CACEI

Consejo de Acreditación de la Enseñanza
de la Ingeniería, A.C.

CONTINUOUS IMPROVEMENT FOCUSED ON LEARNING OUTCOMES.

GUIDELINES FOR THE IMPLEMENTATION OF THE 2018 CACEI'S REFERENCE FRAMEWORK.

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Continuous improvement focused on learning outcomes. Guidelines for the implementation of the 2018 CACEI's Reference Framework
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Series of documents in support of the Training Development Program for Evaluation (PROVAL)

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ACRONYMS

ABET	Accreditation Board for Engineering and Technology, Inc.
AE	Graduate Attributes
ANECA	National Agency for the Evaluation of Quality Quality and Accreditation
ANUIES	National Association of Universities and Higher Education Institutions
CV	Self-Assessment Committee of the Program
CACEI	Accreditation Council for Engineering Education, A.C.
CD	Performance Criteria
CFIA	Federated College of Engineers and Architects of Costa Rica
CE	Evaluation Committee (Visiting Team) of CACEI
CEAB	Canadian Engineering Accreditation Board
CENEVAL	National Center for Higher Education Assessment
EGEL	General Exam for Graduates of Bachelor's Programs (CENEVAL)
EXANI	General Examination for Entering Bachelor's Education
GI	Stakeholders
IES	Higher Education Institution(s)
ICACIT	Institute of Quality and Accreditation of Computer Programs, Engineering and Technology in Engineering
MC	Continuous Improvement
MR2018	CACEI's Reference Framework 2018
OE	Educational Objectives
PE	Educational Program
RIACES	Ibero-AmericanNetwork for Accreditation of Quality in Higher Education
SIGA	Accreditation Management Information System
WA	Washington Accord
Cédula	Spreadsheet

BACKGROUND

Since 2016, CACEI has made substantial changes in its accreditation model to emphasize the importance of evaluating learning outcomes in the continuous improvement of educational processes and other factors that affect the excellence of the education of engineering professionals in Mexico. The growing economic globalization, the challenges of knowledge societies, Industry 4.0 and 5.0, the Sustainable Development Goals of the 2030 Agenda of the United Nations, together with the complex changes in the national environment and the challenges of the development of our country, became key references to rethink the notions of quality and excellence of educational programs. The main changes materialized in the 2018 Reference Framework (MR2018).

Since then, CACEI took on the challenge of internationalization through its entry as a provisional member of the Washington Accord, the agreement with ANECA for the granting of the EUR-ACE Seal®, its active participation in the Lima Accord, the agreements signed with ICACIT (Peru), CFIA (Costa Rica); as well as their entry into RIACES. At the same time, CACEI deployed a transition strategy that included the design of new procedures and supporting documents, the strengthening of work teams, the establishment of an Accreditation Management Information System (SIGA), as well as the design and implementation of a Capacity Development Program for Evaluation (PROVAL). Within the latter framework, from 2017 to 2019, numerous workshops were held aimed at both evaluators and educational institutions.

In the context of the Covid-19 pandemic, since April 2020, CACEI reorganized its training course offerings to deliver four online courses that during that year had a total of 2175 participants:

- Reference Framework 2018. External evaluation and self-assessment (12 editions).
- Evaluation of Graduate Attributes and Measurement Instruments (21 editions).
- Hybrid Modality for the Accreditation Process (12 editions).
- Rubrics for the evaluation of learning in engineering programs (1 edition).

At the same time, the new hybrid modality for the accreditation process was launched, which allowed most of the self-evaluation and external evaluation of 113 educational programs to be carried out online, with the support of 285 evaluators, who received training *explicitly* designed for this modality.

Because of the above, the participants, the evaluators, and those responsible for the self-evaluation of the educational programs expressed doubts, made suggestions, and required specific guidance, which was attended to when necessary. In addition, they requested the formulation of a document, a guide, that included the most

relevant reflections and the answers to the most frequently asked questions, in more precise and detailed terms, from conceptual to technical aspects.

The **guidelines** set out below are intended to meet this request. It has sought to systematize and integrate the issues that have arisen most frequently, both conceptual and methodological and operational, to support the work of all those involved in the self-assessment and accreditation processes. It is not an instruction manual but a supporting document that highlights the main key ideas that have emerged in this rich experience.

However, in the context of the existing diversity due to the 13 subsystems of higher education that exist in Mexico, these guidelines should be taken into account that:

- They include only indicators where significant doubts or concerns have arisen.
- They complement the guidelines of the MR2018 and the Evaluator's Rubric, and the contents of the organized courses but do not replace them.
- They should be taken as guidelines that may vary according to one's own reflection and experience, as well as specific contexts; i.e., they should not be interpreted as rigid rules.
- In case of doubts during an ongoing accreditation process, it is essential to contact the trained staff of CACEI to validate the information required of the program, or that will be requested from the institution as a recommendation or explanation.

Consequently, evaluators and the self-assessment teams of the educational programs (PE) must ensure that they **read and understand** the criteria and indicators of the **MR2018,** including the **annexes,** where fundamental details are specified, the **questions** and scale raised in the **Rubric** for Evaluators, as well as the **indications** of the *cédulas* **(spreadsheets).** This understanding is a precondition for the achievement of this document's purpose.

Finally, since the transition process to a new accreditation paradigm is dynamic, it is hoped that this document will become a **flexible and constantly improving proposal.** It will go through successive versions, thanks to the feedback received and the continuous dynamics of the training courses for evaluation and accreditation processes. Therefore, CACEI will appreciate the sending of doubts, proposals, comments, and suggestions that arise after its reading and use.

GENERAL CONSIDERATIONS

1. **The MR2018 represents a paradigm shift, as it aims at excellence in engineering professionals' education.**

   The MR2018 is based on the premise that an educational program of excellence has all the necessary conditions for its students to acquire the graduate

attributes (AE) required for a professional of the engineering discipline in question, as well as with authentic processes of continuous improvement (MC) that allow to maintain a permanent and participatory dynamic of reflection and self-evaluation on the context of the PE and its design, operation, and results. Figure No. 1 shows the centrality of these elements in the MR2018. This new paradigm benefits students, the profession, and, therefore, society. It is crucial to assume the transformations as part of a transition process that merits a positive attitude towards change, an open mind to various possibilities, and outstanding educational creativity.

Figure No. 1: Centrality of graduate attributes
in the 2018 CACEI Reference Framework.
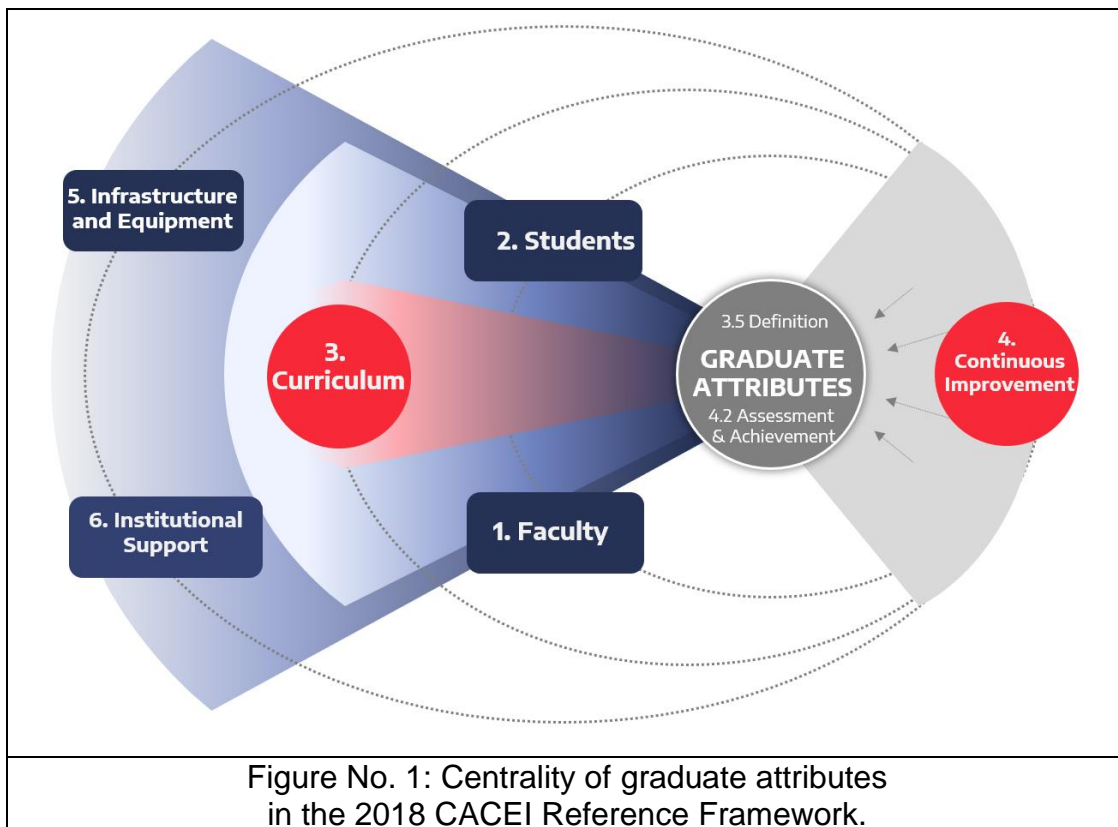
2. The MR2018 includes indicators and graduate attributes aimed at internationalization.

MR2018 includes criteria, indicators, and graduate attributes (AE) compatible with accreditation systems of other countries and international accords. However, this does not mean that homogenization is sought; on the contrary, the focus on learning outcomes makes it possible to assume the diversity of educational models that exist between countries and, at the same time, to agree only on the general terms of engineering AEs in the international context. By participating in an accreditation based on the MR2018, the educational programs (PE) move towards international trends that place learning outcomes and continuous improvement at the heart of the process. The other indicators revolve

around these learning outcomes and processes of change. In the Mexican context, this approach allows us to work better with the diversity of the higher education subsystem.

3. **The continuous improvement of the education of engineering professionals requires collegial reflective processes, teamwork, and effective leadership.**

   The accreditation process starts from the premise that the PE performs a continuous curricular evaluation through collegiate work, which covers the design and realization of the curriculum, and analyzes the monitoring information of the program in all the criteria raised by the MR2018. Consequently, it is important to promote the development of reflective practice, leadership, and teamwork capacities in faculty and other key actors of the program (coordinators, managers). For example, seminars, workshops, or different teaching strategies incorporate a more effective approach that combines teaching and management experience with reflection, educational production, and pedagogical accompaniment.

