CHARACTERIZATION OF A UNIVERSITY UNDERGRADUATE ACADEMIC PROCESSES BASED ON ABET EVALUATION CRITERIA, FOR THE ASSURANCE OF ACADEMIC QUALITY

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ABSTRACT
In this study, a proposal for the characterization of the undergraduate academic processes at National University of Engineering (UNI) is presented, including the analysis and description of the actions, evidence and controls required to meet ABET accreditation criteria. UNI currently has 26 engineering and science programs internationally accredited by ABET. The goal of this work is to facilitate the institutionalization of the academic processes, and the assurance of the academic quality management at undergraduate universities.

ABET is a world-renowned accrediting organization for engineering and science programs. It stimulates innovation, encourages continuous improvement, and facilitates strategic planning, thereby ensuring the competence of graduates entering professional practice. It develops and evaluates accreditation criteria.

Process modeling allows a better understanding of the value chain, of the flow of information within the process and between processes, and of the profile of the responsible parties for activities execution. This, in turn, will facilitate the analysis and continuous improvement of the processes. Likewise, the characterization defines the process itself, its scope, its business rules, and management indicators.

Keywords: Process modeling, ABET criteria, Undergraduate programs accreditation.

INTRODUCTION

In year 2011, UNI started the assessment and evaluation of its engineering programs based on ABET criteria by transforming and aggregating the academic processes and incorporating effectiveness and optimality criteria. The attained changes are evident at different levels: professional formation and competences attainment, faculty training and updating, and higher graduate employability.

A new University Law was enacted in year 2014 stating that the Government Ministry of Education is the responsible entity for monitoring and ensuring the quality of university education based on principles of academic quality and continuous improvement. For that, a new supervising entity was created, the National Superintendence of University Higher Education SUNEDU, whose functions and duties were made compatible with those of the National System of Evaluation, Accreditation and Certification SINEACE created in year 2006. With the coordinated work of SUNEDU and SINEACE, the national licensing and accreditation of Peruvian universities was strengthen and enhanced.

Authorities of National University of Engineering UNI, understanding the importance of accrediting all undergraduate programs, modified its bylaws to make mandatory the international accreditation of all engineering and science programs. At present, 26 programs of UNI have attained the international ABET accreditation, one of the most important engineering and sciences accreditation boards in the world. The accredited programs include 22 engineering programs, 2 natural sciences programs, 1 formal science program, and 1 computer science program.

After the ABET evaluation and accreditation experience, it became clear that, for the sustainability of the evaluation and continuous improvement processes, it is required to systematize and institutionalize the academic processes, ensuring the practicality and effectiveness of the assessment, evaluation and continuous improvement processes in compliance with ABET accreditation criteria. For that, it was made clear that the accreditation is not an end by itself, but the continuous improvement and continuous search of excellence is what really matters. For that, it is important to coordinately work, at program and institutional levels, the academic management processes, the quality standards, the required budgets, the knowledge management, leadership, empowerment, faculty commitment, among other requirements for ensuring a quality professional formation.

At present, Peru has 91 universities licensed by SUNEDU, of which 45 universities, 30 private and 15 nationals, have an average of 21% of their undergraduate programs accredited at the national and / or international level. Accreditations to engineering, health, education and administration programs are highlighted.

From these figures, 22 universities, 5 nationals and 17 privates, they have engineering programs accredited internationally, total 105 engineering programs, of which 22 belong to the UNI.

PROBLEM DEFINITION

In years 2017 and 2018, UNI Central Office of University Quality, revising the application of good practices for assessment, evaluation and continuous improvement of undergraduate programs according to ABET criteria, found that accredited programs neglected the application continuity of best and recommended academic management practices: faculty work teams were renewed without proper training, undergraduate programs accreditation offices were not assigned the required budget, loosen faculty commitment, and there was not a proper analysis of annual assessment data for

evaluation and   continuous improvement. These shortcomings appeared in lesser degree in the programs working in the initial accreditation process started in year 2015.

