Vehicle Automatically Guided (VAG)	Vehicle for test of movement routines. Vehicles for utilitarian routines.
18	Motor vehicle	Modules of each system that conform them.
19	CIM Laboratory	Fully equipped.
20	Laboratory of process control	Module for pressure control. Module for temperature control. Module for level control. Module for flow control. Integrated module.
21	Robots equipped	Robot equipped to be used in manufacturing cells. Robots equipped to be used in element positioning processes.
22	Study Cabinets	Equipped with specialized technical books, manuals, computers connected to the internet and printers, scaners and multimedia projection.

ANNEX 2

APPRECIATION OF THE PERFORMANCE OF THE EMPLOYEES IN THEIR LABOR ACTIVITIES

ASSESSMENT OF THE EMPLOYERS OF THE MECHATRONICS GRADUATES OF THE COLLEGE OF MECHANICAL ENGINEERING, WITH RESPECT TO THE PERFORMANCE SHOWN DURING THEIR PROFESSIONAL ACTIVITY

PROFESSIONAL BEHAVIOR OF EMPLOYEES IN ACTIVITIES		None	Little	Regular	Good	Very Good	Total
1	**MAKES ENGINEERING DESIGNS** Design systems, products, processes or services that meet requirements, as well as economic, social, legal and sustainability constraints.			2%	90%	8%	100%
2	**SOLVING PROBLEMS** Identifies and solves engineering problems by making use of appropriate techniques, methods, tools and standards.			1%	92%	7%	100%
3	**APPLY SCIENTIFIC KNOWLEDGE** Apply knowledge and skills in math, science and engineering for engineering problem solving.		2%	2%	61%	35%	100%
4	**REALIZE EXPERIMENTS AND TESTS** It formulates and conducts experiments and tests, analyzes data and interprets results.	4%	18%	28%	30%	20%	100%
5	**MODERN ENGINEERING PRACTICE** Uses the modern engineering tools and techniques necessary for professional practice.			8%	85%	7%	100%
6	**ANALYZES THE IMPACT OF ENGINEERING** Understands the impact that engineering solutions have on people and society in a local and global context.	2%	4%	89%	10%	4%	109%

7	**PLAN AND MANAGE PROJECTS** Plans and manages engineering projects with criteria of quality, efficiency and profitability.		6%	74%	18%	2%	100%
8	**ACTS WITH ENVIRONMENTAL AWARENESS** It considers the importance of the preservation and improvement of the environment in the development of its professional activities.		10%	30%	53%	7%	100%
9	**MAKES LEARNING IN A SUSTAINED WAY** It recognizes the importance of continuous learning to remain current and up-to-date in its field of professional development.			5%	85%	10%	100%
10	**MEET CONTEMPORARY ISSUES** He is informed of the most relevant national and global events.	5%	7%	70%	12%	6%	100%
11	**ACT WITH ETHICAL AND PROFESSIONAL RESPONSIBILITY** It assumes responsibility for the projects and work carried out and evaluates its decisions and actions from an ethical perspective.				4%	96%	100%
12	**ADEQUATE COMMUNICATION** Communicates clearly and convincingly in oral, written and graphic form according to the different types of interlocutors or audiences.		6%	25%	54%	15%	100%
13	**WORK IN TEAM** Recognizes the importance of group work and integrates and		6%	9%	80%	5%	100%

	participates effectively in multidisciplinary work teams.						
	AVERAGE	4%	7%	29%	52%	17%	100%

Sample: 60 Graduates work in the main Peruvian companies
Date: March 20177

ANNEX 3

DISTRIBUTION OF EMPLOYMENT OF THE MECHANTRONICS GRADUATES OF THE COLLEGE OF MECHANICAL ENGINEERING OF THE NATIONAL UNIVERSITY OF ENGINEERING

PERFORMANCE AREA	CURRENT LABOR ACTIVITY							TOTAL
	PROJECTS	INSTALLATION	MAINTENANCE	COMMERCIAL SERVICES	TEACHING	INVESTIGATION	NOT RELATED TO MECHATRONICS	
MECHANICAL MANUFACTURING	4%	2%	4%	1%	1%	0%	0%	11%
MECHANICAL MANUFACTURING AUTOMATION	4%	4%	3%	3%	1%	1%	0%	15%
ELECTRIC POWER	2%	1%	3%	1%	1%	0%	0%	8%
THERMAL ENERGY	1%	2%	6%	1%	0%	1%	0%	12%
INDUSTRIAL AUTOMATION	7%	4%	6%	3%	2%	1%	0%	23%
ELECTRONIC CONTROL OF MOTOR VEHICLES	1%	1%	3%	1%	1%	1%	0%	7%
SUPERVISION, CONTROL AND DATA ACQUISITION	6%	4%	5%	3%	1%	2%	0%	22%
ACTIVITIES NOT RELATED TO MECHATRONICS	0%	0%	0%	0%	0%	0%	2%	2%
TOTAL	26%	18%	29%	13%	6%	5%	2%	100%