4. **Initiating accreditation with the MR2018 requires the PE to have a complete cycle of continuous improvement.**

   CACEI's accreditation process requires to have a complete cycle of continuous improvement. That is a closed cycle, which covers identifying a problem to its solution; this will allow arguing the program's current state, evidence the actions carried out, generate the necessary information, and base the new actions in the future. For example, modifications made in the teaching processes are reflected in the minutes of the academies or the curricular commissions. Another case occurs when the self-assessment shows a gap between the AE and the educational objectives (EO). Still, the program has already identified the finding, carried out corrective actions (for example) in the organization of the courses or the teaching strategies, and has been able to observe the impact of these actions on improvement. Suppose a subject with high failure rate is identified. In that case, the different causes that generate it are analyzed, considered in order of importance, and actions are decided to impact those most important causes. Immediately the agreed actions are applied, the results are re-measured and analyzed in a comparative way to determine whether the actions were or not appropriate and, in any case, decide on a new set of actions to be applied. This is known as a complete or closed cycle of improvement; it allows to consider the criteria and indicators of the MR2018 integrally in the process of improvement in a spiral mode.

5. The hybrid mode of the accreditation process assumes a formative evaluation approach.

The hybrid modality incorporates 30 days before the visit, where the Evaluation Committee (CE – Visiting Team) and the Self-Assessment Committee (CV) of the PE establish communication. It is imperative to dedicate that time to develop a dialogue based on a complete and correctly filled out report, from the *cédulas* to the requested analysis. This approach will allow progress on the key issues. Suppose the information is incomplete, incorrect, or the analysis included is limited. In that case, the PE will lose valuable time with the CE, focusing on pointing out omissions or errors. PEs should take advantage of CE's feedback and consider it an input to improve the self-assessment exercise and the corresponding document.

6. PEs should be aware of the entire accreditation process, including feedback and review mechanisms to ensure the process's fairness, reliability, and validity.

To carry out the evaluation, the CEs consider the information provided for each indicator (evidence, *cédulas*, argued analyses, and impact on continuous improvement) and complement it with the meetings and interviews carried out before and during the visit. The CE issues a report analyzed by the Discipline Technical Commissions and, ultimately, by the Accreditation Committee, making the final decision on accreditation. Thus, this decision is the result of a collegial process, duly validated at different stages, which includes a period for the PE to clarify the aspects reported in the proposal for a decision with the necessary argumentation, indicating the evidence that gives it support (due process) but without generating new information. Additionally, it could participate in the appeal process.

7. PEs should take the time to carry out their self-assessment in depth.

PEs can carry out their self-assessment based on the MR2018 from the moment they wish, taking the time that their context requires. For this, CACEI has available for download on its website completely transparently the MR2018, the Evaluation rubric, and the *cédulas*. Programs can begin when they decide internally, start the formal process until they are considered adequately prepared, and thus make the best possible use of the advice that CACEI provides. According to the agreement signed, the complete process must take a maximum of 18 months. The PE has one year to complete the documentation of its self-assessment and upload its information to CACEI's SIGA from the moment it receives its password.

8. **Evaluators should conduct themselves based on the principles of fairness, honesty, respect, responsibility, integrity, and common sense, in strict observance of the rules and procedures established by CACEI.**

    CACEI evaluators are key actors in the evaluation and accreditation process. Their voluntary collaboration is a basic condition for free and autonomous performance. They apply the best of their training and educational and professional experience based on the principles established in the Code of Ethics.

    The MR2018 requires evaluators to carry out an in-depth reflection exercise on the context of each of the PEs they evaluate and on the information received so that they can distance themselves from the educational models and experiences of their own institutions, to observe the diverse reality of engineering PEs in Mexico from the perspective of the criteria and indicators of the MR2018, with openness, equity, impartiality, and coherence. For this reason, evaluators should assume that the external evaluation is not reduced to a technical exercise of verification of the completion of the *cédulas*, nor can it focus on the review of timely and casuistry information. Rather, it warrants a systemic, overall, and contextualized vision of the PE in the light of the MR2018; it must be reflected in the clarity of the recommendations they make, and the degree of the contribution they make to the improvement of the PE.

9. **All the criteria need to be reviewed in terms of the overall effect they have on the achievement of the AEs and the PE's continual improvement (MC).**

    For example, indicators 1.1. Academic Faculty Profile, 5.1. Classrooms, Laboratories, Cubicles and Support Offices, and 6.1 Institutional Leadership, it is not a question of reviewing in detail each faculty curriculum vitae, the laboratory's equipment, or the experience of the coordinator of the PE unless it is considered that there is a direct impact on any of the AE or the processes of continuous improvement. Figure No. 2 illustrates this idea. In an extreme case, if the AEs are not reached or there are no continuous improvement (MC) mechanisms, the infrastructure of a PE would be irrelevant. Suppose infrastructure limitations affecting the AEs are identified as part of the self-assessment processes. In that case, this should be incorporated into the findings, actions, and commitments the program establishes for the future.
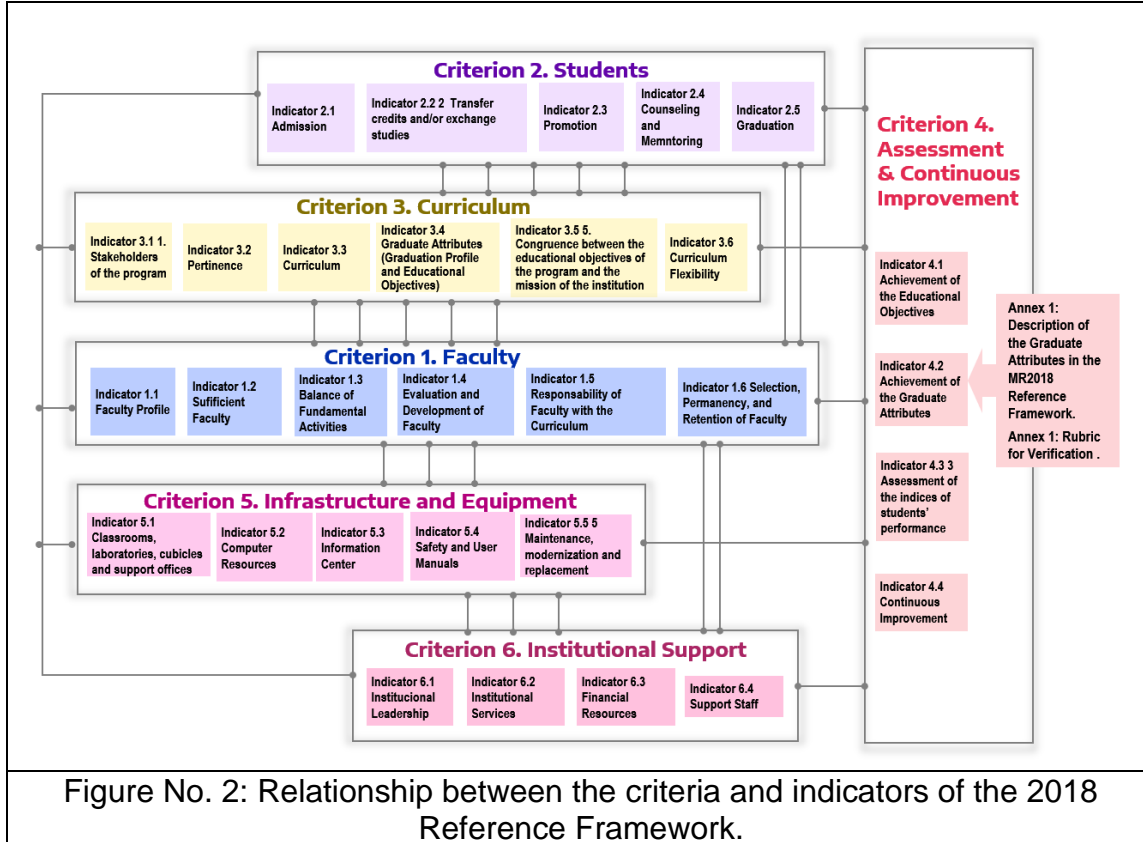
Figure No. 2: Relationship between the criteria and indicators of the 2018 Reference Framework.

10. From 2021 on, PEs must document the extraordinary measures taken during the health contingency caused by Covid-19.

In the context of the measures taken during the health contingency that began in 2020, in general and educational spaces, CACEI will verify that in the accreditations from 2021, and if necessary, the PEs show how they adapted their organization, their collegiate work, and their pedagogical processes (teaching, learning, and evaluation) to work online. In particular, it will be necessary to document in the corresponding indicators the extraordinary measures taken to guarantee the quality of the teaching and learning processes and the achievement of the attributes of graduation by the graduates. In addition to online courses, this will include complementary actions, regulatory changes, support strategies, etc., which were implemented as part of the MC process. One of the advantages of results-oriented evaluation is that the way results are achieved can be very flexible depending on the context. If the PE raises its arguments through a clear and explicit analysis of the decisions taken, the CE will have the necessary sensitivity during the evaluation.

11. The MR2018 virtually no longer sets quantitative standards.

For all the above, the MR2018 no longer establishes quantitative standards for all indicators but only highlights some minimum requirements considered key. For example, there is no minimum required percentage of full-time faculty or faculty with postgraduate degrees, or graduation efficiency. However, they are considered minimum contents in the curricula or the basic equipment of the laboratories. What is sought is for the PEs to document the processes of MC. That is, the analysis, reflection, and follow-up that the program itself carries out to achieve positive trends in the indicators and in such a way that the self-assessment is duly contextualized according to the diversity of institutional frameworks and educational models existing in Mexico. The wording of the arguments and justifications of the PEs are crucial to the evaluation process; these must be based on the evidence presented.

12. Accreditation is not about filling out *cédulas* and "complying" with indicators but about demonstrating authentic self-assessment processes.

For all the above, PEs should not start the accreditation process thinking of demonstrating only the "compliance" of the indicators, nor begin to collect the information to fill out the *cédulas* until the delivery dates are imminent because that would reveal that there is no process of continuous improvement. The formulation of the analysis and the filling out of the *cédulas* hurriedly, without the participation of the faculty and an actual process of prior improvement, supported in the collegiate work, generates self-assessments with incomplete, erroneous, and unsubstantiated information, which negatively affects the possibilities of accreditation.

13. The MR2018 requires PEs to have a systematic and evidence-based analysis of all indicators.

Each indicator of each criterion of the MR2018 requires the PEs a systematic work that must cover the following points:

1. Integration of evidence as part of the day-to-day operation of the program and its continuous improvement processes.
2. Filling out *cédulas* or reports with additional information when required.
3. Analysis, that is, argumentation on the assessment, depending on the supporting information, evidence, and program context.
4. Decision on assessment: Refers to whether it reaches or not the indicator, depending on:
   - the MR2018 questions and
   - the scale of the rubric.