Revising proper bibliography, it was found that these periods of slowing and relaxation of improvement processes were common in many universities and programs with national and international accreditations which, in some cases, were even lost. It was the result not only of the failed or interrupted application of continuous improvement processes, but also due to the lack of motivation and leadership among the new group of authorities at university, college, and program levels.

The weak development of internal quality assurance processes, which promote continuous and sustained actions with assigned budget, constitutes a common weakness in academic institutions. This fact causes the organizations to go into lethargy after the accreditation process has been completed, and to resume when the next accreditation period approaches, which leads to think that the process is not assumed as an inherent part of the institutional life.[1]

There are several factors that must be considered for the successful development of quality assurance processes in university higher education in different countries, one of factors being the importance of faculty to work together around accreditation as a process of innovation and transformation of the institution and its people (authorities, faculty, students, staff, graduates, employers) [1].

THEORETICAL FRAMEWORK
In the IESALC-UNESCO study on quality assurance in higher education [2], The study mentions that accreditation as a process is currently the most widespread way of externally guaranteeing quality and, therefore, the one mainly used by most national higher education systems to guarantee quality. Quality assurance is the process of generating confidence that the provision of education meets expectations or, at least, meets minimum standards, implying that quality is well defined in operational terms, and that it can be verified through pre-established criteria.

The reviews of accrediting agencies are rigorous and evidence-based, evaluating the validity, reliability, and efficiency of the processes to ensure quality. An achievable goal of these external reviews would be to ensure that the internal processes of higher education institutions promote the development and fulfillment of academic standards.

On Curriculum Management [3], Simon Bolivar University of Colombia, within its institutional improvement plan, analyzed and valued academic processes and the strengthening of curriculum management.

This study produced an initial knowledge about the institutional pedagogical horizon, pedagogical management in academic programs, student effective learning, and the competences-based approach from the perspective of students and faculty, the management of the extended classroom as support for the presence, the independent and autonomous work, and training on research. This diagnosis allowed the formulation and implementation of improvement actions that range from redesign of academic of degrees, interdisciplinarity, and the promotion of autonomous learning, permanent faculty training and

skills updating, and the deployment of strategies for monitoring student learning and competence development, which guarantee a suitable performance in different social and professional scenarios.

The described panorama supports the need to implement a curriculum management process aiming to the revision, design, development, evaluation and innovation of the curriculum in its different concretions: institutional structure, study plans, and academic activities of the programs supporting the degrees, the courses and analytical programs, and the planning and development of faculty activities.

Quality management of university processes [4]. In higher education institutions it is necessary to manage the quality of the processes that develop within them. The study proposes a methodology for the management of university processes, divided in 4 phases:

- Phase 1: Identification of university processes, where the processes are classified as strategic, key and supportive.
- Phase 2: Determination of the sub-processes and components of each university process, where only the key processes of teaching-learning, linking, and research are worked out.
- Phase 3: Definition of the activities of each sub-process.
- Phase 4: Establishment of indexes and ratios to measure the performance and quality of each process.

International accreditation and quality assurance [5]. The study was carried out in 15 Peruvian universities that have internationally accredited engineering programs; among its conclusions it raises:

- The model that handles the international accreditation of applied engineering programs in Peru is oriented towards continuous improvement and quality management systems, which allows the improvement of processes and indicators and the satisfaction of stakeholders.
- The tool most related to quality assurance is self-evaluation, insofar as it allows the awareness of the actors of the university community when reviewing the strengths, weaknesses and opportunities, clearly establishing the gaps for which they should be plan activities as a continuous process of improvement, since from a systematic, reflective and participatory evaluation, improvements are generated continuously, which ensures quality.
- Accreditation allows the deployment of good practices and a process-based approach, which gives the guarantee of sustainability by establishing continuous improvement as an institutional practice.
- Incorporate internal and external accreditation standards into the university's management system and not generate isolated subsystems that may affect the unified management model that should exist.

