University Accreditation: Integrated Process Model For Sustainability In University Education

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Abstract: The Peruvian State through laws, rules and regulations seeks to ensure educational quality framed in the process of university accreditation through process management (ISO 9001:2015) and the competency approach. The problem identified is that universities cannot guarantee sustainability in academic training to be comprehensive, because there are uncontrollable factors that cause multiple defections because the assignable causes identified in their analysis exceed each Upper Control Limit (UCL) without identification of causalities. Therefore, this research relates key and redundant standards to fulfill the objective of proposing the integrated process model oriented to guarantee the formative academic sustainability and, comply with the Peruvian society and stakeholders. This research is quantitative with a retrospective longitudinal design; the database of the Faculty of Systems Engineering of the National University of Central Peru from 2014 to 2019 was used. As a result, the model was built to identify 4 key processes: leveling of entrants, social responsibility, articulation with R+D+i and monitoring of student´s performance, which are strategic for sustainability in university education, also confirms the existence of non-controllable factors that generate desertion, which reaches 55% and 44% in the I and VIII semester respectively for the period 2014-2018, 34% for the II semester in the period 2015-2019 and 32% for the first semester in the period 2016-2019.

Keyboard: University Accreditation; Integrated Process; Model for Sustainability and Education.

1.   Introduction

Among the priorities of the university professional training are the axes of economic, social, academic and sustainable growth based on the educational model supported by the "educational philosophy of the institution, with goals and lines of action that drive the continuous improvement of people and their environment" (Farro, 2012, cited by Gutiérrez, 2018, p. 180).

The quality policy within the framework of the University Law N° 30220, published in the DS N° 016-2015-MINEDU (Ministry of Education), establishes to guarantee a quality university educational service focused on people with competences, and the implementation of values in the student through research. In addition, it establishes 4 pillars in order to ensure quality and professional training: reliable information, encouragement to improve performance, accreditation for continuous improvement and licensing to ensure basic conditions.

University accreditation in Peru has become important since the implementation of Law 28740, which enacts the creation of the National System of Evaluation, Accreditation and Certification of Educational Quality (SINEACE), whose function, according to Lora (2016) is "to guarantee a quality educational service to society through public and private institutions" (p. 11). This function frames a strict regularization on the mission of universities, where the graduates are considered a fundamental and sustainable part of society.

There are two very different educational horizons, on the one hand, the public universities and, on the other hand, the private universities with different strategies to guarantee the professional training. In this sense, this research is important to understand that not only the theories and approaches are enough to achieve the formative performance, but it is required to model the integrated process that guarantees the university training and its sustainability with the use of management tools and technological support which is the objective of this study.

According to Lora (2016), the accreditation model in the international context is interpreted through its factors, as main axes, and is oriented to the achievement of the performance of the graduate's competencies, the same that must be measured through its profile, which is the final result of the process of comprehensive training.

In the development of the integrated model, the process approach, the theoretical basis of university accreditation and the Peruvian quality assurance policy were used to identify the standards necessary for sustainability in university education. The evaluation of the model considers the standards matrix and the control diagrams that identify the processes that are outside the control limit.

The research concludes in the construction of an integrated process model that identifies key and redundant processes, which are finally represented in the process mapping that, if a continuous improvement process is considered, can incorporate into the model other uncontrollable exogenous variables that generate student desertion in the short term.

2. Methods

2.1. Quality assurance policy in higher education

The National Center for Strategic Planning (CEPLAN, 2011), in its education policy guidelines, mentions: "Ensure good quality education and the application of good pedagogical practices, with welcoming and inclusive institutions that develop self-evaluation processes and apply for institutional accreditation in accordance with current regulations" (p. 92). In addition, it complements with the following policy: "To transform institutions of higher education into centers of scientific research and technological innovation, generators of knowledge and trainers of competent professionals" (p. 92) and finally establishes "To orient the system of decentralized educational management, at all levels, at the service of educational institutions and students, adapting its structure and implementing a quality system" (p. 93). 93), approaches that CEPLAN orients them towards the commitment that higher education institutions should consider towards their students and stakeholders. In addition, the Ministry of Education (2015) in Peru, within its general objective establishes the quality assurance of university higher education as follows: "... to ensure that all young people in the country have the opportunity to access a quality university education that allows their personal fulfillment, and forms them as citizens and professionals of high productivity." (p. 6); an objective that commits higher education institutions to provide comprehensive, continuous and solid training in accordance with each basic principle established in the regulatory

documents and oriented to train competitive professionals with values that allow an academic reflection of the country through R+D+i (Ministry of Education, 2015), Peruvian society expects to have professionals with ethical principles and quality, able to be productive and valued in the labor market (Lora, 2016).