The four points are indispensable. They must be carried out in accordance with what is stated in the MR2018, in the rubric and the contents of the training

workshops taught by CACEI. By way of example, Figure 3 shows the relationship between these points for the specific case of the AE's self-assessment.
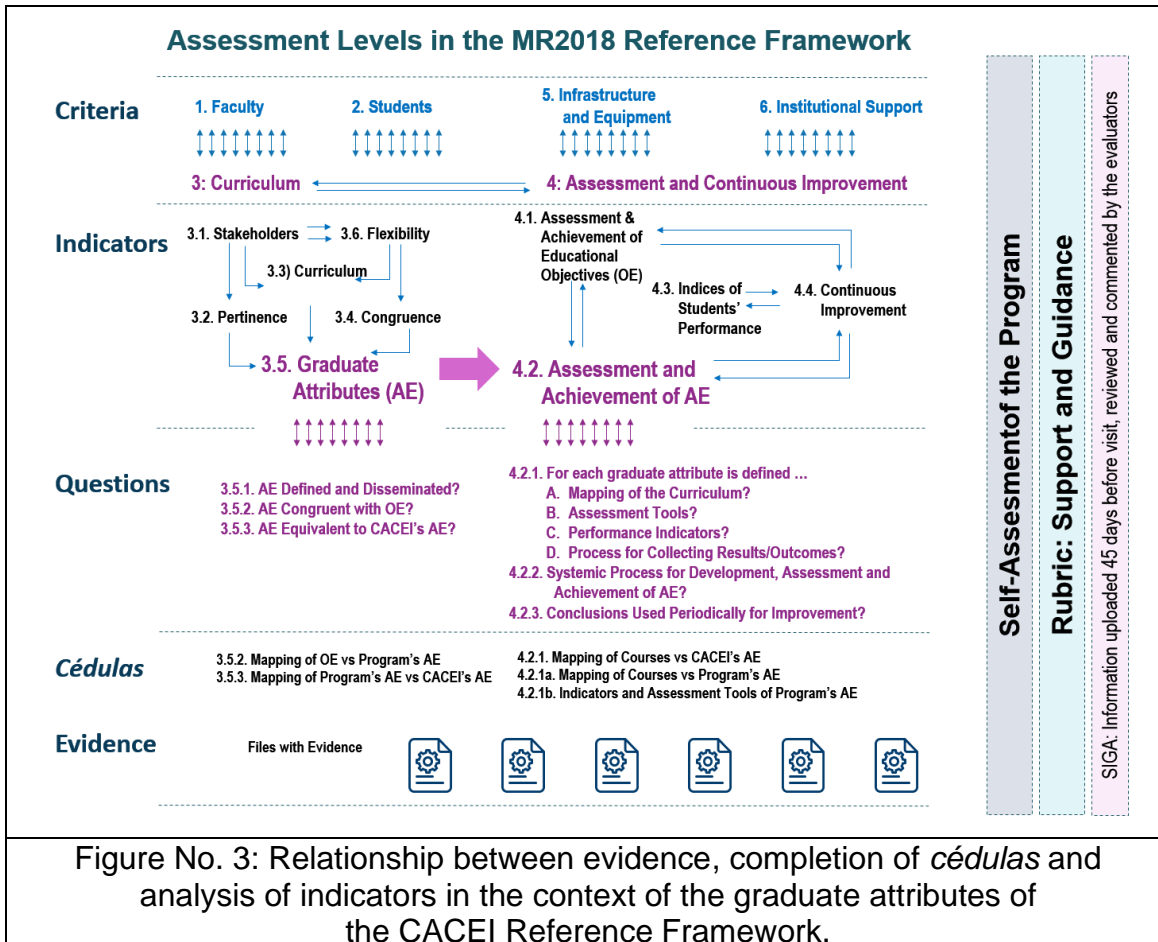

Figure No. 3: Relationship between evidence, completion of *cédulas* and analysis of indicators in the context of the graduate attributes of the CACEI Reference Framework.

The Accreditation Management Information System (SIGA) of CACEI is designed to record and organize such information.

14. The PEs must complete the *cédulas* correctly and completely.

The commitment of a PE to accreditation is reflected, among other things, in the complete, precise, and correct completion of the *cédulas*, i.e., by taking account of the particulars given for each one. CACEI makes an ongoing effort to improve its formats and clarify instructions. Likewise, it maintains communication channels with all the processes in progress to solve all the doubts. Therefore, there should be no incomplete or incorrectly filled out *cédulas*. The consequences of this situation, which occurs with some frequency, are negative for the evaluation process since they overload the evaluators by carrying out a job that corresponds to the coordinator of the PE or the self-assessment team. But above all, it induces errors in the interpretation of the information. In addition,

it suggests that the program's MC processes are not sufficient or effective, that there are no appropriate information systems in place, or that there is an insufficient commitment to accreditation.

15. **The evidence that the PE provides must be representative of the indicator it supports.**

Irrelevant, tangential, repetitive, or supplementary information should not be included. For example, if referring to any specific normative provision is necessary, only the appropriate section, duly marked for its prompt location, should be included and not the entire institutional normative compendium. It should consider that the evidence defined in the MR2018 is uploaded in digital form in the SIGA and must handle an electronic format of everyday use; it should not require specialized software for its visualization. Only one package per indicator must be integrated without mixing information between these. The indications of the SIGA Manual available on CACEI's website should be followed. Responding to more than one indicator with the same evidence should be avoided.

KEY CONCEPTS

16. **The processes of comprehensive curricular evaluation of the educational program are the foundation of the self-assessment.**

In this new paradigm, accreditation is closely linked to curricular evaluation, which in turn has three closely related areas:

- the evaluation of curriculum design (planned curriculum);
- the evaluation of learning outcomes, understood in their broad and diverse notion, that is, like competencies, abilities, knowledge, skills, dispositions, among others; and
- the evaluation of the processes and factors that affect both the first and the second.

17. **The curriculum evaluation refers to the analysis and revision of the curricular design established institutionally.**

The planned curriculum is reflected in the document authorized by the institutional decision-making bodies. It must include its foundation and the educational model that guides it, the profile of egress and the AE, and the curricular organization of the planned contents and processes of teaching, learning and, evaluation. This curricular organization goes from the macro level, which establishes the structure by areas and the progress over time to guarantee the graduality of the learnings (progressions). And in the micro level, the courses' objectives, contents, and strategies are established in a congruent, sufficient, and updated way. It also includes such general pedagogical principles as the

institution deems necessary, such as flexibility and teaching approaches. Finally, it provides for the regulatory aspects that will make it possible to regulate its implementation.

Therefore, the evaluation of the curricular design refers to the assessment of the relevance, congruence, sequence, graduality, sufficiency, and validity of the curriculum; that is, the document where the planned learnings were based and established, as well as the means and resources to achieve them: the contents, strategies, and environments of learning, teaching and evaluation, in addition to the resources, and regulations necessary.

18. **The evaluation of learning outcomes consists of monitoring the learnings achieved by the students.**

It is a question of verifying the extent to which the stated purposes are fulfilled at all levels of the curriculum:

- from the institutional educational model, the general objective of the PE and the graduation profile,
- to the specific objectives or performances established in each learning unit (course, subject, module, seminar, stay, etc.).

For this reason, virtually the entire PE community is involved in the assessment of learning outcomes. Collegial and participatory deliberation on the extent to which they are achieved, and the causes of this is at the heart of the PE's self-assessment.

19. **Evaluation of the processes and factors that affect design and results is equally necessary.**
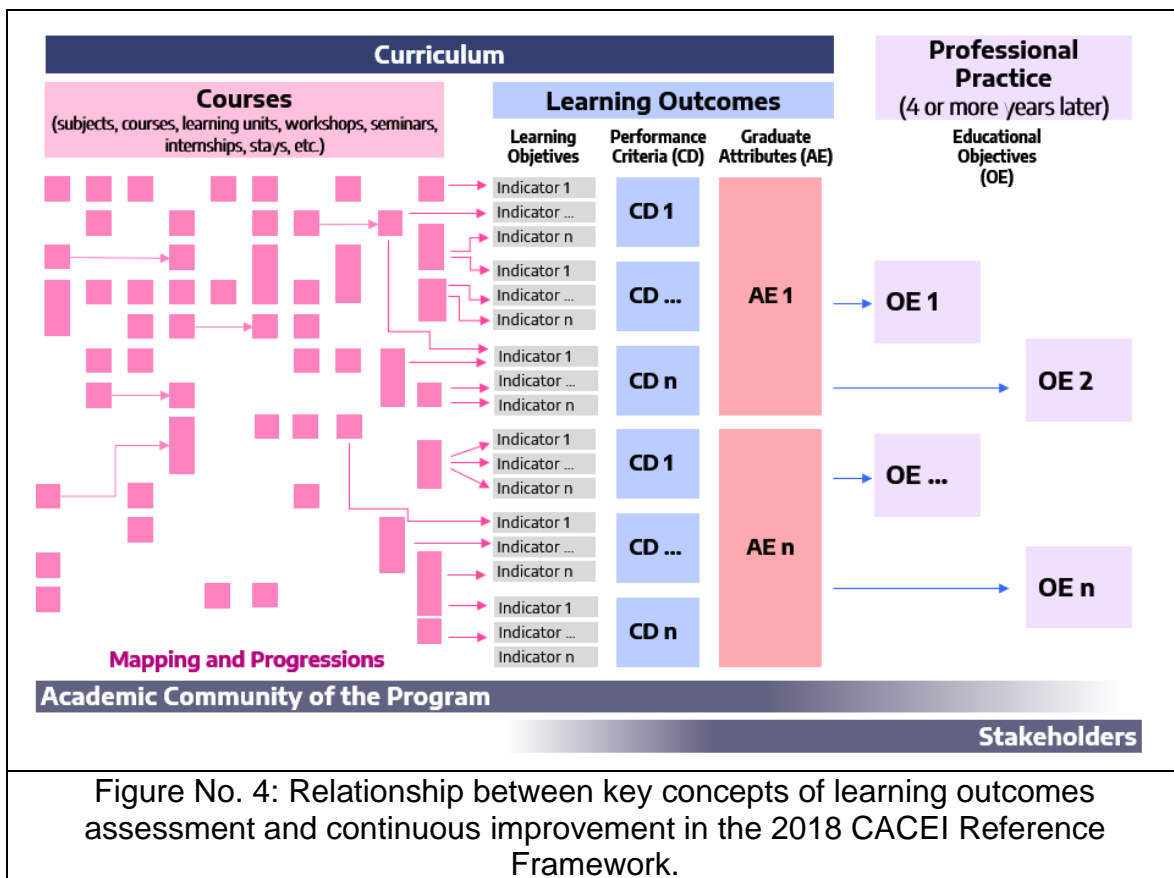
The MR2018 assumes that both results and processes and inputs are important from a systemic perspective to the quality of a PE; that is, it assumes that there is a close relationship between learning outcomes and the factors that affect them, for example: teaching processes, teacher training, teaching, and evaluation strategies, the characteristics, and contexts of students, as well as with the inputs, resources, environments, and conditions in which the curriculum is delivered. That is what the collegiate follow-up carried out by a PE is concerned with.

20. **CACEI does not require assuming a specific educational model, but it requires language compatible with the diversity of Mexican higher education.**

The MR2018 is flexible enough to adapt to different models or curricular approaches, as long as the curricula have the elements and design criteria already indicated, which is usually foreseen in the institutional regulations themselves.

CACEI has developed a language to refer to learning outcomes and the context to which they respond, but institutions are not necessarily expected to take it as their own. It is only an instrument in the face of the diversity of educational models and institutional languages, so each PE must understand these concepts well and adapt the information it provides from its PE. These key concepts, which are outlined in figure No. 4, are:

- Stakeholders in the professional field (GI).
- Educational objectives (OE).
- Learning outcomes in three areas:
    - Graduate attributes (AE) of CACEI and the PE.
    - Performance criteria (CD).
    - Indicators (learning objectives).