METHODOLOGY

Higher Education Institutions are constantly searching for tools that allow them to improve their quality assurance policies at the different levels of higher education, supported by a continuous improvement system that leads to the academic programs meeting their mission and the objectives proposed to society [6]. Process management strategies and methodologies become an interesting alternative to achieve these outcomes.

The processes are modeled for a better understanding of their scope, components and relationships, in order to determine what should be done and who should execute the activities, as well as to determine the value chain and information flow, allowing a more effective assessment, analysis and evaluation for process continuous improvement. Modeling is the basis for process automation and enhancing. [7]

1. For elaborating the proposal of definition and characterization of academic processes, the following references were considered:

- Peruvian Technical Standard No. 001-2018-SGP, December 2018, for the implementation of process management in government-funded and public administration entities.
- ABET accreditation criteria.
  ABET is a non-profit organization based in the United States, recognized by the Council on Higher Education Accreditation (CHEA). It ensures quality through the accreditation of educational programs. It applies criteria to all accredited engineering programs, which promote the systematic search for improvement in the quality of engineering education, satisfying the needs of stakeholders in a dynamic and competitive environment. For engineering programs, institutions must demonstrate compliance with 8 criteria: 1) Students, 2) Program Educational Objectives, 3) Student Outcomes, 4) Continuous Improvement, 5) Curriculum, 6) Faculty, 7) Facilities, 8) Institutional Support, as well as the applicable program criteria [8].
- Workshops and group dynamics with experts from various UNI colleges and programs for consolidating the inventory of academic processes, as well as for developing the processes conceptual model.

2. The levels in process modeling are: [7]

- First level: the process architecture is defined. Linking the mission and strategy with the operation.
- Second level: a conceptual modeling of the process is carried out.
- Third level: executable models are developed with a focus on automation at a higher level of detail.

3. The characterization defines the process, its scope, its business rule, and management indicators. The activities are identified and presented in a flow chart or a BPMN (Business Process Model and Notation). [7]

RESULTS

The mission of National University of Engineering is: "To form leading professionals in science, engineering and architecture, in a humanistic way, focused on scientific research, technology creation and development, committed to quality continuous improvement, and social responsibility, contributing to the country sustainable development".

Figure 1 presents the UNI process architecture (macro-process map) proposed in this work, where the strategic, missional and supportive processes are clearly shown. These processes are identified and defined taking into account the mission, objectives and services provided by the university. This proposal was reviewed and improved by an expert panel in a workshop organized by the CentralOffice for University Quality (OCCU-UNI) in January 2019.

In the research we focus on the Undergraduate Missionary Process PM.01.

In the conceptual modeling of the Missional Process PM.01, Undergraduate Process, to reduce model complexity, the activities have been grouped and the following sub-processes are considered:

- PM 01.1 Curriculum management: Evaluate the progress and fulfillment of the program curriculum, as well as its modification/updating.
- PM 01.2 Student admission management: Ensure that UNI freshmen students have the required skills to be formed as engineers, scientists or architects.
- PM 01.3 Faculty management: Improve the competence of faculty through induction, training, research, and knowledge and skills updating.
- PM 01.4 Enrollment management: Register, monitor and control semester student enrollment.
- PM 01.5 Teaching-learning management: Offer the specialty courses, providing to students the knowledge and skills for meeting the Program Educational Objectives and Student Outcomes.
- PM 01.6 Academic performance and improvement: Evaluate the results of the teaching-learning process through self-evaluation and propose practical and pertinent improvement actions.
- PM 01.7 Academic registration and control: Administer reliable academic and student information (timely, pertinent and updated), unify academic procedures, and manage academic information in an organized and structured way.
- PM 01.8 Degree and professional licensing: Manage the database of Degrees and Licenses issued by the program and ratified by the University Council.
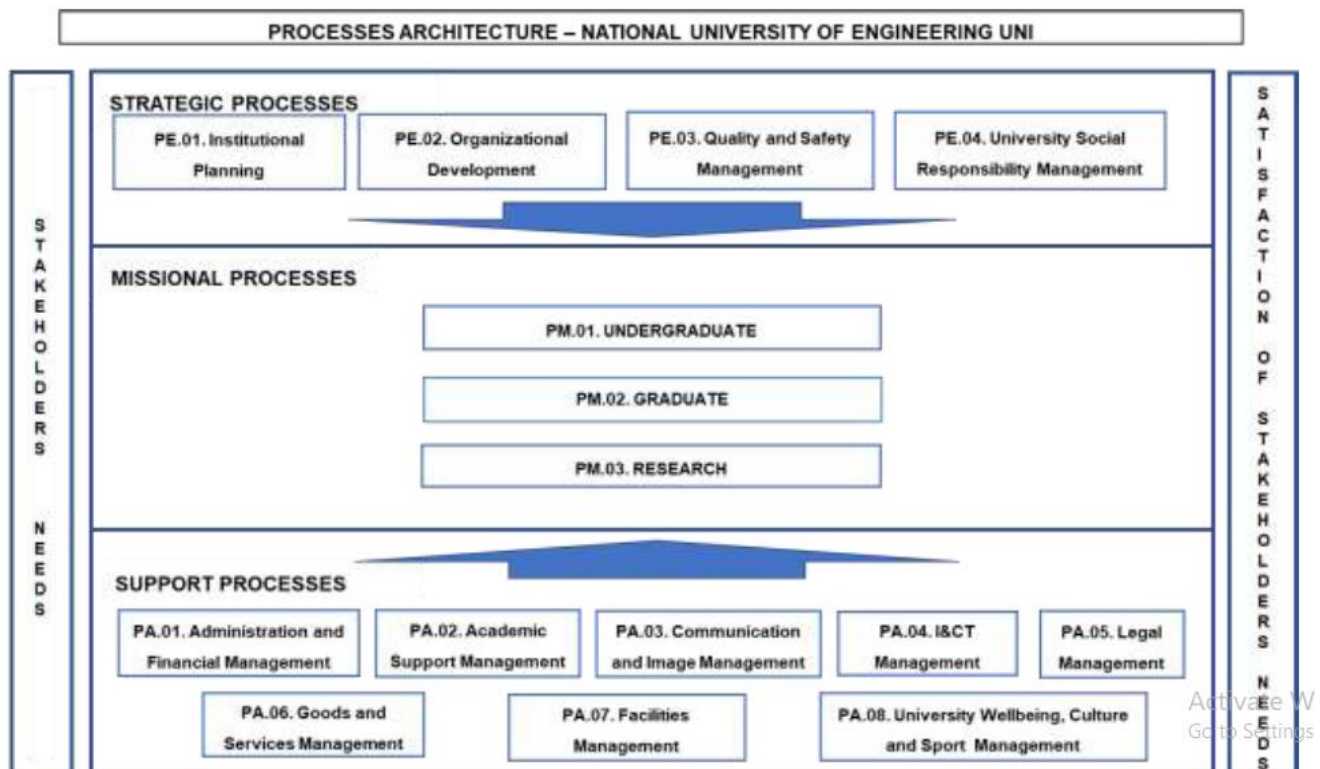

Figure 1. Proposal of UNI process architecture (macro-process map)
Own elaboration

