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**MANAGEMENT SYSTEM FOR RESEARCH FUNCTION BASED ON THE ISO 9001:  
2008 IN COMPLIANCE WITH THE INDICATORS ESTABLISHED BY THE CEACES  
FOR QUALITY ASSURANCE OF EDUCATION IN THE FACULTY OF ENGINEERING  
OF APPLIED SCIENCE AT THE TECHNICAL UNIVERSITY OF THE NORTH.**

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**ÁREA DE INVESTIGACIÓN: CALIDAD, PRODUCTIVIDAD Y SEGURIDAD EN LA  
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# Management System for Research function based on the ISO 9001: 2008 in compliance with the indicators established by the CEAACES for quality assurance of education in the Faculty of Engineering of Applied Science at the Technical University of the North.

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**Abstract.** *This research is a design of quality management system (QMS) based on ISO 9001: 2008 in compliance with the indicators of the evaluation matrix careers Evaluation Council, Accreditation and Quality Assurance of the Higher education; This thesis is focused on the macro-, Research function is complemented with three other theses of the macro processes management, teaching and Liaison; QMS made one for the Engineering Faculty of Applied Science at the Technical University of the North.*

## Keywords

Design, system management, quality, macro process, Research, ISO

**Resumen.** *La presente investigación es un diseño de Sistema de Gestión de la Calidad (SGC) basado en las Normas ISO 9001:2008 en cumplimiento a los indicadores de la Matriz de evaluación por carreras del Consejo de Evaluación, Acreditación y Aseguramiento de la Calidad de la Educación Superior; este trabajo de grado se enfoca en el macroproceso de la función Investigación y se complementa con otros tres de los macro procesos Gestión y Dirección, Académica y Vinculación; conformado un solo SGC para la Facultad de Ingeniería en Ciencias Aplicadas de la Universidad Técnica del Norte.*

## Palabras Claves

Diseño, sistema, gestión, calidad, macroproceso, investigación, ISO.

## 1. Introduction

The Ministry of Education proposed as a strategy to improve the quality of education, educational quality standards that helps guide, support and monitor the management of stakeholders in the education system towards its continuous improvement. These standards are aligned with the objective 4 of the National Plan for Good Living.

The Constitution of Ecuador establishes in Article 26 that "education is a right of people throughout their lives and an unavoidable and inexcusable duty of the State", and Article 27 adds that education should be quality. Therefore there are governing bodies of higher education as Secretary of Higher Education, Science, Technology and Innovation (SENESCYT), CEAACES and CES that regulate and promote the General System of Quality Assurance in the country, based on the principle of quality Art 93 described in LOES which states: the quality principle consists in the constant and systematic pursuit of excellence, relevance, optimal production, knowledge transfer and development of thought through self-criticism, external criticism and improvement permanent.

In the General Report on the Evaluation, Accreditation and Categorization of Universities and Polytechnics, approved by the full CEAACES, by Resolution No.001-073-CEAACES-2013, dated November 26, 2013 the Technical University Northern he placed in category B. as the authorities have appointed commissions as academic, curriculum and assessment and accreditation process for institutional accreditation and accreditation re careers and trying to climb in the categorization of universities.

In compliance with the functions assigned by the LOES in Article 174, the CEAACES shall evaluate,

accredit and categorize all the races of the Institutions of Higher Education. For which it has established an evaluation matrix indicators detailing the guidelines that the race must meet to prove.

That is why it has been necessary to design a quality management system focused on compliance assessment indicators Research LOES within the FICA function, so that the UTN proving their careers in research. Since research function is essential for the development of students and teachers so that there should be a management system within the Faculty indicators covering all of the established role in the assessment matrix CEAACES.

## 2. Materials and Methods

### Materials

The materials used in this research are stationery and office supplies : paper, ink , CDs , flash memory , camera, computer , printer ; also it has been used checklists ISO 9001 : 2008 and CEAACES indicators to lift the information on the current situation of the Faculty.

### Methods

On the theoretical foundation is used the inductive method - deductive because the collection of information on regulations, publications, books, thesis, among other documents relating to quality in higher education and the CEAACES indicators will require for then by analyzing synthesize it, adapt it to the reality and structuring the theoretical basis for the design of the management system.