Figure No. 4: Relationship between key concepts of learning outcomes assessment and continuous improvement in the 2018 CACEI Reference Framework.

The curricula design must be sufficiently clear and explicit to allow identifying the learning outcomes required by CACEI. AEs, CDs, and, indicators, regardless of what they are called in the institutional educational model (purposes, profiles, competencies, sub-competencies, general and specific objectives, etc.). It should also provide for the necessary strategies and instruments, as already mentioned. AE mapping, the definition of the progressions, and the review of the

unity of the subject's program are tools that help evaluate the curricular design according to the MR2018.

Both MR2018 and the supporting documents that CACEI uses, the concepts of "course", "subject", and "learning objectives" are used in their broadest notion, i.e.:

- Course or subject is understood as any form of organization of the contents and activities provided for in the curriculum, for example: subjects, modules, workshops, seminars, practices, stays, laboratories, etc. It also accommodates the specific terminology of some educational models that refer to them as "learning units", "training spaces", among others.

- A learning objective is defined as any learning expected to be achieved in students within a course. In some educational models, they are called competencies, sub-competencies, units of competence, and performances, among others.

21. Stakeholders (GI) are the actors outside the institution whose views are necessary to analyze the relevance of the PE.

Stakeholders are important to an educational program because education is a public interest for the various social actors. In the context of a plurality of today's societies, attention to stakeholder's points of view is necessary as one of the essential elements that monitor the educational program's relevance. For this reason, the GIs are references for the analysis and thougth of the collegiate bodies of the educational program. They should be considered as reference groups, not as external evaluators of graduates and the program.

These GIs must include, at the very least, employers, graduates, and professional organizations, i.e., actors outside the institution. The information they provide is essential since it questions the needs that PE graduates must meet. Still, it should not be assumed as the only reference for the program, as other aspects must be considered in the relevance analysis, for example, scientific and technological advances. GIs' suggestions, although valuable to PEs, should not be interpreted as mandatory. Meaning that the PE must record, analyze, and value the information arising from the GIs, and argue the decisions made. The PE should communicate and assess the achievement of the AE and its contribution to the EOs with them. This information can be obtained through independent meetings, forums, surveys, or other mechanisms, as will be seen below.

22. Educational objectives (EOs) are the vision of success of graduates four or more years in the practice of their profession.

Educational objectives reflect the medium-term expectations about the leading professional functions, activities, and contributions of the graduates to the field

of engineering and society in a manner consistent with the mission of the HEI. EOs should not be expressed as training objectives, as their development no longer depends on the educational program but various factors in the professional context. Its periodic evaluation has as its purpose:

1) Validate whether EOs are relevant and relevant to the professional context.
2) Analyze if they are congruent with the institutional mission.
3) Identify trends in the labor field.
4) Qualitatively analyze whether the graduate attributes contribute to the achievement of the EOs; that is, if they are a positive factor for this or if it is necessary to adjust the AE.

The contributions of the GIs are necessary to carry out these analyzes. It is not a question of whether the EOs are achieved in quantitative terms, as this depends on many factors beyond the educational program's control. EOs must be clearly defined, published on the PEs' websites, and disseminated to the internal and external academic community and the professional field.

23. The AE of CACEI are statements that generally establish the characteristics that all recent graduates of engineering programs in Mexico must possess.

The AE are the base platform that give graduates the ability to insert themselves in the professional field and, where appropriate, achieve educational objectives. The MR2018 has an annex where a deeper conceptualization of each of them is offered. The acronym AE in this document will refer to the graduate attributes of the educational program unless it is explicitly indicated if it is the AE of CACEI.

24. The AE of the PE are the statements that express the capacities that the recent graduates of each program must possess in their professional discipline and context.

It is important to note that the AE of CACEI should not replace the AE of the program. But should be expressed in accordance with the corresponding discipline of engineering, as well as with the specific time and context of the PE since the important thing is to argue and justify the alignment and unity of the AE of the program with the AE of CACEI, that is, their equivalence.

The AE of the PE are generally formulated based on the analysis and articulation of three sources that reflect the formative intentions of the PE:

o the graduate profile declared and formally authorized as part of the curriculum;
o the general objectives or approaches of the PE as set out in its documents; and
o the educational model of the institution in which the PE is inserted.

25. Performance criteria and indicators are learning outcomes with higher degrees of concreteness.

The AEs of the PE are the first area of expression of a PE's learning outcomes in the curriculum. The performance criteria (CD) and their indicators are the second and third areas, respectively, allowing greater concreteness to express the learning. The consistent, sufficient, and gradual design of these three areas of learning outcomes in the curriculum is the backbone of the curriculum and the assessment of their levels of achievement. To demonstrate the above, CACEI requires PEs to specify a basic progression towards the acquisition of the graduate attributes at three levels of achievement of course objectives: introductory (I), medium (M), and advanced (A).

26. The performance criteria allow for greater accuracy of the AE.

The performance criteria (CDs) express the domains or graduality of the EAs so that they allow to show a more precise and operational level, that is, the expected achievements, but they do not refer to specific performances. Each attribute must have the number of CDs needed to cover its entire approach. CDs should be aimed at all students and should be made of their knowledge, including the expected level of achievement and how they will be assessed. Some curricular designs express the CDs in levels of achievement; for example, initial, intermediate and advanced, which allows establishing its progression in the curricular mapping exercise. There is no single answer of where they will be located once identified because this depends on the curricular structure of the program.

27. The indicators correspond to the general and specific learning objectives of the courses.

The indicators are the detailed and precise definitions of the learning to obtain the performance criteria. They are formed by all the learning objectives (or as they are called in the educational model of the institution) of each of the courses, workshops, laboratories, stays, etc., that the curriculum provides. Learning is conceived here in a broad sense, as it includes competencies, capacities, knowledge, skills, and dispositions, among others. The indicators help to give internal unity to the courses while articulating them with the CDs and the AE. They can include both general and specific objectives of thematic units, modules, or sections. They must be sufficiently clear to identify the specific learning performances or products that should be found according to the level of progression of the objective. For this reason, the indicators of the advanced level courses should be sufficient to cover the performance criteria and these, in turn, to acquire the graduate attribute in question.

Criterion 1 Faculty

Methodological aspects

28. About the analysis of the faculty as a whole.

The criteria of Faculty require an overall analysis of the faculty, not a punctual and fragmented analysis. The PE must integrate and review the information of this indicator's *cédulas* to answer the questions of the MR2018 and the rubric through the due argumentation on whether it is considered that, as a whole, the faculty attends to the indicators. It is not simply a question of answering "yes" or "no" for each indicator or subsection, but of arguing the reason for the answer based on the statistics of central tendency or dispersion that arise from the quantitative analysis of the *cédulas* and the gaps, areas of opportunity and findings offered by the qualitative analysis.

It is very important to contextualize the results of the evaluation of this criterion. For example, if indicator 1.1 asks whether the faculty has "6) Practice in engineering design", it should be answered according to the professors who are in charge of the engineering design axis and who intervene in the AE related to design, not according to the totality of the professors who participate in the PE. If the institution does not conduct scientific research among its functions, it does not apply subsection 5 of indicator 1.1, which refers to research; 7 (productivity) will relate mainly to technological development. It is not enough to omit the information in these cases, but the reasons must be clarified in the argumentation.

29. About the comprehensive system of evaluation and updating of faculty.

A comprehensive system of evaluation and updating of faculty allows identifying the strengths and weaknesses of the faculty and each professor, in particular, to provide feedback and even stimulate their performance. It includes institutionally established processes and programs such as academic stimulus. However, to be considered comprehensive, the different mechanisms must operate in an articulated manner, especially with a process of evaluation of teaching in which several actors participate and whose results are systematically processed so that they contribute to the improvement of teaching.

For example, it is a comprehensive system if it includes the evaluation of students on the performance of teachers in the classroom and their extra-class support; if academic peers participate in evaluating the mastery of the subject; if the authorities assess their degree of responsibility to assume their teaching task and issues such as punctuality to start their class, to deliver their grades, for the delivery of the program, etc.; and, finally, if it includes the teacher's own self-

assessment where he/she reflects on the three previous aspects and proposes his/her own ways of improvement and teaching innovation. The integral system must be oriented towards decision-making to increase the faculty's quality and development, respecting the subsystem's regulations.

30. **About the academic research of faculty.**

CACEI does not include in the MR2018 an indicator on the academic research carried out in the PE since it must adjust its indicators to the diversity of higher education institutions in Mexico, where such a function does not always exist explicitly. However, it does provide for the contribution of research professors through the teaching they carry out, as well as how research is explicitly integrated into the curriculum, to the training of students regarding the development of AE 3 and to the other AE of the PE; that is, the impact of research on the development and achievement of the AE in PE students.

Technical aspects

31. **About the general filling out of *cédulas* 0 and 1.1.1.**

A key aspect of *cédulas* 0 and 1.1.1 is their complete and correct completion because often, much information is omitted, or instructions are not fully complied with. For example, *cédula* 1.1.1 omits to mark in bold and underline the engineering and applied engineering design courses. As already mentioned, incomplete or incorrect ballot papers can generate interpretation errors during the external evaluation process, among other problems already mentioned. Other examples are provided below. To avoid inconsistencies, it is recommended first to fill out *cédula* 1.1.1, and based on this, fill *cédula* 0.

When faculty are given *cédula* 0 to fill out and to avoid errors, they should be supported with a process of prior guidance, which explains the meaning of the information requested, and the necessary advice and validation for a complete and correct filling.

Cédula 1.1.1 must relate and include the data of all the faculty who participated in the PE as instructors or facilitators, whatever their assignment or mode of hiring or if they are also officials or managers. What matters is to include all faculty who participate in at least one course, without omitting any, even if they are attached to another program, department, faculty, or institution. For the particular case of engineering in technological universities, all professors must be registered, including those of the first semesters corresponding to the training of the TSU corresponding to the family of disciplines to which engineering is associated.

32. About professional experience.

There are usually errors in completing the sections of non-teaching professional experience, experience in design, and academic management in these *cédulas*. Professional experience is all those functions performed in the field of engineering as a professional in the area. Design experience is those activities whose product generated in the academic or professional field was designing a prototype, process, improvement, or adaptation in the productive sector. Academic management refers to positions or assignments held in an institution as coordinator, head of a department, director, coordinator of a curricular evaluation commission, etc.

Master's or doctoral studies should not be considered professional experience unless formally included a period of physical stay in the professional field, in a company, government, social sector, etc., or documented technical stays. Teaching experience in one's institution (or in other institutions) should also not be considered a professional experience for CACEI accreditation. In the field of professional achievements, obtaining certifications, prototypes, or patents must be included, taking into account that it does not refer to academic achievements since these are reflected in other areas of the cédula.