Sample: 120 graduates working in the main Peruvian companies
Date: March 2017

ANEXO 4

SYNTHESIS OF THE INVESTIGATION PLAN TO RELATE THE PROFILE OF THE GRADUATES OF THE SPECIALTY OF MECHATRONICS ENGINEERING OF THE NATIONAL UNIVERSITY OF ENGINEERING WITH THE COMPETITIVE EMPLOYMENT IN METROPOLITAN LIMA

PLACE WHERE THE RESEARCH HAS BEEN DEVELOPED:

Lima - Peru

RESPONSIBLE FOR THE INVESTIGATION:

Academic Direction of Applied Engineering of the College of Mechanical Engineering.

DELIMITATION OF THE INVESTIGATION:

Spatial delimitation:

This work will be developed in Metropolitan Lima.

Temporal delimitation:

This research will cover the period from 2010 to date (March 2017).

Social delimitation:

The research will establish social relationships with the people involved with mechatronics in Metropolitan Lima, graduates, employers, university teachers and entrepreneurs.

Theoretical delimitation:

In this research is framed within the following theories:

- Profile of graduates in Mechatronics Engineering
- Competitive employment

MAIN HYPOTHESIS

The profile of graduates in Mechatronics Engineering facilitates competitive employment in Lima.

SECONDARY HYPOTHESIS

- Comprehensive academic training facilitates the competitive employment of graduates in Mechatronics Engineering in Lima.
- Training in general skills facilitates the competitive employment of graduates in Mechatronics Engineering in Lima.
- Training in specialist skills facilitates the competitive employment of graduates in Mechatronics Engineering in Lima.
- Humanist training facilitates the competitive employment of graduates in Mechatronics Engineering in Lima.

JUSTIFICATION AND IMPORTANCE OF THE INVESTIGATION

The justification and importance of this research is to present a way to correlate the profile of mechatronics engineering graduates of the College of Mechanical Engineering of the National University of Engineering with competitive employment whose main function is to increase the added value of the products or services that companies offer to the market.

OPERATION OF THE VARIABLES, DIMENSIONS AND INDICATORS OF THE INVESTIGATION

TABLE OF OPERATION OF THE VARIABLES, DIMENSIONS AND INDICATORS:

VARIABLES	DIMENSIONS	INDICATORS	MEASURING SCALE	RELATION
INDEPENDENT VARIABLE X. Profile of graduates in Mechatronics Engineering	X.1. Integral academic training	Degree of comprehensive academic training.	High, Medium, Low.	X- Y- Z X.1., Y.1., Z X.2. , Y.2., Z X.3., Y.3., Z X.4., Y.4., Z
	X.2. Training in general skills	Degree of training in general skills.	High, Medium, Low.	
	X.3. Training in specialized skills	Degree of training in specialized skills.	High, Medium, Low.	
	X.4. Humanist training	Degree of humanist formation.	High, Medium, Low.	
DEPENDENT VARIABLE Y. Competitive employment	Y.1. Labor productivity	Degree of labor productivity.	High, Medium, Low.	
	Y.2. Continuous work improvement	Degree of continuous work improvement.	High, Medium, Low.	
	Y.3. Labor Competitiveness	Degree of labor competitiveness.	High, Medium, Low.	
	Y.4. Total satisfaction of workers	Degree of total satisfaction of workers.	High, Medium, Low.	

Source: Design of the Directorate of Applied Engineering

TRATEGY FOLLOWED FOR THE CONTRASTING OF HYPOTHESES

The strategy followed to test the hypothesis was as follows:

1) First, the number of people to be surveyed was defined: This figure to date is 278.
2) Secondly, 5% was set as the margin of error parameter of the work.
3) Third, we will define the alternative hypothesis and the null hypothesis of the research
4) The research instrument was applied, ie the survey questionnaire, containing corresponding questions. This instrument is in Annex C.3.
5) Data has been processed using SPSS software.
6) The system will provide the following results at the level of statistical tables, correlation, regression, anova and coefficient.

7) In these tables there are several elements that can be analyzed, however the most important is the degree of significance (Sig) that is compared with the margin of error proposed by the researcher. If the degree of significance is less than the margin of error, then it rejects the null hypothesis and accepts the alternative hypothesis or main hypothesis of the work. This is what is technically called hypothesis testing or hypothesis testing.