In the diagnosis of the current situation will be used the descriptive method will need to gather information related to compliance with the indicators of evaluation of the CEAACES and points of ISO 9001:2008, through observation and description of the facts; It will be also used qualitative method because it is required for the performance of audits to the staff involved and from that evaluate and analyse the results obtained through the use of the quantitative method (tabulations of percentages of compliance and non-compliance).

The development of this system will be used the inductive method because through the diagnosis with their respective analysis raises the integration of one proposal for improvement, finally in the comparison of the results the analytical method is used between the before and after the introduction of the design of QMS.

### 2.1 Diagnosis of the current situation of the FICA

The Faculty of Engineering of Applied Science (FICA) is an academic unit of the Technical University of the North, public, contributing to the development of knowledge and serves the needs of the provinces of

Imbabura, Carchi and country, forming professionals in Systems engineering, Textile, Electronics and Communication Networks, Industrial, Mechatronics, Electrical Maintenance Automotive Maintenance and scientifically prepared, technical, humanist generating science, technology, create services, have social awareness and protect the environment.

In order to diagnose the situation and address management function has been performed a SWOT analysis.

Internal and external factors detailed in the they have been obtained mainly from information provided by authorities, academic staff, administrative and student representatives who participated in internal audits to those involved in the research function of the university, not However, it is noteworthy that has been taken as a starting point the analysis in the annual plan of public policies of both the faculty and the institution.

Table 2.1 SWOT function Research

SWOT ANALYSIS				
	D	WEAKNESSES	F	STRENGTHS
INTERNAL ENVIRONMENT	1	Unspecialized to perform and conduct research in laboratories, documentation centers , facilities staff social and natural environments .	1	Program Linking with society through research and innovation projects with social, productive and business purposes.
	2	Scarce design, management and participation in networks and programs of local , national and international research.	2	System development is encouraged research through the Research Institute and Research Centers ( CUICYT )
	3	Low participation in committees or academic councils and publishers of scientific and scholarly journals indexed and high-impact scientific or academic.	3	There is a committee dedicated to developing research work at the Faculty.
	4	Reduced equipment and high-tech laboratories that contribute to research.	4	Involvement of students in tasks related to research, in order to develop their creative abilities in all areas of zone 1.
	5	Lack of binding CUICYT with faculty to train project.	5	Research encourages students in the chairs
EXTERNAL ENVIRONMENT	A	THREATS	O	OPPORTUNITIES
	1	Lack of openness by public and private companies to carry out research projects because of the new laws established by the government.	1	Growth in the manufacturing sector with the emergence of new enterprises requiring become better , with the contribution of linkage programs through research

			projects.
2	Lack of agreements with public and private companies for research.	2	With the creation of the city of knowledge Yachay may be able to contribute to the development of the human talent.
3	Low budget designation by the regulatory bodies of education for research programs at the university and the Faculty respectively	3	With the revival of some large companies in zone 1 ( Puerto San Lorenzo Refinery and Pacific ) open new fields for research training.

For the initial situation of the FICA has also conducted internal audits based on ISO 9001: 2008 and the Matrix of Generic Evaluation Model Learning Environment Career face and blended learning Universities and Polytechnics of Ecuador issued by the CEAACES .

The objective of the audit was to collect important aspects of both conformities as nonconformities to verify the degree of compliance indicators CEAACES and points of the standard and on this basis propose improvement actions.

For the implementation of audit planning it has been conducted , consisting of a program and audit plan .

Internal audits both CEAACES and ISO 9001: 2008 performed the function FICA Research yielded the results presented below.

## 2.2 Analysis of the results of the audit based on ISO 9001: 2008 ( Provision Research Service function)

Table 2.2 Analysis of compliance with the requirements of providing function Research

ITEMS	% current compliance	% expected compliance
7.1. Planning for the provision of the service	2,17%	8,70%
7.2. Processes related to the user	10,87%	19,57%
7.3. Development	19,57%	41,30%
7.4. Shopping	15,22%	30,43%
<b>TOTAL</b>	<b>47,83%</b>	<b>100%</b>

It is noteworthy that the determination of compliance is not full, which means that compliance is considered

when the number of affirmative responses check list is made greater.

The percentage of expected compliance refers to full compliance with the items in each point of the ISO 9001: 2008; requiring compliance with all the requirements expressed by the reference standard.