2.2. Educational quality

Education for society is a full right and without discrimination, therefore educational institutions have the duty to ensure quality education. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, cited in Paredes, 2008), educational quality is "... the adequacy of being and doing of higher education, to what it should be"; furthermore, the General Law of Education (Law 28044) mentions that "the optimal level of training that people should reach to face the challenges of human development, exercise their citizenship and continue learning throughout life" (p. 13). The Peruvian State is responsible of providing students with a professional training that contributes to the sustainable development of society, according to the General Law of Education (2003), in its Article 9 paragraph a, mentions the purpose of Peruvian education and states:

> To form persons capable of achieving their ethical, intellectual, artistic, cultural, affective, physical, spiritual and religious fulfillment, promoting the formation and consolidation of their identity and self-esteem and their adequate and critical integration into society for the exercise of their citizenship in harmony with their environment, as well as the development of their capacities and abilities to link their lives with the world of work and to confront the incessant changes in society and knowledge (p. 4).

The National Superintendence of University Higher Education (SUNEDU), in the model of university accreditation implements processes based on the quality of academic service with homogeneous standards of voluntary certification through SINEACE. Hugo and Cornejo (2016) point out that:

> ... SUNEDU, as a specialized body with competence to supervise the quality of university education, is not contrary to the Constitution. Therefore, the determination of the required quality standards is a competence inherent to its specific function (p. 255).

The universities of Peru, in order to continue functioning, omitted to comply with the accreditation standards under the cover of their university autonomy, a fact that was endorsed by the ruling of the Constitutional Court on the creation of SUNEDU, which does not violate the principle of university autonomy. Under these regulations, SINEACE, together with SUNEDU, have established norms and organizational policies with the purpose of guaranteeing the quality of education.

The professional careers of public and private universities are committed to guaranteeing a quality educational service to their students, which is a State policy that demands the commitment of the institutions to the development of society.

2.3. The university accreditation model

Paredes (2008) conceptualizes accreditation as "a complex multifactorial process of quality assurance of an institution or an educational program that is based on a previous evaluation" (p. 44). At the same time, this author says: "the university institutions that train human resources have a commitment to society to deliver professionals of the highest human, scientific-technical and ethical quality" (p. 45), the accreditation model is based on the process approach, where each study program is self-evaluated in order to know the operation of its internal processes, under a self-regulated and

sustainable continuous improvement approach, sustainable and self-regulated. The accreditation model is based on the process approach where each study program is self-evaluated in order to know the operation of its internal processes, under an approach of continuous self-regulated and sustainable improvement of learning for their incoming students, trainees and graduates through follow-up, monitoring and evaluation of performance to ensure a quality service.

Within the context of accreditation, Lora (2016) differentiates between evaluation and quality measurement:

> [...] the former is expressed in qualitative terms as opposed to the latter, which is established quantitatively. An evaluation makes use of measurement, but it goes further, it issues a value judgment as a consequence of the in-depth analysis of the aspects involved" (p. 24).

According to the model, each study program in Peru must define its graduate profile taking into account its vision, mission and values with local, regional, national and international focus, where employer companies and society will measure the performance of graduates at work, and the results of this accreditation model are indicated in its 4 dimensions and 12 factors that are important for the verification of the graduate profile as a result of the achievement of competence (Lora, 2016). The accreditation model according to continuous improvement is a cyclical process that aims to ensure the satisfaction of society (Salas-Rueda, 2018).

2.4.   Process Management

In the analysis made by Llanes et al. (2014), the purpose of process management is "to improve the efficiency and effectiveness of the organization to achieve the defined objectives" and also that the purpose of integrated process management is "to improve the integration of the organizational system to achieve the defined objectives" (p. 259).

Transforming major organizations from a functional structure to process management dates back many years of scientific management study and development. Its recognition of success is a compelling reason for other organizations to implement process management (Medina et al., 2019).

For Beltrán (2009), process mapping is "...the most representative way to reflect identified processes and their interrelationships is through a process map, which is the graphic representation of the structure of processes that make up the management system" (p. 20).