33. About the disciplinary and pedagogical updating.

Something similar happens with the disciplinary and pedagogical update, referring to the courses taken in the last five years. The first refers to the updating in the faculty's discipline of work. In contrast, the second refers to pedagogical aspects, that is, related to the teaching function of faculty to improve their teaching. These courses must have evidence of being offered by a recognized institution of higher education or organization. Courses taken beyond the five years indicated (not referring to the date on which the evidentiary document was issued, but to the date of completion) or specific actions such as attendance at conferences or participation in congresses should not be included.

34. About the type of hiring.

It is vital that if a faculty member is not hired **full-time,** but in practical terms impacts the program academically as if it were (for example, with 40 hours), it must be included among the full-time faculty (PTC). It is considered equivalent, regardless of whether or not the figure of PTC exists in the institution. It is not a mandatory requirement that this type of appointment formally exist since it depends on the kind of institution the PE belongs to.

35. About the contributions to the improvement of the PE.

In the category of relevant contributions to the improvement of the PE, the activities carried out intended to improve the education of students, the curricular design, and the monitoring of the planned learning, for example, participation in

academies or curricular commissions, the organization of complementary activities for students (such as cultural activities), etc. must be recorded. In a general sense, it is evaluated how the faculty is actively involved in the formative process of the students, not only through his/her teaching practice but as part of an academic community responsible for the PE.

36. **About the evidentiary documents.**

The supporting documents of the faculty CVs must be kept in the HEI and made available to the CE. They should not be uploaded to SIGA but should be available if the evaluators require them to validate any data.

Criterion 2. Students

Methodological aspects

37. **About the school or academic year.**

A school or academic cycle can be a semester, when the PE has enrolment every semester, or a year when it has annual enrolment. It should not be confused with the improvement cycle established as a precondition for the accreditation process or the Improvement Plan provided for in Criterion 4.

38. **About the attraction of applicants to the PE.**

An important factor in the viability and quality of a PE is attracting applicants to the educational program, as it allows more talented students to be incorporated. Although it is always important, there are institutions where it also becomes a critical factor for the viability of a PE that seems on the verge of extinction and where it is difficult to justify the invested resources based on the low results obtained. In these cases, the PE needs to incorporate in its analysis a clear argumentation on the efforts made, the current situation, the actions to be carried out, and their future prospects. For example, in addition to thinking about the wide dissemination of the program, the question often goes further: there may be an excessive educational offer for the PE's area of influence; or it may be necessary to improve the PE's link with secondary and upper secondary education.

39. **About the entry processes.**

CACEI recognizes the diversity of approaches and regulations on entry processes to the PEs in the subsystems of higher education, as long as there are mechanisms aimed at providing the conditions for students' optimal performance. For example, suppose admission to a PE is given solely based on quota (without considering academic aspects). In that case, there must be regulated, standardized, and transparent processes that guarantee equity and learning support programs. Transparency refers to the fact that the regulations

and their procedures are clearly and widely disseminated, that they have verification mechanisms and that they report results in a public way.

However, when the PE recognizes that the entry criteria generate other difficulties derived from the students' insufficient previous learning, CACEI will expect to see support strategies, through consultancies and various modalities of tutoring and accompaniment or leveling courses, among other possibilities. In summary, CACEI does not seek to establish a single form of admission. Still, it does expect to see the PE's responsibility with the admitted students, whatever the mechanism used, so that they are in real possibilities of achieving the AE. This can be demonstrated by measuring the impact of the actions implemented on the failure rates of the early semesters.

40. **About the analysis of the school progression.**

School progression analysis refers to the monitoring carried out by the PE of the quantitative and qualitative aspects of the students' performance throughout their stay in the PE. It has four components:

- The existence of statistics and quantitative indicators (such as failure, delay, retention, and school dropout) allow for identifying trends, bottlenecks, areas of opportunity, red lights, and the obstacles to the smooth transit of students in the PE. These quantitative indicators must take care of the validity and reliability of the information.

- The existence of specific qualitative and quantitative studies allows identifying the causes of the identified trends. It is advisable to include analysis results of the entrance exams (such as the EXANI), the general knowledge exam (such as the EGEL), as well as other intermediates (EXILCBI). If the PE does not have EGEL, then it should be pointed out. In this case, departmental examinations may be established if the program deems it necessary.

- The identification of the strategies and improvement actions that the program can carry out based on the two previous points.

- The impact, i.e., the effectiveness of the actions implemented, must be reflected in an improvement in trends as a whole, that is, in a global way in the PE and taking into account that many of them are affected by multiple factors.

For the analysis of the school progression, it is necessary to use these data and explain the interpretation and argumentation that the PE makes of them in each of the four points indicated.

41. About failure, lagging, and dropout rates.

It is necessary to be clear about certain concepts that are required in this criterion and in others. For example, about:

- The failure rate consists of the percentage of students who have not met the objectives set for a course and therefore do not pass it.

- The lagging students refer to the students who, by not complying with the objectives established for a course, need to repeat it or are temporarily discharged for a period and therefore are delayed if the ideal route provided for in the curriculum is taken as a reference.

- The dropout rate takes into consideration students who have dropped out of the PE. It should be noted that there is currently a tendency to refer to this indicator as school dropout, so that, for the purposes of CAEI accreditation, they are considered synonymous.

Technical aspects

42. About the evidence of the analysis of the school progression.

As evidence of the school progression, the quantitative and qualitative analysis of the program cohorts should be presented, as well as the undertaken improvement actions and their impact. The first accreditation must include at least the last three cohorts. When the PE only has one cohort, it should be considered the cohort already graduated and the three in process. In case of reaccreditation, the five cohorts after the last accreditation should be analyzed. There is no format or *cédula* for this since the analysis depends on the specificity of each PE. However, in addition to the reports used by each PE, it is necessary to incorporate the information requested in *cédula* 4.3.1.

43. About the evidence of tutoring and counseling.

The evidence of **the tutorials and consultancies** should preferably cover the last two academic or school cycles as defined before. However, it is important to emphasize that the most relevant thing is the analysis made on the impact of these actions improving the students' progression, mainly in the retention.

44. About the graduation options.

In the case of **graduation** options and their effectiveness, the existing rules in the subsystem in question must be considered. For example, in Technological Universities, the realization of a professional stay is the only mechanism. The PE must explain the situation based on its internal regulations and guidelines to contextualize the analysis. It is not only a question of seeing if all the options are used, seeking to increase or reduce the options of qualification, but delving into

the factors that affect their selection and optimal functioning in terms of education and evaluation of learning.

Criterion 3. Curriculum

Methodological aspects

45. About stakeholders.

The PE must present the list and justification of the stakeholders and explain the systematic monitoring of their contributions, at least on an annual basis: this includes consultation with external actors, as already mentioned, at least graduates, employers, and professional associations. There is no fixed or standard number of GI members in each sector. The important issues is that they are representative according to the PE context, that they participate in a systematic and committed way to improve the PE, and that everything is documented appropriately. When there are other internal actors (teachers, students, etc.) or other external actors (civil society organizations, parents, other educational institutions), it is necessary to argue their relevance and contributions to the analysis of the OEs.

46. About the methodologies for assessing OEs.

The methodologies used to assess the OE's should be explained, i.e., as noted above, to support their validity and relevance, analyze their congruence with the institutional mission, analyze trends in the labor field and analyze the contribution of the AEs. These methodologies may include interviews, forums, meetings, surveys, etc., with both a quantitative and qualitative approach, provided that they are used systematically and regularly and allow for a twin-track dialogue between the PE and stakeholders. The assessment should be done by cohort as far as possible, especially when there have been different curricula. It should be noted that employer satisfaction surveys are not sufficient as a consultation with stakeholders when their results only offer the percentages of different degrees of satisfaction, without it being possible to know the causes and factors that affect them and their relationship with the educational objectives and graduate attributes.

47. About the key questions of alumni follow-up.

The follow-up of alumni must be systematical and oriented to provide information on at least four fundamental issues, subject to the others that the PE deems necessary in its context. These issues are:

- About the labor field: if the former student is in the professional area for which he/she was trained. If positive, the functions or activities he or she performs,

work conditions, etc., are explored. If not, check if he or she is studying a postgraduate degree. Otherwise, the reasons should be investigated.

- About the educational objectives: from the description of the OEs, graduates are asked about the degree to which they reflect the activities they perform, for example, using a Likert scale.

- About the education received: the graduates are consulted to what extent they perceive having reached the AE and its usefulness in the labor field, if there are gaps between their education and their professional functions, as well as the recommendations that they have for the curriculum, teaching, etc. Here also could be included variables related to satisfaction, as long as these are not confused with the substantive aspects of education.

- Competencies required in the labor field: the type of competencies and skills that currently require the labor field are investigated, and the vision for the future.

48. About the methods and techniques to follow-up alumni.

The information provided by the follow-up alumni is key, so it is recommended to systematically use both quantitative and qualitative methodologies to be able to feedback into decision-making on the PE. In any case, it must be conducted annually, including cohorts that are at least two years old. In all cases, samples must represent the method selected for their realization to avoid biases or misinterpretations. For example, in the case of surveys that yield quantitative results, it is essential to be clear about the size of the sample and the type of analysis to be performed (parametric, non-parametric, etc.) to guarantee the validity and reliability of the results. If a qualitative method is used, such as interviews or focus groups, the selection of participants must be taken very well to provide inputs with the necessary quality and depth.

It should be noted that the programs in reaccreditation must be followed by alumni of the five cohorts that have graduated since accreditation, in the same way as the first accreditation programs that already have such graduates. In other cases, information should be included from the cohorts where the two-year criterion of graduation applies. If it does not yet apply, then at least the design of the process and instruments should be in place. It is suggested that TICs be used for this process, for example, through mobile applications, videoconferencing, etc.

49. About the description of the AE.

AE should be described sufficiently clear and precise terms to express the professional skills that recent graduates will possess in terms of high-level learning outcomes. For example, an AE cannot consist of a general statement

applied to any other professional field or any engineering. Nor can it consist of technical skills or one-off learning.

It is necessary to strengthen the definition of the PE's AE, that is to say, to include the precise verbs, the object of work, and its context of realization, since only in this way can its degree of difficulty or complexity be made explicit. It is important not to define them in ambiguous or confusing terms; for example, "apply knowledge of X or Y theme" or "be aware of X or Y" since such phrases do not explain what such application or consciousness consists of. Nor should they be raised as extensive lists of knowledge, skills, attitudes, etc., as this constitutes another area of curriculum design. The number of AE is not important in itself; what matters is that they can be clearly stated, that they can be mapped, evaluated, and evidenced, and that, as a whole, they are equivalent to those of CACEI. Both excessive fragmentation or concentration of AE is counterproductive in practical terms.

50. **About curriculum mapping.**

Courses (courses, subjects, modules, laboratories, workshops, seminars, stays, internships, etc.) are mapped according to their learning objectives. As already seen, these objectives are considered the indicators of the contribution of the courses to the graduate attributes. One course can contribute to several attributes. It is not a question of defining this contribution according to the syllabuses since the mere list of topics that a course addresses does not allow us to know the expected type of learning.