An analysis of the results of the audit to the point 7 of the ISO 9001:2008 is presented

### 2.2.1 Planning the provision of the service

According to the results of the audit function Research partially meet this requirement of the standard. This means you do not have a planning and development processes that are necessary for the development of the activities of the Research function. At this point, a detailed planning and development of processes for conducting research activities is the interrelation between the processes involved is required.

Corrective action:

The following for the requirement is proposed:

- Define processes (direct and support) and resources to develop the activities of the Research function.
- To design a process map and characterization of processes within the Quality Manual to determine this consistency.
- For planning to be performed for the service should be taken into account: the objectives of Quality, service specifications, need to establish processes, documents, provide resources specific to the service; the activities of verification, validation, monitoring and inspection test / service specific test, acceptance criteria, records evidencing compliance with the requirements
- The results should be presented according to the way of working of the QMS.

### 2.2.2 Processes related to the student or faculty researcher

According to this point of the standard, the results of the audit yielded the following information:

FICA if you have requirements of students or researchers who wish to develop educational activities Research function. parameters established by the Institute of Electrical and Electronics Engineering (IEEE) to present research to both teachers and students account. It takes into account all the laws and regulations of the state and the governing bodies of Higher Education Institutions (HEI) to develop research activities function both inside and outside of the Faculty.

Regarding the review of requirements related research activities FICA function partially meets this point. They are

defined those responsible for the management (issue, review and approval) of the activities and the ability of the FICA to meet the requirements linked to society in research projects is analyzed.

Regarding communication with students or teachers researchers, there are established means for continuous communication and resolve issues such as: provide information, answer questions, among others.

Corrective action:

Although most of this requirement of the standard is met the following for full compliance it is proposed:

- Socialize all information regarding research parameters.
- Define processes and procedures for students or teachers researchers who wish to develop an investigation.
- Establish provisions to communicate more directly with students and faculty researchers.
- Dissemination about the mainstream media for communication activities Research function.
- Determine procedures for communication with students or teachers and manage the information will help improve the quality of educational services.

### 2.2.3 Design and Research Development function

The audit results provide information that meets FICA most items this point. With the audit the following information was collected:

There is a planning design and development activities Research function. This includes planning stages of design, verification and validation where established review criteria of each of these stages are.

The audit determined that all input activities are defined input elements. For example, for teachers investigations necessary academic notes, while for students it is the draft thesis.

According to the results of design review and development of the activities of the Research function; FICA keep records of revisions made in research students through a control sheet, which is not true for researchers teachers. Each stage of development of investigations handled acceptance criteria according to the parameters established by research coordinators and teachers if the tutor should be a student.

Corrective action:

- Define responsible for developing each stage of the design and development of the activities of the Research function.
- You need to keep records of all inputs for research activities function.

For a specific control for design reviews and research development is recommended:

- Develop standard formats for design review and research development for both teachers and students. Where the progress of processes, achieving goals, identifying and correcting problems, identifying opportunities for improvement in these processes are evidenced.

As for design validation and development it is necessary to maintain records evidencing the development of research activities function.

In the Control of design and development changes must keep records of any changes made throughout the development of research.

- Record changes or modifications made.
- Changes made in any investigation both teachers and students is necessary to submit to verification and validation.
- Validate changes or modifications made.
  - Determine responsible for validating these modifications.

### 2.2.4 Production and Service Delivery

At this point the non-compliance with the standard was evident in the absence of a correct approach to conducting research activities. The audit helped identify failures in carrying out the activities of the function and know the most important aspects for research.

Corrective action:

Regarding the control of production and service delivery it was identified that there is a computer system that maintains information orderly certain activities Research function. It is recommended to take into account the following aspects:

- To systematize all research activities function.
- Provide work instructions describing research activities function
- Perform and document activities to improve research function.
- Define indicators that assess the research management function.

As regards the identification and traceability is necessary to maintain orderly information to review it as many times as required. It is recommended:

- Identify each Research with some code or number that allows you to distinguish itself from others.
- Investigations Sort according to the number or code to get that information the moment it requires.

Regarding the property of the student and teacher research is necessary:

- Define an appropriate and concrete methodology for communication of students and faculty researchers about the weaknesses that occurred in the development of research activities function

- Register any communication.