2.5.   Integrated Process Model

Referenced by Llanes et al. (2014) and Núñez-Pilligua and Michelena-Fernández (2017), as interrelated processes and their environment, focused on meeting the expectations of stakeholders, a change in any process causes changes in the others. One of the differences between process management and integrated process management made by Llanes et al. (2014) is that the former "improves the efficiency and effectiveness of the organization to achieve defined objectives" (p. 259), while the latter "improves the integration of the organizational system to achieve defined objectives" (p. 259).

Llanes et al. (2014) also mention that "integration is the coordination of all processes that through relationships add value or reinforce the fulfillment of the mission to meet the present and future needs of society and customers" (p. 262).

In the study of Medina León et al. (1970) cited by Ortiz, Pérez and Velásquez (2015) states that "Processes represent the common thread that makes the organization a dynamic and complex system, which is why managing them in an integrated way has become a necessity to improve organizational performance" (p. 92).

Likewise, Ortiz Pérez et al., (2015) in their scientific article identify that:

The proposed procedure for the evaluation of the level of integration of processes in universities constitutes a methodological guide for the work of managers. This helps to achieve greater effectiveness in the decision-making process by carrying out an integrated analysis of the university (p. 102).

Núñez-Pilligua and Michelena-Fernández (2017) detail in one of their results of their research article that "Self-evaluations allow to know the results and impacts of the managements that are carried out in the careers, non-integrated management makes it difficult or requires more resources for its execution and auditing..." (p. 14).

Finally, Núñez-Pilligua and Michelena-Fernández (2017), state in their scientific article that:

The tools designed to assess the reliability and level of integration of the processes allow the results to be measured in an integrated way. This favors effective short-, medium- and long-term decision making and the evaluation of the performance of the processes that are developed in universities. (p. 16)

For modeling, the Integrated Definition Language (IDEF) was used, which is a graphical analysis of processes to implement systems (Guevara, 2002). For modeling the integrated process, the IDEF0 method was used to analyze the standards already converted into procedures as a set of related activities and the ICOM (Input, Control, Output and Mechanism) technique for the classification of standards:

- **Input:** information or material that is to be transformed or consumed by a procedure, activity or function resulting in an output.
- **Control:** information that governs or regulates the process as a specific rule, function or activity allowing the outputs or results to have a high performance.

- **Output:** information or material produced by the process, activity or function.
- **Mechanism:** necessary human or physical resource that is used by the process, activity or function to be executed properly.

The accreditation model considers the 34 standards raised by SINEACE (2017) and identifies those that are articulated with the policy of quality assurance and sustainability to ensure university education, which are:

Entrance

- **Standard 05**: Relevance of the graduate profile.

Information provided by each group of interest to the study programs for the respective evaluation of the relevance of the graduate profile. Jaramillo (2015) defines the professional profile as the result of the curricular structure comprised of content and social demands for compliance with quality and social relevance. Hernandez et al. (2019) evaluates the graduate profile and concludes that the main barrier to the achievement of the graduate profile are teachers and students, who do not assume a training posture, nor their role as social transformer despite being knowledgeable about the contents. Ortíz et al. (2016, cited by Bravo et al., 2017) identify 4 dimensions: "(a) level of evaluation of the formative act by graduates, (b) level of development achieved by students in different formative cycles, (c) level of transfer of competences developed in the formative process, and (d) influences or changes at the level of professional contexts" (p. 31).

- **Standard 18**: Admission to the curriculum.

Based on the approach of the admission profile that each program of study establishes and that are disseminated in the admission prospectus. Guevara et al. (2011) define admission as the application of an internal test related to

knowledge of different subjects, reasoning and reading comprehension "... whose results take into account the qualifications obtained in secondary education and diversified education..." (p. 35). Aguilera and Cruz (2005) define admissions policy as the art of defining the necessary orientations and actions to "... define a system that, in accordance with the mission, vision, values and development plans of each institution, provides a socially just response to the demand for admission of applicants to its classrooms" (p. 485).

Control

- **Standard 06**: Revision of the graduate profile.

Based on the referential information given by each community of interest for the review of the entry profile, Martínez Márquez (2015) explains that the development of the curriculum consists of the planning and organization of the educational process whose purpose is to determine the type of professional that society requires, so it becomes important so the review of the graduate profile becomes continuously important.

- **Standard 09**: Curriculum.