Figure 2 shows the proposal of sub-processes flow. It was revised by an expert panel.
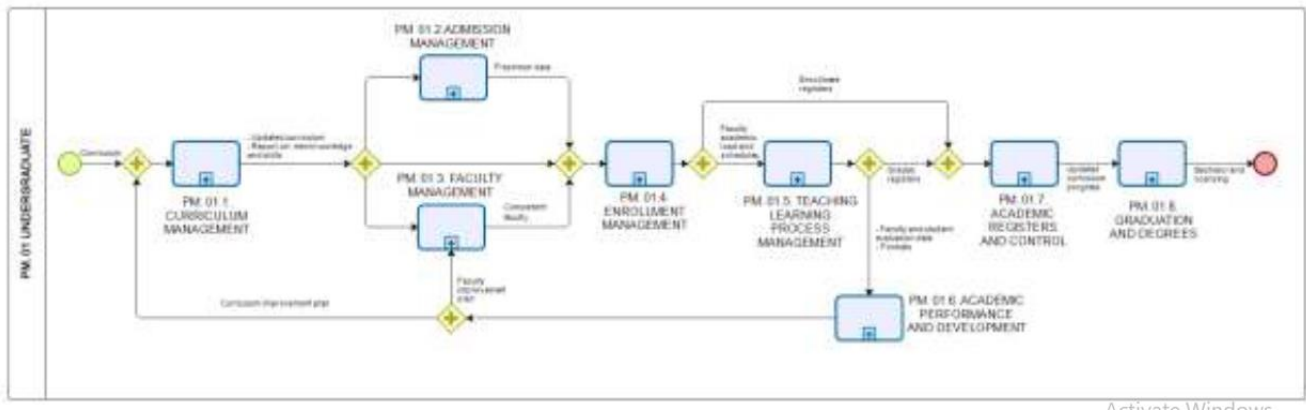

Figure 2. Conceptual modeling of UNI Undergraduate Process.
Own elaboration

For the characterization of the processes, ABET criteria have been taken into account. Figure 3 shows, for example, the proposal of sub-process characterization for the process: PM 01.1 Curriculum management.

In this sub-process, it is emphasized that the curriculum review must be continuous, if possible, annually, to evaluate its compliance and make the necessary adjustments. In its review, the Consultative Committee of the respective program, graduates and employers, must participate as part of the society. This proposal, like all those related to sub-processes, were reviewed and opinions were collected in the group work developed with experts.

A market study is required to keep up to date on the supply and demand of the program. Also, the improvement plans that are derived from the PM sub-process. 01.6 Academic performance and improvement.

| CHARACTERIZATION OF OPERATIONAL PROCESS: CURRICULUM MANAGEMENT (Level 1) | | Code: |
| Responsible: Program Chair | | PM. 01.1 |

Objectives
- Updating of program curriculum based on a study of country and city needs, job market trends, technological changes, continuos improvement.
- Evaluating the processes for curriculum implementation and student formation up to the awarding of the bachelor degree.

Requirements
- University Law
- UNI Bylaws
- UNI Quality Policies
- ABET Accreditation Criteria
- Quality Assurane Policies for University Higher Education - Ministry of Education MINEDU

Scope
From the curriculum design updating to the curriculum implementation and knowledge management.

Classification
Missional Process

| Risks | - Los of continuity of curriculum periodic revision - Inappropriate selection of actors participating in curriculum revision and updating |

Process Description

Suppliers	Inputs	Main Activities	Executor	Outputs	Citizens or Recipients of Goods and Services
- Society - Peruvian Engineers Association CIP - Employers - Reserachers - Government - Sub-process: Academic Performance and Improvement - Faculty - Students	- Curriculum - Market research - Curriculum Improvement plan - Policies - Indicators, indexes	- Conformation of specialist team for curriculum revision, updating and/or planning of its implementation. - Design and development of new curriculum and/or proposal for its implementation. - Submision and reception of proposals for continuous improvement. - Improvement of initial proposal. - If there are changes: approval of new curriculum or updated curriculum. - Continuous curriculum evaluation	- Academic Departments - Program Chair	- New curriculum or updated curriculum or actions plan for its proper implementation. - Report on new knowledges and skills.	- Faculty management - Student admission management - Enrolment management

Identification of Critical Resources for Process Execution and Control

Controls and inspections	Resources	Documentos y Formatos
- Profile of the control and inspection teams. - Constituents survey on new curriculum. - Program situational diagnosis. - Study of job market.	Human Resources: - Program Chair - Department Director - Academic Commission - Support Personel Tecnological Resources: - Hardware and software - Internet - Information systems - Servers and software Physical Resources: - Work environment	- Report with change proposals