Regarding the preservation of function activities research is needed:

- Define an appropriate methodology for updating activities in the research function.
- To demonstrate compliance with the methodology.

### 2.2.5 Control of monitoring and measuring devices

According to the audit FICA has no control to assess the performance of the activities of the Research function. This point would violate the rule entirely .

Corrective action:

- Develop a list of all the tools that assess the performance of research activities function.
- Establish the scope and frequency with which these tools are used.

## 2.3 Analysis of the results of the audit based on the matrix CEAACES

In the internal audit function Research evidence calling for the six indicators CEEACES assessment matrix corresponding to the function is analyzed. Most of the evidence does not exist, or are not updated their whereabouts are known ; therefore it is necessary to maintain a structured control this evidence to present them in audits of Higher Education Council (CES) .

This audit was conducted personnel directly involved with the research role in helping to get the information detailed below according to each analyzed indicator.

### 2.3.1 Academic Production - Scientific

The evidence of esta indicador is partially met. According to the auditoriums found the existence f Academician of scientific articles published and / or accepted for publication and is maintained This Digital Archives of accordance with the requirements of indexed journals.

Corrective action:

- Structuring information in a single database for better organization.

Of the articles published collect the necessary evidence to ask the CEAACES .

Collect notifications of acceptance of the articles to be published in a magazine base SCIMAGO ( Scopus) or ISI Web .

Documenting acceptance certificates or work . It can be an email from the editor of the magazine. Maintain catalographic sheets with:

- Article's name
- Name of the journal.
- SSN magazine.
- Article DOI.
- Volume, number, pages of the article.
- Publication date

### 2.3.2 Regional Production

Evidence of this indicator is partially met. According to the audit it found that there are regional publications with digital files of each academic-scientific article accordance with the requirements of regional magazines.

Corrective action:

- Structuring information in a single database for better organization.
- Of the articles published collect the necessary evidence to ask the CEAACES .

o Perform cataloging records with :

- Article's name
- Name of the journal.
- SSN magazine.
- Volume, number, pages of the article.
- Publication date

Collect notification of acceptance or article to be published in a journal of regional databases

### 2.3.3 Books or chapters of books

Evidence of this indicator is not met. The audit determined that there is no evidence , nor is aware of recent publications.

Corrective action:

- Update information on books or book chapters published by researchers teachers.
- Structuring all information regarding books or book chapters according to the evidence calls for CEAACES .

o Have physical copies of books and digital files of chapters of books.

o Maintain catalographic sheets with :

- Name of the book.
- Chaptername .

- c . ISBN of the book.
- d . Publication date.

### 2.3.4 Presentations

Evidence of this indicator is partially met. According to the audit the following information was collected :

Career coordinators handle information about digital files of papers and certificates or invitations to participate as a speaker at academic and scientific national or international events .

Corrective action:

- It is necessary to structure the information in a single database for better information management.
- Document the reports published by the organizer of the academic event

### 2.3.5 Basic Bibliography

This indicator assesses the availability of library materials to meet the basic needs of compulsory bibliography of the subjects of the race. According to the audit it determined that all the evidence requested there. For example:

- The current curriculum coordinators have each race.
- The syllabi for each subject of the current academic planning coordinators have careers.
- catalog of existing in the library of the race, or IES Faculty physical and virtual books is the library director .
- The subject list of students enrolled in the trial period have coordinators career.

Corrective action:

- Structuring information in a single database to facilitate administration thereof

### 2.3.6 Bibliographic quality

This indicator assesses the quality of the race literature. According to the internal audit it was determined that the evidence the Director of the university library is handled.

- The Library Director manages the inventory of existing books or faculty career .
  - a. It handles the number of physical copies that exist book
  - b. Virtual copies that exist depending on the subject syllabi .
- Budget executed in acquiring bibliographic material is handled by the director of the library.

Corrective action:

- Structuring the information to maintain a single database to facilitate administration thereof .

## 3. Results

### 3.1 Design SGC

The Quality Management Systems are designed and implemented primarily for companies producing goods but there are currently implementing successful experiences in business services, improve the quality of processes and streamline customer service. Therefore it was considered important and timely design a quality management system based on the requirements of ISO 9001: 2008 compliance indicators CEAACES. This is a system that the design of four parts focusing on macro processes by which to manage the FICA is complemented; Management and Leadership, Academic, Research and Liaison.