Base document known by students during their professional training and that any curriculum evaluates according to the satisfaction and needs of the community of interest for its updating. Miche (2003) mentions that the curriculum responds to a logic in the development of science, technological scientific advances and the solution to professional problems through different approaches and disciplines must be addressed by university curricula. Martínez Márquez (2015) considers it "... as a reflection not only of social demands but also of university planning and budgeting policies, of the institution's own organizational culture and of the

material and human resources available" (p. 214).

- **Standard 11**: Competency-based approach.

Applied through teaching and learning, social responsibility and R+D+i with the aim of fulfilling the competences of the graduate profile. According to López, Guerrero and García (2018) the competences "...entail an important change from the pedagogical and didactic point of view that directly affects university education and teaching practice" (p. 529), also Casanova et al. (2018) consider that the competences demand "...a number of conditions for their implementation in university education, conceiving the human being from the integrality and complexity of its dimensions, in permanent interaction with the context" (p. 114).

Mechanism

- **Standard 13**: Mobility.

Establishment of national and international agreements by any study program for student exchange. Corbella and Elías (2018) say that "the international mobility of higher education students allows them to improve their training by incorporating an international cultural and technical vision in their studies. It also enriches the teaching and learning processes by increasing the diversity of students in university classrooms" (p. 121), likewise Ardila-Muñoz (2016) considers that mobility "...moves between the interest of attracting resources and the intention of strengthening academic and research ties, where there is evidence of an eagerness to achieve greater international visibility" (p. 90).

- **Standard** 21: Extracurricular Activities.

It is the approach of extracurricular activities in order to improve student performance. Alcántara et al. (2017) consider that the implementation responds to a strategy to ensure professional

training and guidance. Ivanova and Logvinova (2017) cited by Iso et al. (2020) assert that the activities have a positive impact on the integral development of students.

Exit

- **Standard 23**: R&D&I for the degree and diploma.

  The study program guarantees authentic R+D+i work for the respective university degree.
- **Standard 33**: Achievement of Competencies.

  When the proposed activities, mobilities and teaching and learning activities ensure that the graduate meets the graduate profile. Gordón (2017) affirms that "... analyzing the principles and foundations that guide the educational task represented by a diversity of ideological, anthropological, sociological, epistemological, pedagogical and psychological conceptions in which they are concretized" (p. 130).

- **Standard 34**: Follow-up on graduates and educational objectives.

The information from stakeholders is important for the achieving the educational objectives, because it provides information for updating the curriculum; whose purpose is to maintain the employability of graduates of study programs. Fergusson and Ganoza (2020) consider the graduate as the result of a whole learning process and reflection of the quality of education they have received considered in the educational model.

Process

- **Standard 12**: Articulation with R&D&I and social responsibility.

Applied in the formative stage of the students where their training is integrated with research and projection, proposing lasting and impact projects.

- **Standard 19**: Entry Level.

The curricula raise the teaching mechanisms based on the results of the entrance exam to achieve an adequate leveling in their students and the results will serve for their respective restructuring of the leveling mechanisms. Alonso et al. (2018) "... considers orientation and leveling as a process of formative character, which cannot be summarized in instrumental and/or administrative aspects of applying for requirements and necessary documentation to be able to access the higher level" (p. 36)

- **Standard 20**: Monitoring Student Performance.

The study program through the results of curricular subjects, extracurricular activities and achievement of competencies guarantee the monitoring of student performance. Vergara-Díaz and Peredo-López (2017) interpret this as a "... concern for college entrance exams is a growing global trend and its effects are analyzed based on tracking studies that allow discrimination regarding the best predictive ability of student academic performance in college" (p. 2).

- **Standard 25**: Social Responsibility

It is based on the strategies that are applied for the benefit of society and are considered in the integral formation of students. Vallaeys (2016) and Sissa (2015, cited by Pérez et al., 2019) mention that "... it is developed when an organization is aware of itself, its environment and especially its role in the relationship with it" (p. 66), also defines it as: "... quality policy of the performance of the university community through the responsible management of the impacts that the university generates..." so it must consider an open and participatory dialogue with stakeholders.

2.6. Sustainability in university education

Rueda and Pinilla (2014) state that the university is an organization that generates impacts on teachers, students and administrators through its functional environment. Society is now more demanding of the responsibility that universities have because they are places "... of convergence between the production of scientific knowledge (research), the reproduction of this knowledge (transmission of knowledge and training of professional citizens who socialize sciences and technologies) ..." (p. 224)

Vallaeys (2016) mentions that "the synergy created between academic training, institutional management and social participation ensures an ethical working environment at the University and the affirmation in everyday and academic life of the values of solidarity and sustainable development" (p. 81). Social initiatives start from the dynamics of sustained academic training and university administration stimulated by research, with students being the actors and whose benefits are given between the external and academic community and on the side of teachers improve learning processes based on social projects. "The projection expenses are part of the normal academic investment of the University (temporary and financial sustainability)" (Vallaeys, 2016, p. 81).