METHODS OF THE INVESTIGATION APPLIED

This research will use the following methods:

- Descriptive

To describe all aspects related to the profile of graduates in Mechatronics Engineering and the competitive employment of Metropolitan Lima.

- Inductive

To infer that the profile of graduates in Mechatronics Engineering in the competitive employment of Metropolitan Lima.

- Deductive

To draw the conclusions of the profile of graduates in Mechatronics Engineering and the competitive employment of Metropolitan Lima.

DESIGN OF THE INVESTIGATION

The design is the plan or strategy that will be developed to obtain the information required in the research. The design to be applied will be non-experimental.

Non-experimental design is defined as the research to be done without deliberately manipulating the profile of graduates in Mechatronics Engineering and the competitive employment of Metropolitan Lima.

In this design the profile of graduates in Mechatronics Engineering and the competitive employment of Metropolitan Lima will be observed, as they are given in their natural context, and then analyzed.

POPULATION AND SAMPLE OF THE INVESTIGATION

The total population of the research will be made up of 1,000 people related to Mechatronics Engineering and the sample will be composed of 278 people related to Mechatronics Engineering.

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ANNEX 4.1: THE PROFILE OF EMPLOYEES IN MECHANICAL ENGINEERING AND COMPETITIVE EMPLOYMENT IN LIMA METROPOLITANA, PROPOSAL UPDATED TO MARCH 2017

PROBLEMS	OBJECTIVES	HYPOTHESIS	VARIABLES, DIMENSIONS, INDICATORS	METHOD
MAIN PROBLEM How can the profile of graduates in Mechatronics Engineering facilitate competitive employment in Metropolitan Lima? **SECONDARY PROBLEMS** 1) In what way can comprehensive academic training facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima? 2) In what way can general competence training facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima? 3) In what way the training in specialist skills can facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima? 4) In what way can humanist training facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima?	**GENERAL OBJECTIVE** Establish how the profile of graduates in Mechatronics Engineering can facilitate competitive employment in Metropolitan Lima. **SPECIFIC OBJECTIVES** 1) Determine how integral academic training can facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 2) Establish how the training in general competences can facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 3) Establish how the training in specialist skills can facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 4) Establish how humanist training can facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima.	**MAIN HYPOTHESIS** The profile of graduates in Mechatronics Engineering facilitates competitive employment in Metropolitan Lima. **SECONDARY HYPOTHESIS** 1) Comprehensive academic training facilitates the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 2) Training in general skills facilitates the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 3) Training in specialist skills facilitates the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima. 4) Humanist training facilitates the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima.	**INDEPENDENT VARIABLE:** X. Profile of graduates in Mechatronics Engineering Dimensions: X.1. Integral academic training X.2. Training in general skills X.3. Training in specialized skills X.4. Humanist training **DEPENDENT VARIABLE:** Y. Competitive employment Dimensions: Y.1. Labor productivity Y.2. Continuous work improvement Y.3. Labor Competitiveness Y.4. Total satisfaction of workers **INTERVENTION** **Z.** Metropolitan Lima	This research will be descriptive, explanatory and correlational. The research will be at the descriptive-explanatory-correlational level. The research will use the following methods: Descriptive, Inductive, Deductive The design to be applied will be non-experimental. The research population will be made up of 1,000 people The sample will be made up of 278 people To define the sample size, the probabilistic method will be used. The data collection techniques to be used will be as follows: Surveys; Taking of information and Documentary analysis. The instruments for data collection to be used will be the following questionnaires, fact sheets and analysis guides. The following data processing techniques will be applied: Sorting and classification; Manual recording; Computerized process with Excel; Computerized process with SPSS. The following analysis techniques will be applied: Documentary analysis; Inquiry; Conciliation of data; Tabulation of tables with quantities and percentages; graphics understanding.

ANNEX 4.2

INSTRUMENT USED: SURVEY

GENERAL INSTRUCTIONS:
This survey is personal and anonymous, is directed to people related to Mechatronics Engineering in Metropolitan Lima.
I thank you to give your answer with the most transparency and veracity to the various questions of the questionnaire, all of which will allow a scientific approach to the concrete reality of the Profile of graduates in mechatronics engineering and Competitive employment in metropolitan Lima.

SPECIFIC INSTRUCTIONS:
Mark in the box corresponding to your answer.

