College of Engineering
Academy of Software and Software

Bachelor in Software Engineering
Program Review
2013

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1. Introduction.

This document presents the results generated by the Academy of Computer Science and Software Engineering for the Software Engineering program review process. The Academy of Computer Science and Software Engineering is comprised by the following faculty members:

- M.S. Guillermo Cheang (chair) – Mexicali Campus.
- M.S. Dania Licea – Mexicali Campus.
- M.S. Josefina Becerra – Mexicali Campus.
- Dr. Adán Hirales – Tijuana Campus.
- M.S. Jaime Ramos – Tijuana Campus.
- M.A. Lucía Beltrán – Ensenada Campus.

Also, the Dean of the College of Engineering, Dr. Miguel Salinas, who collaborates and is strongly involved with the Software Engineering program, was invited as a member of the Academy of Computer Science and Software Engineering for the program review process. Also, as a policy established by the College of Engineering, any new full-time faculty member, with specialization in Computer Science and/or Software Engineering, will become a member of the Academy of Computer Science and Software Engineering.

The Software Engineering program was launched in 2007 in the Ensenada Campus. In 2012, the Software Engineering program began the program review process, led by the Academy of Computer Science and Software Engineering, following the guidelines established by the CETYS Periodic Academic Program Review Process. Work was done via face to face workshops, as well as taking advantage of technology, such as e-mail and videoconferencing for distance interaction.

Also, a Program Review Task Force was assembled in the first semester of 2011, comprised by Academy and Team Leaders involved in program review and assessment processes, as well as the College Deans. The purpose of the Task Force was to provide a peer review team for program review processes and provide multidisciplinary and timely feedback to the Academies. In addition to the feedback provided by the Task Force, faculty from the Academies participated in various program review and assessment workshops from external consultants (Dr. Gloria Rodgers, Dr. Marilee Bresciani), and the program review documents as well as the assessment plans were reviewed by external consultants and experts (such as Dr. Marilee Bresciani) who provided observations and feedback.

The review components that are presented in this document reflect the methodology that the academy followed to undergo the review process, which began with an analysis of the Mission and Vision of the program, as well as its educational objectives and learning outcomes, following with the curricular mapping and assessment processes, identifying indicators for student achievement, and the analysis of students, faculty and support resources. It also includes the information gathered

from comparative analysis with other programs external reviewers. The areas of opportunity and recommendations identified by the academy during the process and reflected in this document are presented to the College of Engineering, who in turn will present them to the Vice-Presidency of Academic Affairs, to be considered for implementation in the future versions of the academic programs.

2. Revision of the mission, vision and educational objectives

For the analysis of the Mission and Vision of the Software Engineering program, we begin with identifying some important historical and contextual information, as well as significant achievements of the program:

- The first professionals in the area of software engineering graduated from the program in 2011.
- CETYS participated in 1982 as founding members of the National Association of Higher Education Institutions in Informatics (ANIEI), now known as the National Association of Higher Education Institutions in Information Technologies. CETYS has a chair in the Board of ANIEI.
- Graduates were involved in the design, integration and deployment of systems technology for various companies in the region like Softtek, Government, CICESE, NAVICO to name a few.

The total number of graduates of the program is 5.

Three aspects are considered in the analysis of the Mission and Vision of the Software Engineering Program: alignment with the institutional Mission and Vision, impact in the regional and national development, level of alignment of the program with the current educational objectives.

The Bachelor in Software Engineering is focused on the following Main Areas of Knowledge, also called Professional Formation Lines:

a) Software Development.
b) Project Management
c) Quality Management

Also, as part of the school of engineering 2007 program update, the following Complementary Areas of Knowledge have been added, also known as Complementary Formation Lines, or Emphasis options of the program:

a) Animation and Video Game Design.
b) Business Processes and Applications.

In addition to the above mentioned elements the CETYS University's educational model promotes the integral development of its professionals, which includes critical

thinking, global and international mindsets, information literacy, values and the contribution to social, economic and technological development and sustainability.

The Mission and Vision for the Software Engineering Program, established as a part of the previous review process states:

The Mission of the Bachelor in Software Engineering is to generate highly qualified professionals who apply knowledge in the areas of software development and information technology to provide efficient solutions to the needs of the industry with custom made software systems, using a process based on high quality standards and accepted by the software industry.