For the SGC has been made a quality manual, process map, inventory processes, characterization and process a manual of all procedures. In this thesis is the design of the QMS focused on the macro process Research function.

It has built a Quality Manual entire SGC mentioning each point of the standard and procedures raised for each Management and Leadership, Academic, Research and Liaison function; plasma herein policy, quality objectives, six required by the standard procedures, records, instructions, among others.

In order to facilitate the identification of processes and procedures function Research has developed a coded inventory is summarized in the following.

Table 3.1 Inventory processes and procedures Research function

PROCESS					
CO D	NAME	CO D	NAME	CO D	NAME
I	Investigation	I.1	Addressing Research	I.1.1	Define and update Research Lines
I		I.2	Project management	I.2.1	Drafting of Internal Investigation
I		I.2	Project management	I.2.2	Presentation and external approval Research projects
I		I.2	Project management	I.2.3	Follow-up investigations
I		I.2	Project management	I.2.4	Reporting research
I		I.2	Project management	I.2.5	Socialization research to CUICYT

I	Investigation	I.3	Research Publication	I.3.1	Publication of scientific articles in journals FICA
I		I.3	Research Publication	I.3.2	Publication of scientific articles indexed journals.
I		I.3	Research Publication	I.3.3	Publication of books or book chapters
I		I.4	Management Presentations	I.4.1	Preparation and approval of a paper .
I		I.4	Management Presentations	I.4.2	Participation of papers in academic events
I		I.5	Bibliographical Material Management	I.5.1	Getting bibliographic material
I		I.5	Bibliographical Material Management	I.5.2	Verification of the quality of bibliographic material

It was made characterizations for the 5 processes mentioned in the inventory and manuals for the 13 procedures, which can guide the actions of the Research function.

### 3.2 Comparative Analysis and Research function Improvement Plan

We performed a comparative analysis of the research function between the initial audit of the requirements of paragraph 7 (Service Provision ) of ISO 9001 : 2008 conducted in the situational diagnosis and a new audit of the current situation of the FICA after SGC design for the Faculty .

Table 3.2 Comparative analysis of compliance with the requirements of providing function Research

ÍTEMS	% current compliance	% compliance with the QMS design	% expected compliance
7.1. Planning for the provision of the service	2,17%	8,70%	8,70%
7.2. Processes related to the user	10,87%	15,22%	19,57%
7.3. Development	19,57%	36,96%	41,30%
7.4. Shopping	15,22%	26,09%	30,43%
<b>TOTAL</b>	<b>47,83%</b>	<b>86,97%</b>	<b>100%</b>

The improvement plan includes preventive , corrective and improvement actions applied to non - conformities Research at the Faculty function . Involving all staff of the academic unit .

is detected shortcomings in carrying out the service ( point 7 ) Research of the Faculty of Applied Science Engineering function because you do not meet all requirements of ISO 9001 : 2008 it requires .

For this improvement plan is an action plan comprising:

- Activities
- Responsible
- Resources
- Evaluation of the effectiveness of each activit

### 4. Conclusions

• This design Quality Management System ISO 9001: 2008 compliance indicators CEEACES represents an opportunity for improvement in the management of the Faculty, allowing streamline processes and thereby improve the quality of educational services.

• Analyze theoretical basis of different authors specializing in the design of the SGC, effective legal bodies that apply to higher education institutions have been allowed to have a key to the development of quality management system of the FICA livelihood.

• The diagnosis of the current situation allowed to know how that management is handled when the FICA in Research function. Implementation of Internal Audits help identify that a high percentage of disagreements as to the requirements of ISO 9001: 2008. In addition it was found that the research function in FICA does not meet all the performance indicators Matrix CEEACES assessment.

• SGC design was performed for the four functions with which the FICA is handled; Management and Leadership, Academic, Research and Liaison. This degree work focused on the realization of part of the research function, performing a manual with 13 procedures 1 and 17 instructional formats that help the proper management of the processes that frame this function.

• An improvement plan for non-conformities found in the comparative analysis between the initial audit and the final audit was performed. With the improvement plan is to suggest actions to comply with all the requirements of ISO 9001: 2008.

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