2.7. Methodology

2.7.1. Approach

It is quantitative because it analyzes the standards to formulate the integrated process model. The model focuses on: accreditation standards, quality assurance policy, process theory and control diagrams. The proposed approach helps us to guarantee the formative academic sustainability in the students of the Systems Engineering program within the framework of the University Law No. 30220 and it is

quantitative because it analyzes the students' dropout.

2.7.2. Units of analysis

The unit of analysis is the students per academic semester of the study program of the Faculty of Systems Engineering of the National University of Central Peru (UNCP) of the period 2014 - 2019.

2.7.3. Data collection techniques

The technique used in the data collection is the content analysis based on the administrative record of the students of the Faculty of Systems Engineering that allows identifying the categories of the model (incoming students, students in training and graduates).

2.7.4. Analysis processing

For the processing of the data analysis, modeling and process mapping software was used and for the elaboration of the graphs, Microsoft Excel software was used by means of a descriptive statistical analysis.

For the construction of the control charts for attributes, the estimated variability of the standard deviation ($\pm 3s$) and is represented by the upper (UCL) and lower (LCL) control limits. Data of a variable nature use the formula: $\frac{c_i}{n_i} \pm 3\sqrt{\frac{\mu}{n}}$ and their determination of the central limit (CL) is analysed with the relation $\frac{c_i}{n_i}$ and for data exceeding the LCI a value of zero (0) is assigned (Gutierrez Pulido and Vara Salazar, 2018, cited by Rojas-Bujaico et al., 2021).

3. Results

Using the IDEF0 methodology, the standards were classified according to the degree of importance and necessity of the purpose of the research, following the theoretical foundation and background, the integrated process model for sustainability in university education was

elaborated and classified based on the ICOM technique.

The integrated process model considers the processes that manages the study program of Systems Engineering at UNCP and taking into account the flow of information which considers two promotions: 2014 to 2018 and 2015 to 2019, and another that still has no promotion (2016 to 2019). Two main macro-processes were identified, the first supported by keys (leveling process of entrants, social responsibility, articulation with R+D+i and social responsibility and finally monitoring the performance of students) and the second, as the redundant ones as admission to the program of study, relevance of the graduate profile and other standards that are found as inputs, outputs, control and mechanism, as shown in Figure 1.
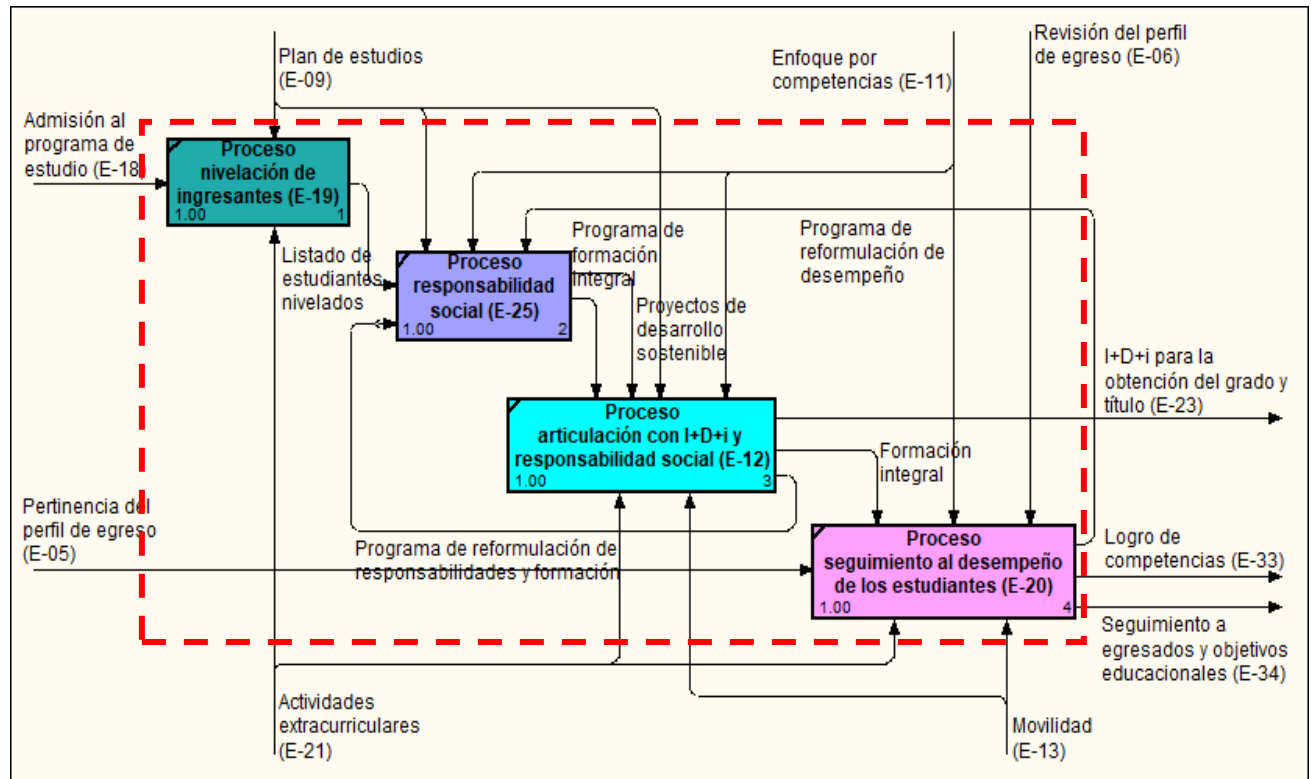