The main consideration in formulating the mapping is to verify what type the objectives of each course are (general, specific, competencies, etc.) and how many learning objectives are related to the attributes, their performance criteria, and the learning progressions. It does not refer to the topics but each course's objectives (or competencies). If the objectives are not sufficient or congruent, this allows us to identify an opportunity for improvement.

51. **About progressions.**

Progressions refer to the levels of achievement of the indicators, expressed in stages necessary to achieve the complex attributes and learnings. The progressions do not refer to additional information, but to the identification of the level of achievement that corresponds to the indicators or the CDs, that is why they are the key piece to carry out the mapping since they allow to locate the courses that contribute to each CD and therefore to each attribute. If the stages in which the graduate attributes are developed are not clear, it will not be possible to establish their progression through the objectives of the courses. It is necessary to consider the degrees of difficulty, complexity, and uncertainty of learning, and the best possible sequence to achieve them.

The identification or design of progressions requires clear knowledge of how certain types of knowledge are learned and evaluated or certain skills are developed. There are several learning taxonomies whose consultation can help as an input for analysis. It is suggested to use specific taxonomies for the development of competencies or the field of engineering. Specifically, the MR2018 asks to specify these progressions at the introductory (I), medium (M), and advanced (A) levels.

52. About indicators of learning outcomes.

When the MR2018 refers to indicators of learning outcomes, it refers directly to the learning objectives of each course, whether general or specific. Concerning them, the following should be noted:

- They must accurately express the learnings sought in each case. That is, they cannot have the same degree of generality or abstraction as AEs or CDs. For example, in the indicators field, statements cannot appear about competencies to be developed (teamwork, entrepreneurship, communication) but rather about the behaviors, knowledge, skills, attitudes, dispositions, etc., that reflect these competencies in observable terms.

- Learning indicators do not refer to goals, standards, or quantitative achievements sought by courses, so they should not be expressed in terms of percentages of performance criteria or learning objectives.

- Nor do they refer to assessment instruments, learning products, or scales or domains of the rubrics used in the courses.

- The indicators cannot refer only to "applying" the knowledge provided in the course syllabus but must specify which applications are involved.

- The same indicators should not be repeated for courses of different levels, stages, or other contents.

53. About curricular flexibility strategies.

Some examples of strategies to promote curricular flexibility that PEs may consider are summer courses, recognition of credits to students for taking subjects from other programs or in other HEI, teaching courses in different modalities: face-to-face, tutorial or online, freedom of choice of workloads, courses with flexible content, dual model, exercises of integration of contents or practices, multi and interdisciplinary works that cover several courses or PE, among others.

In general, flexibility refers to strategies that allow intersecting fields or opportunities that are rigid due to the normative, curricular, or pedagogical limits

already instituted, for example, the division between disciplines, the separation of educational programs, fixed learning rhythms, among others.

54. **About comprehensive courses or capstone courses.**

Capstone courses, also called comprehensive courses, are advanced-level courses where several AEs are expected to be consolidated simultaneously, mainly those that have to do with complex problem solving and engineering design. These courses are very demanding both for students, for faculty, and their design. They require making explicit all the learning sought (objectives, competencies, etc.) and the strategies for their development, as well as the results and products of learning and its evaluation; for example, projects, problem-solving proposals, or specific designs. In general, they also require external linkage mechanisms that make it viable to the degree of contingency and complexity that the desired learnings must-have. For all these reasons, the PEs must clearly and explicitly substantiate their design and demonstrate that the profile of the faculty is adequate to teach them.

Technical aspects

55. **About *cédula* 3.3.1.**

Cédula 3.3.1 must be completed for the entire curriculum, including optional subjects, stays, and other curricular activities. To calculate the hours in the curricular areas, it is important to consider that the hours of the same course can be distributed in two or more areas, depending on their learning objectives and contents. In these cases, the number of hours dedicated to each area will be recorded in each column, taking care the sum of the entire row corresponds to the row of the total hours of the course. Only the hours in front of the group are recorded, not the student's additional or independent work hours. A key point is the assessment of the indicator, which must be formulated based on the reasoned answer to question 3.3.1 of the heading. This assessment does not consist of answering whether it complies or not, but in substantiating the answer based on the data that the same *cédula* has.

56. **About *cédula* 3.3.2.**

Cédula 3.3.2 must be completed for each of the curricular activities taught in the last two complete cycles, including compulsory and optional courses, seminars, workshops, stays, and any other activity foreseen in the curriculum. It must be filled out by the faculty who teach the courses and, where appropriate, agreed when two or more faculty taught the same course. It is vital to remember to fill in the field of the abbreviated name of the AEs of the PE since they will be used in the following *cédulas*. In assessing this information, the course design updates that have been made during the previous cycles of continuous improvement should be commented on. It is also important to take care of the homogeneity in

the keys of the courses in this *cédula* and all the others where it will be required to link the information. The key of the course is the common thread that allows to cross information. In the field where the average grade of the course is requested, the last time on which it was taught must be noted, including all the course groups. This cédula includes information reported on cédulas 4.2.1 and 4.2.1a, so it is essential to check their consistency.

57. **About *cédula* 3.5.2.**

Cédula 3.5.2 seeks to verify the contributions of AE to OE. In the justification of the contribution, it should be explained why AE contributes to the graduates to achieve the educational objectives in the professional field. Clear and precise language should be used, with explicit reasoning, avoiding the use of tautologies. It is not a question of justifying the importance of the educational objectives themselves, either in terms of the regional or professional context nor of referring to the curriculum or subjects offered to achieve the AE. It is important to avoid establishing relationships that cannot be demonstrated (for example, knowing how to conduct experiments implies leadership skills or that analyzing information statistically is equal to communicating to different audiences).

58. **About *cédula* 3.5.3.**

The purpose of *cédula* 3.5.3 is to demonstrate the equivalence of the AEs of PE with the AEs of CACEI. Columns containing the synthetic names of CACEI attributes should not be modified or replaced with other statements. The justification column should establish why the AE-PE is equivalent to the AE-CACEI; what are its similar components in terms of the content and complexity of the attribute, in a precise and clear language, with explicit reasoning, avoiding tautologies. It is not a question of analyzing how the AE-PE contributes to the AE-CACEI, nor explaining the importance of any of them depending on the professional field. Nor should it be taken for granted that a PE graduate attribute is equivalent to another from CACEI if no part of the attribute explicitly indicates it, as if it were an automatic result of another learning or as if it were implicit in it by the methods used to teach it. For example, "Determining the structural or volumetric characteristics of the materials" does not contribute to the attribute of oral and written communication by the fact that they are asked for laboratory reports. Nor does it contribute to the attribute of experimentation by the mere fact that laboratory practices are done in some subjects. In short, equivalence is posed in terms of explicitly expected learning outcomes, not unsubstantiated methods or assumptions.

Criterion 4. Assessment and continuous improvement

Methodological aspects

59. About curriculum mapping and alignment of indicators.

Mapping exercises make it possible to evaluate the alignment of the indicators with the AEs of PE and the AE of CACEI at the level of the courses. It is a collegial exercise that identifies certain problems, for example: the emphases given to certain attributes, the gaps, the overloads in some subjects, the subjects that do not contribute, the weakly sustained attributes, etc. This identification should be accompanied by a deep thought documenting the areas of opportunity identified, and the improvement measures to be taken. If the analysis was carried out, the findings should identify the alignment problems between attributes, criteria and indicators to propose their improvement.

The consensus of collegiate bodies (academies, curricular commissions, for example) on mapping is a good decision-making mechanism at the design level, but it cannot be the only one. It has to be reviewed and compared with reality, that is, with the actual learning outcomes of students and the factors that influence them. If it is seen that the attributes are not sufficiently achieved, it must be reviewed from the mapping to the subjects, that is, the teaching and evaluation strategies used to see where there are opportunities for improvement.

60. About the outcomes of learning and the instruments for its evaluation.

In the accreditation process, it is expected that the evidence of the evaluation of learning will be constituted by tangible and representative samples that include both the assessment instruments and the outcomes that the students developed. The first ones can be the rubrics that the teachers designed and used, the checklists, the questions or reagents of an exam, etc. The second are student reports, exams, grades, etc., as long as the relationship between instruments and outcomes is very clear. Therefore, evidence of learning outcomes can be of two types:

- Evidence on the instruments: Likewise, here would be the samples of the questions, lists, rubrics, the portfolio guide, etc.

- Evidence on the outcomes obtained. As already mentioned, they would be the samples of the reports, notes, plans, or behaviors made.

It should be clarified that surveys on student satisfaction with the training received cannot be used to measure achievement of the attributes, as they are indirect estimates that reflect perceptions, not specific learning.

It should also be noted that AE are not evaluated directly but through the instruments and outcomes that evaluate the indicators and, on this basis, progressively, CDs. That is why consistency between all of them is so important.

61. About the concept of cohort in the MR2018.

It is essential to understand the concept of a cohort to calculate school performance indices of this criterion. This refers to the follow-up of all students who entered together, until their graduation once a maximum of 1.5 times the duration formally foreseen for the curriculum has elapsed. That which has been approved by the governing bodies of the institution and registered with the General Directorate of Professions of SEP. Therefore, the cohort does not include students who enter later due to mobility, career changes, revalidations, etc. It also does not includes students lagging behind other cohorts. It should be noted that CACEI does not expect this definition of a cohort to be adopted by the PE. It is only an operational definition to interpret the information in the face of the great diversity of higher education subsystems that exist in Mexico.

When the cohort is less than 1.5 times by PE regulation, then the data can be expected to reflect only the period established by the PE. If the institutional regulations mark more than 1.5 times, the indices are calculated according to what is indicated by CACEI; they must also be explained and contextualized. These clarifications should be made in the section on the qualitative analysis of the indicator, where the situation in which the PE finds itself and all the nuances deemed necessary for its interpretation can be explained. Thus, for indicator 4.3 and its respective id, only the students' information of the last five cohorts, whether complete or not (understood as complete when the duration of the curriculum reaches 1.5 times), should be included. For example, if a PE curriculum lasts for eight semesters, the period covered by the cohort is 12 semesters. If the 2014 cohort entered in August 2014, then it runs through July 2020. In that case, the cohort includes the calculation of:

a) The baseline with students enrolled in August 2014.
b) Students who graduated between 2018 and 2020 who passed all the credits in the curriculum but do not yet graduate. The data of the graduates is the one that is used for graduation efficiency.
c) Lagging students; those who remain enrolled but have not yet complete their credits or semesters, courses, etc.
d) Dropped out students; those who voluntarily unsubscribed or were discharged by applying the regulations.
e) Students who have already completed their graduation.

The sum of the last four (b, c, d, and e) must be equal to the baseline to constitute 100% of the population analyzed. For these reasons, in no case should there be inconsistencies in the data. For example, when adding students who are still in the PE and graduates, it exceeds 100%.