1) Does the profile of graduates in Mechatronics Engineering facilitate competitive employment in Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

2) Does comprehensive academic training facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

3) Does the training in general skills facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

4) Does the training in specialist skills facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

5) Does the humanist training facilitate the competitive employment of graduates in Mechatronics Engineering in Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

6) Does the integral academic training cover the theoretical knowledge, the competences, the humanistic, ethical and moral aspect of the graduate in Mechatronics Engineering?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

7) Does the training in general competences consider economic, financial, labor and other aspects necessary for the professional development of the graduate in Mechatronics Engineering?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

8) Does the training in specialized competences cover everything related to the field of Mechatronics engineering proper to be applied by graduates in this specialty?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

9) Does the humanist training comprise the knowledge of the personal and group interrelations, as well as the ethics and morals that the graduate in Mechatronics Engineering should apply?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

10) Does the profile of the graduate in Mechatronics Engineering have to be a dynamic instrument and must be formulated taking into account the competences required by the labour market for this specialty?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

11) Does the profile of the graduate in Mechatronics Engineering also have to be formulated by looking at other similar entities, in such a way as to train professionals for the competitive labour market?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

12) Competitive employment is one that requires a solid academic training of graduates in Mechatronics Engineering in Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

13) Is the job competitive when it demands a high level of productivity and continuous improvement in the graduates of Mechatronics Engineering of Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

14) Is the job competitive when it demands the graduates in Mechatronics Engineering a high level of competences specific to their specialty and others as a person?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

15) Does labor productivity is the maximum utilization of labor skills of the graduates of Mechatronics Engineering of Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

16) Does the continuous work improvement require the permanent reinvention of the graduate in Mechatronics Engineering of Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

17) Does the continuous work improvement require the graduate of Mechatronics Engineering his permanent participation, his team work and change to positive attitudes to get inserted in the market of Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

18) Is the labor competitiveness achieved with a solid academic training, as well as with the experiences acquired by graduates of Mechatronics Engineering of Metropolitan Lima?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

19) Is job satisfaction possible through good remuneration and especially because of the treatment received by graduates in Mechatronics Engineering in the Metropolitan Lima labour market?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

20) Does the job satisfaction result from the permanent incentives for productivity and competitiveness of graduates of Mechatronics Engineering in the Metropolitan Lima labour market?

Totally agree	Agree	Neutral	Disagree	Strongly Disagree
□	□	□	□	□

ANNEX 4.3

VALIDATION OF THE INSTRUMENT

The validation of the research instrument to establish the correlation between the Profile of graduates in mechatronics engineering and competitive employment in metropolitan Lima (proposal updated to March 2017) was considered, according to the advisory teachers that it has as a standard a value greater than 85%.
The qualification of the advisory teachers was as follows:

No.	QUESTION	55%	65%	75%	85%	95%	100%
1	In what percentage will the hypothesis be contrasted with this instrument?						X
2	In what percentage do you consider the questions to be related to the variables and indicators of the research?						X
3	What percentage of the questions raised are sufficient to achieve the overall objective of the research?						X
4	In what percentage, the questions are easy to understand?					X	
5	What percentage of questions follow a logical sequence?				X		
6	In what percentage will similar data be obtained with this test by applying it in other samples?				X		

Final consideration regarding the instrument used to collect data:
"All the questions of the instrument exceed the parameter of 85%, therefore the instrument was validated".

ANNEX 4.4

RELIABILITY OF THE INSTRUMENT WITH THE ALPHA OF CRONBACH

The research instrument to establish the correlation between the Profile of graduates in mechatronics engineering and competitive employment in metropolitan Lima (proposal updated to March 2017), is feasible for reproduction by other researchers.

The results obtained with the instrument on a given occasion, under certain conditions, will be similar if the same variables were re-measured under identical conditions.

This aspect of the reasonable accuracy with which the instrument measures what was intended to be measured is what is called the reliability of the instrument, the same that is fulfilled with the instrument of inquiry of this work.

Having obtained the results of a preliminary sampling shown in the following table:

DETERMINATION OF RELIABILITY COEFFICIENT

VARIABLES	ALFA DE CRONBACH COEFFICIENT	NUMBER OF ITEMS
PROFILE OF GRADUATES IN MECHATRONICS ENGINEERING	0.9590	10
COMPETITIVE EMPLOYMENT	0.9695	10
TOTAL	**0.9695**	**20**

With respect to the reliability of the instrument to be used, the following was concluded:

1) For the independent variable PROFILE OF THE GRADUATES IN MECHATRONICS ENGINEERING, the value of the coefficient is 0.9590, which indicates high reliability.
2) For the dependent variable COMPETITIVE EMPLOYMENT, the value of the coefficient is 0.9695, indicating a high reliability.
3) The Alpha de Cronbach coefficient for the full scale is 0.9695, which indicates a high reliability of the instrument.
4) Finally, the reliability of both the total scale and the two variables in particular have values that make the instrument useful to achieve the objectives of the research.

De esta manera los Docentes Asesores constataron la confiabilidad del instrumento de recolección de datos usado.