Figure 1. Integrated process model for sustainability in university education-Faculty of Systems Engineering - UNCP, 2017. Original version in Spanish

Source: own laboration with information.

Figure 1 identifies the classification and integration of the standards according to the purposes established by the input, control, process, mechanism and output that must work according to the established activities (see Annex) individually and associated; for the approach of the integrated process the principle of process management was considered. The outgoing information of each procedure serves as input for the next one, becoming a continuous and uninterrupted work process, due to its interactive degree, it can be stated that if one of them fails, the next one will stop interacting with the rest.

In the model, the procedures have a feedback effect in such a way that they lead to an effect of continuous improvement that is used for the correction and updating of information that, according to its importance, feeds an input, a

control or a mechanism of the other procedures (see Annex).

As a result of the integrated process model (Figure 1), the mapping of processes was developed, its structure involves procedures that help achieve institutional objectives and are classified as strategic, mission and support processes, as shown in Figure 2.
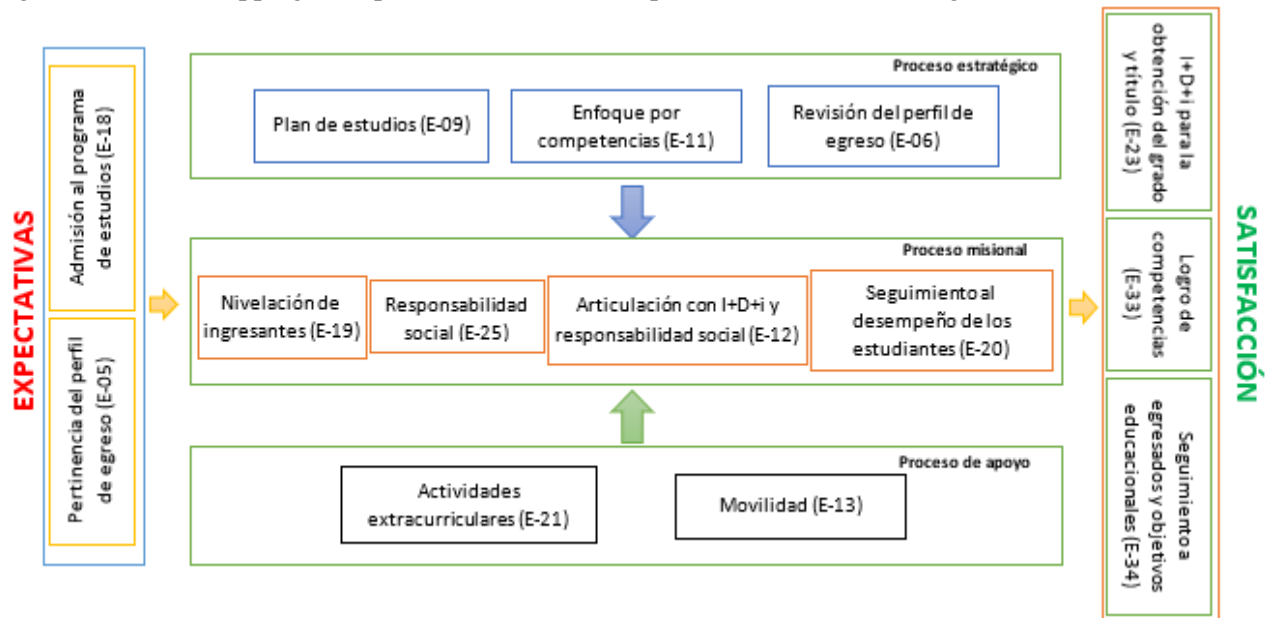