62. About the closed or complete cycle of improvement.

As explained in the general considerations, the closed cycle of improvement is a requirement that CAEI establishes for accreditation since it intends to demonstrate that the program has a systematic and continuous process of self-assessment aimed at continuous improvement. On this point, it is necessary to clarify the following:

To show the closed cycle of continuous improvement, it is necessary for the PE to document the work done prior to the PE's self-assessment for accreditation purposes, i.e., in the months or years prior to the self-assessment for accreditation purposes. There is no single, fixed period for this closed cycle, nor a certificate on its content, because it is highly dependent on the context of the PE. It may even include different times, for example, when the time it took to adjust the curriculum is different from the time it took to solve a problem in a lab. In the analysis presented for indicator 4.4, this process should be described and explained, from identifying key issues to the impact or results that have been had with the actions implemented. However, among the issues that the PE considers relevant, it will be necessary to verify that the MC process is working, that the assessment of the OEs and AEs have been included, and that the GIs participate, as well as the internal collegiate bodies, representative of faculty, students, managers, etc. according to their internal regulations.

63. About the Improvement Plan.

The Improvement Plan refers to the findings during the self-assessment process for accreditation purposes, i.e., new areas of opportunity and future actions proposed by the PE in all the criteria of the MR2018 and AE of the PE, as indicated in *cédula* 4.4.1.

Technical aspects

64. About *cédula* 4.2.1 and 4.2.1a in general:

Cédulas 4.2.1 and 4.2.1a: the PE must analyze in these *cédulas* whether the graduality of the learning allows achieving the attribute in optimal conditions, both at the level of design and actual performance. Therefore, the findings will refer to contradictions, gaps, etc. Improvement actions should provide for how to resolve the problems identified.

65. About *cédula* 4.2.1b:

Cédula 4.2.1b; only the advanced level courses should be analyzed, not all those identified in the mapping. The findings of the analysis of this cédula are of three types:

- First, the congruence between attributes, performance criteria, and indicators must be analyzed, both at the design and actual performance levels. Therefore, the findings will refer to contradictions, gaps, insufficiency, etc. Improvement actions should provide for how to resolve the problems identified.

- Secondly, the consistency between indicators and evaluation instruments (including outcomes, as noted above) should be analyzed.

- Thirdly, the assessment results should be analyzed, i.e., the degree to which recent graduates reach the AE, based on the achievement of the advanced level indicators, not on the number or percentage of courses passed. Clear information should be provided on the reasons for responding yes or no and for substantiated areas of opportunity. It is not valid to state that it is achieved from generic or abstract statements nor by repeating the graduate attribute in tautological form. It is crucial to emphasize that it is not a question of expressing the percentage of students who pass the course, but specifically the percentage that the indicators (learning objectives) reach. It is necessary to clearly explain the information used in the *cédula* and attach the analysis report with the results in tabular or graphic form, including the argumentation about the factors that affect, their causes, findings, etc. It is here that the results of the EGEL can be a complementary input for the analysis of learning outcomes of the PE and the analysis of progressions; they cannot replace the direct evaluation of the achievement of the specific attributes of the PE graduates.

The findings must be a logical consequence of the analysis performed and be explicitly related to it. It is important to use clear and precise language, avoid contradictions, tautologies, or statements of such a general nature that serve as a "wild card". For example, something like "strengthening systematization and diversifying evaluation processes" should not be noted if nothing in the preceding analysis shows that there is no systematization or diversification. Nor is it a question of making general statements about the need to improve teaching strategies. In these cases, it should be pointed out in which processes, which strategies, which new instruments, in which courses, etc.

66. **About the instruments and outcomes for the evaluation of learning in** *cédula* **4.2.1b:**

Cédula 4.2.1b must specify the evaluation instrument and the outcome to which the instrument is applied. For example, not only "rubric" but "rubric for review of the practice report". To this end, a clear distinction must be made between assessment instruments and learning outcomes.

- Evaluation instruments are the tools or means that faculty and students use to define the extent to which the desired results were achieved. They detail the evaluation criteria, scales, domains, records, etc.

- Learning outcomes are the expected or deliverable behaviors visible that allow demonstrating that the learning has been acquired. Some examples can be the reports, field notes, plans, models, prototypes, etc., formulated by the students, or the realization of certain activities under qualified supervision.

The instruments apply to outcomes. Outcomes are specified in the indicators (specific learning objectives and performances).

67. **About the congruence of the assessment instruments and the learning objectives in** *cédula* **4.2.1b:**

Cédula 4.2.1b must assess the degree of congruence between the evaluation instruments and the degree of complexity of the indicator, that is, of the learning objective sought. For example, if the student is expected to develop a final project and the assessment instrument is a rubric, the justification should explain the domains and scales of the rubric. It is not a question of writing down a general statement about the theoretical benefits or advantages of certain instruments, nor generic phrases repeated in all the rows as a "wildcard". It is important to verify that the evaluation of advanced-level courses corresponds to the level of difficulty, complexity, and integration of the indicator (objective of the course) and that this is congruent with what is expressed in the performance criteria and the attribute that is, that its evaluation does not concentrate on only a part of the expected learning or on fragmented performances. It is not a question of affirming that an evaluation is carried out with phrases such as "There is a measurement and analysis of the attributes of egress"; but to provide accurate information about it.

68. **About the goal requested in** *cédula* **4.2.1b:**

Cédula 4.2.1b: on the requested goal must be recorded what is expected to be reached. For example, 100% of students must reach a minimum of 70% achievement of the attribute, explaining the basis for calculating the goal. It does not refer to the pass percentages of a subject or the requirements students must meet.

69. **About the Improvement Plan in** *cédula* **4.4.1:**

Cédula 4.4.1: el Improvement Plan is the integrating tool of the entire process of reflection and self-assessment of the PE since it allows to align the findings with the criteria and indicators of the MR2018 and the learning outcomes. A finding in the Improvement Plan refers to the area of opportunity detected, those issues or obstacles that must be resolved. The improvement action refers to the

measures that will be taken to address this area of opportunity. A finding and an action for the program's improvement cannot consist of an intention of a general type that does not offer specific information and would be "valid" in any circumstance. Such as: "Review in Academia the indicators periodically to check their effectiveness in contributing to the achievement of the attribute". Findings and actions must be expressed in precise and concrete terms, but they must reflect the collegial analysis' depth.

70. **About *cédula* 4.3.1:**

On *cédula* 4.3.1, it is relevant to comply with its completion instructions since it is often delivered with errors. In addition to what has already been indicated for the cohort, the following must be taken care of:

- For PEs seeking reaccreditation (or those seeking accreditation for the first time, but who already have more than four complete cohorts), five complete cohorts must be included in the *cédula*, taking care to meet the cohort limit of 1.5 of the duration of the formally approved curriculum, as explained above.

- For first-time accredited PEs, who have no more than four complete cohorts, the completed cohorts must be considered, and the rest are highlighted "in process"; but they are included.

- For a PE with one graduated cohort, the analysis of all cohorts in process should be included even if they are not complete. Therefore, at the time of the evaluation and visit, the PE must already have one cohort graduate and at least three in process.

- PEs that do not have graduates cannot opt for CACEI's accreditation process.

- Students who are not part of the cohort because they did not enter since the first school year (for example, via mobility) should not be included in the cohort calculations.

- The specificities and details that may affect the *cédula's* interpretation must be explained in the qualitative analysis and argumentation of the indicator. Thus, describe the situation of students who are not part of the cohort, for example.

Criterion 5. Infrastructure and Equipment

Methodological aspects

71. About the meaning of infrastructure and equipment in the MR2018.

As already mentioned, MR2018 starts from the premise that infrastructure and equipment of a PE make sense to the extent that they contribute to the achievement of its educational purposes expressed through AE. For this reason, when talking about the existence, sufficiency, and current state of resources (classrooms, laboratories, cubicles, sports facilities, support and service spaces, computer resources and information centers) it is necessary to consider in the first instance the minimum requirements by engineering discipline that have been established in the corresponding annex to the MR2018, depending on the fields of knowledge and learning required in the curricula for these disciplines. The evaluation results of learning outcomes (AE, CD, and indicators) and the factors that affect them should be taken up in the second instance. This implies that the analysis and argumentation of indicators 5.1, 5.2, and 5.3 also requires a review of the congruence between these resources and the teaching and learning strategies envisaged for the courses, in particular with the practical activities provided for in 3.3.2. This analysis should point out the strengths of the resources that allow learning outcomes to be achieved, and the weaknesses detected. It is not appropriate to point out equipment shortages if they do not relate to the AE and the substantive aspects of the curriculum and course programs. As in other indicators, the PE needs to argue on a sound basis for its analysis.

72. About the accessibility of the facilities.

Regarding the facilities' accessibility, HEIs are experiencing a transition towards policies and guidelines for construction and equipment with more detailed specifications so that the access and mobility of people are safe and comfortable for all in an equitable way. Although this is a common policy for higher education, it is still possible to find institutions where it has not been possible to make substantial progress in the constructing ramps, placement of railings, etc. At this point, it is necessary to argue how PE resolves specific situations that arise, and the provisions in the PE's development plan and the resource management that have been made, among other things.

73. About the role of the observer in the hybrid mode.

It is in this criterion that the hybrid assessment mode provides for the participation of an *on-site* observer. It is essential to understand that, although the observer is part of CACEI's register of evaluators, his/her role in this process is not such; he/she must only verify what the CE requests, using synchronous

transmission. This verification does not replace the previous submission of evidence by the PE, for example, previously recorded videos.

Technical aspects

74. About the availability of infrastructure and equipment.

It should be noted that CACEI refers to resources (classrooms, laboratories, cubicles, field and sports facilities, support and service spaces, computer resources, and information centers) available for student learning, regardless of whether they are for the exclusive use of the program or are shared, whether they are located in the program facilities, within the same educational institution or outside it. The trend in higher education is to optimize infrastructure and share equipment to the extent that national or state laboratories, among others, have been thought of. The important goal, in any case, is to show that the students use it.

For example, evidence must be provided in case of **resources shared** with other PEs, institutions, or organizations (e.g., companies). It must be reliably verified that these resources are being used effectively. The terms of the agreements for this purpose (agreements on timetables, number of students, periodicity, etc.) must be shown. Evaluators will be able **to triangulate** this information in interviews with students and faculty, and even with those responsible for these resources, as a form of validation necessary to maintain the reliability of the accreditation process.

75. About *cédula* 5.1.1.

A 5.1.1 *cédula* must be completed for each type of classroom that the PE has according to its characteristics and operating conditions. There is no need to complete one *cédula* per classroom, but to integrate the information as much as possible; for example, one for ten generic classrooms, another for four audiovisual classrooms with certain special characteristics, etc.

76. About the licenses of computer software.

The required evidence on the licensing of computer software can be given in three ways. Firstly, it may happen that an open license is being used, in which case it will only be sufficient to clarify it. The second way is to purchase a license to use a particular version of the programs indefinitely. The third way is that the PE pays periodically for a program that receives constant updates. The relevance of each of these types of licenses and the degree of updating of the software depends on the analysis and argumentation that each PE offers since it is based on the type of software, the courses where they are used, the learnings sought, etc. In any case, the ownership of the licenses must be institutionally owned and not by faculty or students. This includes simulation

software, as well as those that give web access to remote practices or laboratories.