Process Evidences and Indicators (Indexes)

Registers	Indicators (Indexes)
Aprobal of curriculum design or curriculum improvement plan (Dean Resolution, President Resolution)	- Number of implemented curriculum evaluation and improvement actions (annual)

Figure 3. Proposal of sub-process characterization: PM 01.1 Curricular management. Own Elaboration

Quality assurance in higher education is a global trend, and a closely related tool is self-assessment, which allows the awareness of university community actors by reviewing the strengths, weaknesses and opportunities and clearly establishing the gaps for which activities should be planned, as a continuous process of improvement. From a systematic, reflective and participatory evaluation, improvements can be generated continuously, which ensures quality. [9]

This research identifies the importance of self-assessment for quality assurance, which is why it is necessary to systematize the self-assessment report of engineering programs at UNI.

For the systematization of the self-evaluation report, according to the experience and joint opinion with experts in ABET accreditation, the relationship of the general and specific criteria with the undergraduate processes and sub-processes of the UNI is proposed.

Figure 4 presents the relationship between the specific ABET criteria and UNI undergraduate processes and sub-processes, and Figure 5 presents the relationship between the general criteria and UNI undergraduate processes and sub-processes.
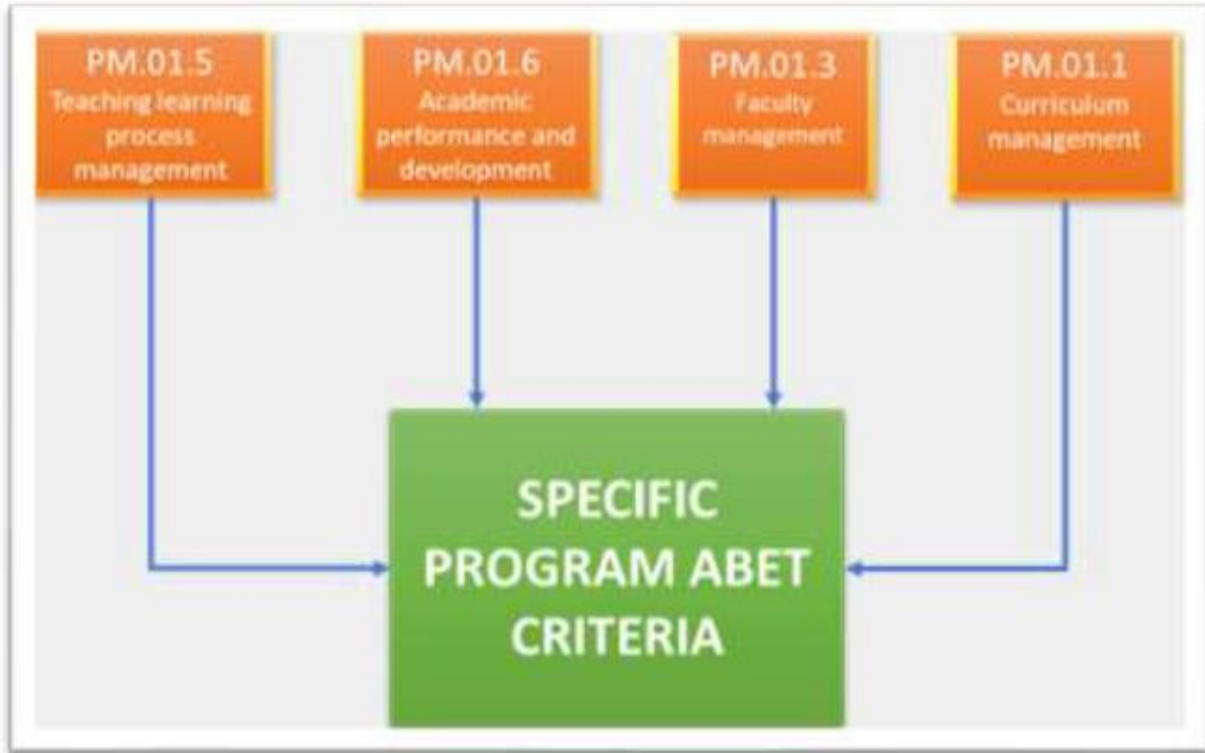