The Vision of the Bachelor in Software Engineering Program is be the primary source in the region for all organizations that need professionals with the abilities involved in software development using high quality standards and applied to the innovation process.

As we analyze the institutional mission and the mission of the academic program, we conclude that the second complements the first one. The mission of CETYS University as well as the mission from the Bachelor in Software Engineering Program point out the importance of the development of “intellectual capacity.” Nonetheless, the mission of the program does not specify explicitly the importance of the “moral capacity” development in the students, but by “professionals” it means a “high standard of professional ethics, behavior and work activities while carrying out one's profession” and thus implicitly refer to the “moral capacity” as mentioned in the institutional mission.

The mission statement of CETYS University is as follows:

> *It is the purpose of the Centro de Enseñanza Técnica y Superior to contribute in the education of persons with the moral and intellectual capacity required to participate in an important way in the economic, social, and cultural improvement of the country. CETYS University seeks, as a result, to make indestructible those values that have traditionally been considered as basic so man can live in society in a peaceful way, and satisfy the needs that his capacity to do work allows him.*

The institutional mission points out the following points regarding students:

- Moral and intellectual capacity for the economic, social, and cultural improvement of the country.
- Basic values for living in society in a peaceful way and the satisfaction of his needs that his capacity to do work allows him.

We understand as moral capacity that the students should be decent, respectful, and noble persons; regardless of the profession they choose to undertake. This would allow them to live a successful life despite of socioeconomic level. The institutional mission points out the intellectual capacity of alumni suitable for successfully carrying

out the work that their profession demands. In other words, the value of students as persons and as professionals should be guided towards the “economic, social, and cultural improvement of the country.”

The second part of the institutional mission points out that the students must be able to satisfy their needs through their work and by living in peace with the rest of the people. Once again, we can detect the existence of the students’ ability in their profession as well as the respect to others.

Taking the above components and elements as guidelines and always with the Institutional Mission and Vision as fundamental foundation blocks, the Academy of Computer Science and Software Engineering, through a process of review and analysis, has re-defined the Mission and Vision of the Software Engineering program as follows:

> *The Mission of the Software Engineering program is to generate professionals with a deep understanding of the fundamentals of engineering software for the development of computer applications on various platforms and the management and integration of software applications, that are capable of developing a successful career in the software industry, as employees or independent professionals.*
>
> *The vision of the Bachelor in Software Engineering is to be the main source of professionals in the software industry in the region, with the skills required for the development, management and integration of software projects.*

The mission of the academic program strengthens the institutional commitment of training professionals capable of excelling within the work field, but it only implicitly states their role as a person and their commitment with society through a “successful professional life”.

While the institutional mission focuses on the development of the country, the vision of the program adopts a more local perspective. This represents an opportunity to develop Program Level Learning Outcomes, and an assessment program that responds to the challenge proposed in the vision.

The vision of the academic program reassures the institutional commitment of educating persons with the moral capacity, but it adds the following:

- Software professionals
- Management and integration of software applications

The vision of the program points out in a clear way, that the program should move towards software and integration problems. This would have to be reflected in the curricular and co-curricular courses, departments, and support and infrastructure centers that in one way or the other impact the academic program.

The following Educational Objectives stem from the institutional mission and the academic program:

- Graduates of this program will be able to participle in an important way in projects related with software engineering.
- Graduates of this program will be able to successfully pursue graduate studies.
- Graduates of this program will be able to find a professional job within 6 months after graduation.
- Graduates of this program will be able to start their own business.
- Graduates of this program will be able to fill middle or top management positions within 3 years after graduation.

3. Revision of the program's capacity

3.1 Structure of the program.

CETYS University's academic programs at the Bachelor level have the following structure and degree obtainment requirements:

- Accreditation of 42 subjects plus 4 additional complementary subjects (a total of 360 credits). Of the 42 subjects, 32 are program-specific subjects and 10 are general education subjects from CETYS.
  - Completion of 400 hours of professional practice.
  - Completion of 500 hours of social service.
  - Completion of the corresponding EGEL (undergraduate exit test) examination administered by CENEVAL (organization in México that offers various examination services).