Figure 2. Process mapping for sustainability in university education in the UNCP Systems Engineering study program, 2017. Original version in Spanish

Source: own elaboration with information from the disaggregated process of sustainability in university education, 2017.

Figure 2 shows the interacting procedures for each process considered in the process mapping. For the input, the relevance standards of the graduate profile and admission to the study program are considered, which are fundamental elements for sustainability. For the output the R+D+i is considered for obtaining the degree and the title, achievement of the competences and the follow-up to graduates and educational objectives as a resultant part and of service to society. For the strategic process, the curriculum,

the competency-based approach and the review of the graduate profile are considered, which are guidelines for the control of the mission process where the leveling of entrants, social responsibility, articulation with R+D+i and social responsibility and the monitoring of student performance are considered, which are relevant and important processes for the achievement of sustainability in professional training; finally, this mission process is supported by the support process in which extracurricular activities and mobility are considered (see Annex).

The following figures show that, despite the application of different strategies proposed in the model, the student dropout variable is considered a non-controllable variable in relation to the behavior of the variables in the construction of the control limits, as can be seen in Figures 3, 4 and 5.
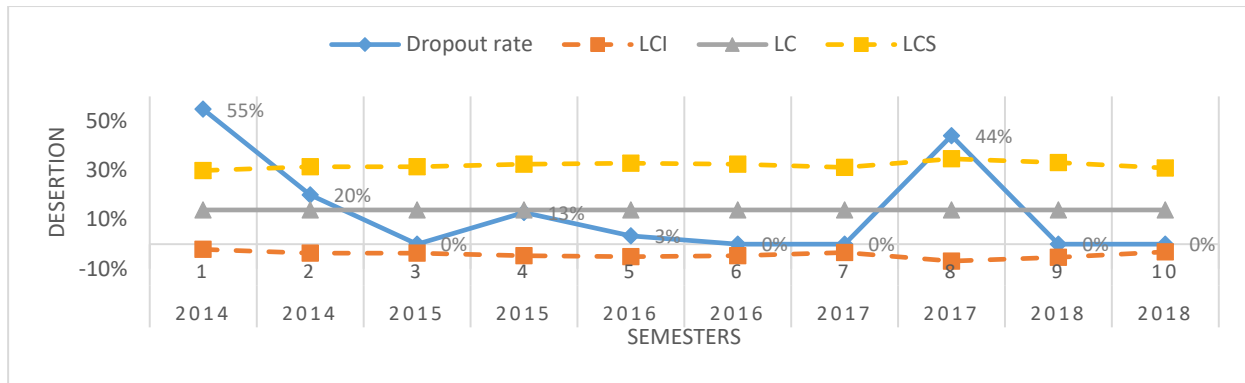
Figure 3. Attrition of students from the Systems Engineering program of study, class of 2014-2018, UNCP.

Source: own elaboration with information from the database of the office of academic affairs of the FIS-UNCP, 2019.