Figure 4: Relationship between specific program criteria and UNI processes and sub-processes
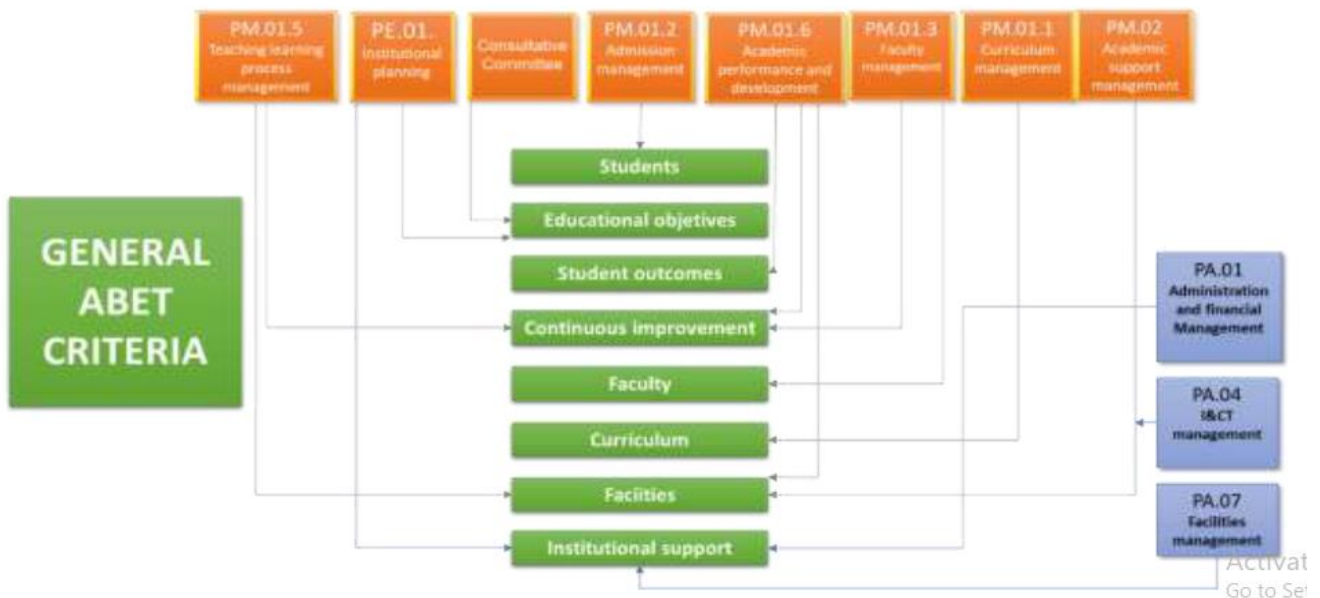**Own elaboration**

Figure 5: Relationship between the general ABET criteria and the UNI processes and sub-processes
Own elaboration

CONCLUSIONS

1. The accreditation processes of university programs are important to validate the quality and effectiveness of the program, as well as to encourage change and compliance with the best academic practices and accreditation criteria. However, continuous improvement requires a systemic and integrated institutional effort within the university.

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2. The process management approach allows a better understanding and an efficient design of the information flow, and of the activities supporting the achievement of the objectives set, and its implementation becomes a great opportunity to institutionalize the improvement and redesign of academic processes.

3. It is necessary to define the roles and empowerment levels, and institutionalize the processes in order to establish the work-teams responsible for their compliance, and for the sustainability of the continuous improvement and academic quality.

4. Having all processes identified and characterized, the process leaders can set performance levels and metrics, allocate resources, and support improvement initiatives pointing to a virtuous spiral towards academic excellence.

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