77. About connectivity.

Regarding the adequacy of connectivity, each particular situation should be analyzed in the context of the PE. The important thing is that the PE has an internet connection for educational purposes provided, in the places where it is required. It is a question of this being sufficient for what academic activities require, without this meaning that the PE has to offer it without restrictions or limits, for example, in terms of security. Therefore, the formulation of a satisfaction survey should take care of the questions that are asked, so that they are very specific, as has already been mentioned for other indicators, where it is also suggested that they be done.

78. About maintenance programs.

Sometimes equipment and facilities maintenance programs operate on an institutional agenda and are not dependent on the PE. The relevant thing is to document with clear evidence that the maintenance is carried out through logs or preventive and corrective maintenance programs and that the equipment is maintained in the optimal conditions for its safe and effective use at the time of carrying out the practices. In the same way, it is relevant to present the maintenance program that attests to the systematization and periodicity of this. Documentation of specialized external calibrations and verifications may also be submitted when available.

79. About the evidence of the digital material.

Evidence on the material contained in electronic databases should be accompanied by statistics on its use so that it is possible to analyze the degree of access and relevance in the PE.

80. About the manuals of use and safety of the equipment.

The equipment and specialized facilities' manuals of use and security must be available to all students, faculty, and workers who have access to said equipment, preferably in a repository, electronic form and Spanish. If this is not possible, then its public location must be transparent and in the public domain. This item includes both 1) use and safety general manuals, for example, to deal with a fire event; as 2) manuals and guides for the practices that are carried out in them as part of the courses and that therefore must be provided for in cédula 3.3.2. This is because manuals and practice guides should reflect in detail safety indications and requirements, such as the necessary protective equipment, etc.

81. About the plans of attention to risks and contingencies.

It is imperative to review that clear and conclusive evidence is shown that contingency care plans are in place and that drills are carried out to verify their operability. This is relevant, as the safety of students, faculty, and support workers is the institution's responsibility while inside its facilities. The existence of contingency plans and the conduct of drills can represent a crucial difference in the event of an accident. In this case, these are not generic documents expressed in conceptual or abstract terms, but indications for decision-making, responsibilities, procedures, signals, etc., depending on each of the existing risks (dangerous substances, earthquakes, floods, etc.).

There should be a security commission, but it is understood that in a PE with few students, this may have been constituted at the department or faculty level or the whole institution. In this area, the necessary equipment for contingency plans to work, such as fire extinguishers or emergency stairs, should also be considered. Again, the included argumentation in the analysis of the contextual factors in each PE is essential to understand the specific situations.

82. About the video evidence.

When videos are used as the initial evidence of the indicators of this criterion, they should not be uploaded to the SIGA platform. They instead should be uploaded to some cloud storage service where they are accessible to the team of evaluators through a web link. These videos do not replace the visit of an observer planned in the hybrid modality if the CE requires it.

Criterion 6. Institutional Support

Methodological aspects

83. About institutional leadership.

Institutional leadership refers to the optimal conditions for decision-making that must prevail in the PEs, from the organizational level to the profile of the person in charge of the PE. In some cases, a very brief argumentation is used to explain this indicator, and even organizational charts, organizational manuals, and many other documents are attached with numerous pages, full of official information; but without further analysis or argumentation that clearly explains whether there is a support structure, from the institutional level to the PE coordinator, so that the program moves towards its MC.

In short, it is not only a question of showing the existence of a formal organizational structure but of explaining the functional structure with which the PE operates and analyzing who the main decisions fall on to stimulate and conduct the processes of change necessary for the PE's CM. It includes both

single-member bodies and collegiate bodies, as well as rules distributing rights and responsibilities. The degree of commitment and participation of faculty in MC processes is a direct result of institutional leadership.

84. About the profile of the PE coordinator.

In particular, it will be necessary to argue the appropriateness of the coordinator's profile, management, and leadership skills. Regardless of what it is called in each institutional context, the coordinator here is understood as the person directly responsible for the operation and monitoring of the PE and who must be, at the same time, the leader of the self-assessment team for accreditation purposes.

In a matrix organization, where different areas supporting the PE's activities can intervene, it has to be clarified who is responsible for its operation and improvement. For example, suppose graduate tracking is done by planning or linking units. In that case, that does not mean that the coordinator is not responsible for verifying and tracking PE data. If a department head is responsible for the faculty, the PE coordinator must maintain communication with them, as far as the PE is well-running. If decision-making and responsibilities are shared during the accreditation process, then it is necessary that there is a clear communication mechanism and that both are present during the visit. The same is true if one coordinator completes his or her term of office and another begins throughout the accreditation process.

It is expected that the coordinator and others involved in decision-making will have the necessary experience and skills to manage the PE, such as teamwork, problem solving, conflict management, resource management, among others. It is desirable that it also has specific training in academic management matters as part of a training program for institution administrators. It should be clarified that it is not for the CACEI to evaluate the above, but for the PE, which must incorporate it into the analysis section of the corresponding indicator, and there offer the arguments and the necessary information based on the CV delivered and other information that is considered relevant. A satisfaction survey may be used, as long as it is based on precise questions and not general perceptions whose interpretation may be ambiguous or biased. If in the light of the analysis of the coordinator's profile, weaknesses are found, then it is necessary to address them in the Improvement Plan.

85. About institutional services.

It is important that, in order to analyze the institutional services, it is reviewed whether they are complete, whether they are offered at times and in ways accessible to students and other users and whether they contribute to the smooth running of the PE. This requires the PE to describe the services, explain their operation, and argue why they provide, both in quantitative and qualitative

terms, relying where appropriate on the results of satisfaction surveys or external certifications, for example, ISO. It should be noted that these surveys support analysis and argumentation, but they do not replace it.

86. About the degree of acceptance of the PE among graduates.

The degree of acceptance of the PE among the graduates may form part of the questions that are asked in the follow-up of the graduates, or it can be, in addition, an independent study that is carried out. For example, as soon as each cohort graduates. The degree of acceptance does not refer to the relevance of the OEs, nor to the achievement of the AE, but to the perception that graduates have about teaching, the curriculum in general, faculty as a whole, and about the various services provided by the PE, such as libraries, connectivity, laboratories, practices, etc.

87. About the PE's development plan.

The PE is expected to have its own development plan in the context of the academic entity's plan (DES, campus, etc.), which should be consistent with the institution's. A development plan contains a mission, vision, strategic objectives, policies, and goals in the short, medium, and long term (indicators of results and dates), actions and accountable parties. The PE's development plan, in turn, must be sufficiently precise to contain the goals and actions specifically associated with the PE. The period covered by the development plan depends on the institutional regulations; it must be sufficient to give continuity to the efforts in the long term, beyond the periods that the administrators are in their positions. It is understood that the accreditation process could occur during the transition from one plan to another, in which case it should be explained in the analysis of the indicator.

It is important not to confuse a development plan with a *Programa Operativo Anual* (POA), that is, with the annual operational program; this usually includes only short-term forecasts for the regular operation of the PE and budget programming and the exercise of financial resources. Although aligned with the development plan, the POA does not include the processes of future strategic change by its very nature. It is also necessary to insist that the development plan and the Continuous Improvement Plan in the MR2018 are very different issues. The latter is the result of the self-assessment process for accreditation purposes and includes indicators at a much higher level of accuracy than development plans are usually included. The PE will have to make an argument on the congruence of the planning mechanisms.

88. About the PE's administrative support.

The administrative support of a PE includes staff from the areas of laboratories and workshops, library, medical, psychological support, career guidance, school services, and cultural and sports activities, among others. It does not include

academic faculty or administrators whose evaluation corresponds to other indicators. To evaluate them, the PEs must explain the congruence between the profiles of the staff and the positions they occupy, as well as the results of the satisfaction surveys on the services provided. Whether these surveys are certified with ISO standards or not, they must be well designed and not based on general assessments but clearly defined criteria for the services provided by the institution and under the established policies. For example, it is understood that library or payment services are provided under specific guidelines of schedules, procedures, etc.; therefore, questions should be asked based on these.

89. About financial resources.

Although staff salaries and perceptions are part of the PE's resources, CACEI does not consider it appropriate to include them in the indicator on financial resources. They are considered constant factors of a given system or subsystem beyond the reach of the PEs, entities, dependencies, and even many higher education institutions. Nor can they be considered a determining factor in fulfilling PE member's responsibilities since it is based on the premise that a work commitment is acquired in terms of institutional and contractual regulations. Therefore, salaries and perceptions are not part of the information requested for the self-assessment, nor should they be part of the topics to be worked on during the visits.

Technical aspects

90. About the evidence of the profile of the PE coordinator.

CACEI sees it as good to include the coordinator's *cédula* 0 instead of an extensive CV with too much information without prioritizing. It is important to remember that this is the only case in which a person's evidentiary documents should be included in the evidence uploaded to SIGA.

BY WAY OF CLOSURE

CACEI has reiterated its gratitude to the evaluators and participants in the online courses that have been offered in 2020. In addition to its high responsibility with the accreditation process, it is necessary to highlight its commitment to students, to give a 180-degree turn in external evaluation approaches so that continuous improvement processes focus on the learning obtained by graduates.

The magnitude of this challenge requires a transition strategy on practice, which includes education and training for evaluation, the implementation of accreditation processes, and the lessons we can learn from it all through reflections and findings shared among all actors. Moreover, in the Covid-19 pandemic context, all this disrupted many aspects of our educational work, among many other things.

This document seeks to support this process of change and enrich the communication processes among the CACEI community: self-assessment teams, committees of evaluators, members of commissions, directors, faculty, among others. Their improvement will depend on the feedback received from all of them.

ADDITIONAL INFORMATION

CACEI assumes the principle of transparency is essential to ensure a clear, participatory evaluation exercise guided by ethical principles of equity, impartiality, and coherence. To this end, it makes available to all HEI, PEs, educational authorities, and society in general, the following resources and documents:

- CACEI website:
  http://www.cacei.org.mx/

- Reference Framework 2018 with the full description of the 6 criteria and 30 indicators: http://www.cacei.org.mx/nvfs/nvfs02/nvfs0210.php

- *Cédulas* for Evaluators:
  http://www.cacei.org.mx/nvfs/nvfs02/nvfs0210.php

- *Cédulas* for information systematization:
  http://www.cacei.org.mx/nvfs/nvfs02/nvfs0210.php

- SIGA Manual:
  http://www.cacei.org.mx/nvtu/nvtu06/nvtu060101.php

- CACEI's Facebook: https://www.facebook.com/cacei.org.mx/

- CACEI's YouTube channel:
  https://www.youtube.com/channel/UCMCQ7CeE-lxjEMR64eQ_jNQ

- Conference *"Capstone courses in the training of engineers"*:
  https://www.facebook.com/cacei.org.mx/posts/3032090143571228

- CACEI welcomes proposals, comments, doubts and suggestions on this document. Please send them to planeacion@cacei.org.mx