Figure 3 shows that in the period of the promotion group (2014 - 2018), the proportion of attrition was 55% and 44%, these considered from the first to the eighth semester respectively considered these as unstable variables, they exceed the upper control limits (UCL), the other semesters are within the permissible control limits.
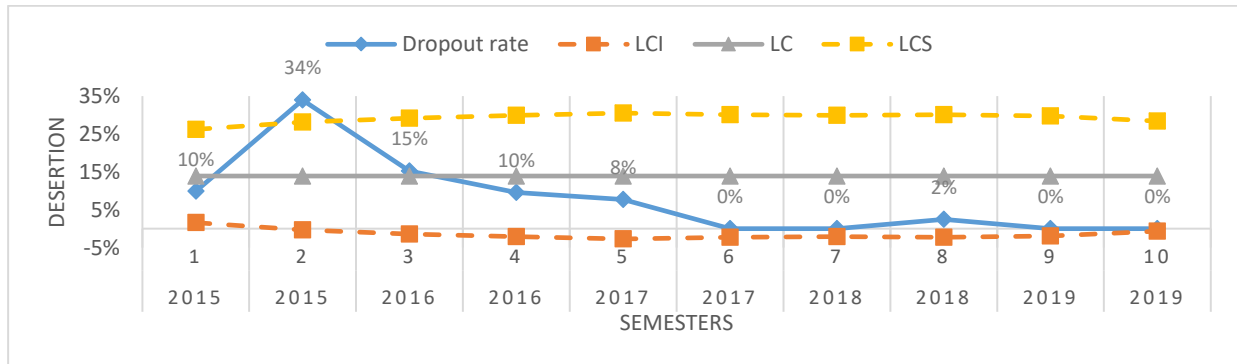

Figure 4: Attrition of students from the Systems Engineering program of study, class of 2015-2019, UNCP.

Source: own elaboration with information from the database of the office of academic affairs of the FIS-UNCP, 2019.

Figure 4 shows that in the period of the promotion group (2015-2019), the proportion of dropout was 34% of students in the second semester with unstable behavior so it exceeds the LCS, the other semesters are within the permissible limits.
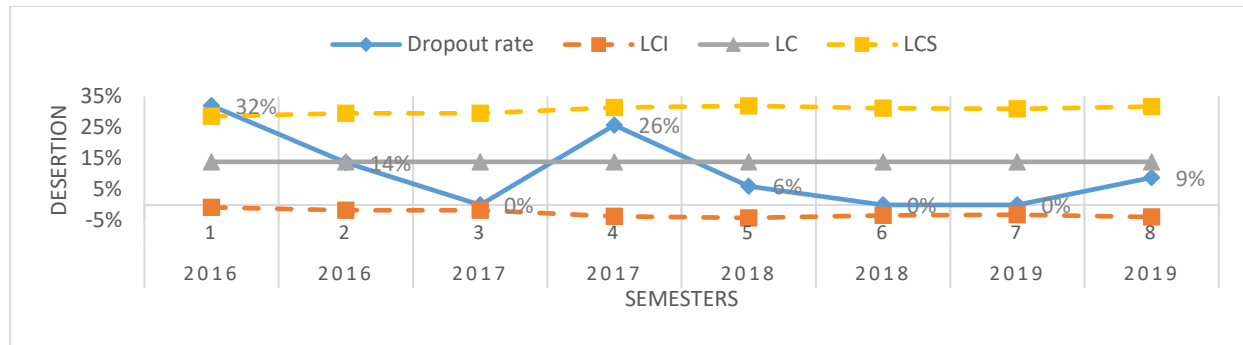
Figure 5: Attrition of students in the Systems Engineering program of study, class of 2016-2019, UNCP.

Source: own elaboration with information from the database of the office of academic affairs of the FIS-UNCP, 2019.

Figure 5 shows that in the group period (2016-2019), the proportion of attrition was 32% of students in the first semester with unstable behavior, this exceeds the LCS, the other semesters are within the permissible limits.

4. Conclusions

In the design of the model, 4 key processes were identified: leveling of entrants, social responsibility, articulation with R+D+i and finally the process of monitoring student performance, but it was identified that student desertion is a non-controllable variable due to exogenous factors that affect the model.

The integrated process model considers continuous improvement as the basis for incorporating uncontrollable variables in the future, such as the case of student desertion. Therefore, it is not possible in the short term to guarantee sustainability in professional training, despite the existence of the university accreditation model and educational quality policies.

In the mapping of processes, it was identified that: curriculum, competency-based approach and review of the graduate profile are strategic processes; and, leveling of entrants,

social responsibility, articulation with R+D+i and monitoring of student performance are missionary or key processes. Finally, extracurricular activities and mobility are support processes.

The pertinence of the graduate profile and the admission to the study program are expectations that society expects to achieve through the professional training that universities provide to students, so it is necessary to continue with the integrated process to incorporate non-controllable variables oriented to student and society satisfaction.

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ANNEX

Programa de reformulación de desempeño

Formación integral

Programa de formación integral

Proyecto de desarrollo sostenible

Programa de reformulación de

Listado de estudiantes nivelados