The curricula of this program revision centers in the 32 program-specific courses:

SUBJECT	SEMESTER
Mathematics	1
Programming Methods I	1
Computer Aided Draw	1
Differential Calculus	1
Programming Methods II	2
Physics I	2
Integral Calculus	2
Physics II	3
Numerical Methods	3
Probability	3

Physics III	4
Statistics Inference	5
Multivariable Calculus	5
Introduction to software engineering	1
Computer Systems and Components	2
Data Structures	3
Software Engineering I	4
Database Design	4
Software Engineering II	5
Operating Systems	5
Programming and mobile computing	5
Software project management	6
Database Systems	6
Software Engineering III	6
Business Intelligence Systems	7
Agile Systems Development	7
Computer Networks	7
Information Technology Management	8
Network management and Security	8
Distributed Computing Technology	8
Elective I	7
Elective II	8
Emphasis Elective I (AVG, BPA)	5
Emphasis Elective II (AVG, BPA)	6
Emphasis Elective III (AVG, BPA)	7
Emphasis Elective IV (AVG, BPA)	8

3.2 Program and Institutional Learning Outcomes.

The Student Learning Outcomes for an academic program are comprised by two main blocks: Institutional Learning Outcomes and Program Learning Outcomes. The Institutional Learning Outcomes are defined and reviewed by the Academy of Institutional Learning Outcomes. The Program Level Learning Outcomes are defined and reviewed by the Academies.

The Institutional Learning Outcomes are four and focus on: Verbal and Written Communication Skills, Critical Thinking, Continuous Learning/Information Literacy and Tolerance to Diversity.

The Program Level Learning Outcomes, for the programs offered by the College of Engineering are divided into two blocks: learning outcomes common to all engineering programs (with a strong emphasis on basic sciences and problem solving)

and learning outcomes specific to the academic program (with a strong emphasis on the primary and complementary areas of knowledge of the program).

This document will focus on the analysis and review process for the Program Level learning outcomes done by the College of Engineering and the Academy of Computer Science and Software Engineering.

The Program Level Learning Outcomes that apply to all engineering programs, defined in the previous program review process (included in Evidence #35 of the Capacity Report for the WASC Initial Accreditation), were five and were identified as follows:

The student of a CETYS University Bachelor in Engineering Program will…

- SLO_ENG1: …correctly apply to engineering, the tools provided by the basic sciences, such as physics, calculus, probability, statistics and programming to the solution of diverse problems.
- SLO_ENG2: …design analytic and functional models, quantitatively and qualitatively, for the analysis and improvement of systems for diverse applications.
- SLO_ENG3: … effectively use software tools and technologies to build solutions to engineering problems.
- SLO_ENG4: … effectively design and manage projects.
- SLO_ENG5: … (Clear and effective communication in English) … be able to express his ideas clearly and with an appropriate language, in a verbal, written, and visual way in English.

The review of these learning outcomes took into consideration the following three general guidelines:

1. Since these learning outcomes apply to all engineering programs, all Academies should participate in the review process.
2. As a part of the WASC process, recommendations were made with regards to the amount of learning outcomes regarding assessment implications, thus integration of learning outcomes to reduce the amount is desirable.
3. The learning outcome that has to do with “Clear and effective communication in English” must be included.

The Academies analyzed the five original learning outcomes and re-defined them into the following three Program Level Learning Outcomes that apply to all engineering programs:

The student of a CETYS University Bachelor’s in Engineering Program will…

- SLO_ENG1: …solve problems relating to the improvement of diverse systems, correctly applying the knowledge and tools provided by the basic sciences and/or software technologies.
- SLO_ENG2: … effectively design and manage projects.

- SLO_ENG3: … (Clear and effective communication in English) … be able to express his ideas clearly and with an appropriate language, in a verbal, written, and visual way in English.

This re-definition allows for a more clear identification of the learning outcomes expected for all engineering programs, and also allows the design of a more manageable program level assessment process and plan (which will be explained in further sections of this document).

Also as a part of the previous program review process, Program Level Learning Outcomes that apply to specific engineering programs were defined (also included in Evidence #35 of the Capacity Report for the WASC Initial Accreditation). These learning outcomes, for the Software Engineering program were three and were identified as follows:

The student of the Bachelor in Software Engineering program will…

- SLO_ISW1: … build systems based on software using high quality processes accepted as a standard in the industry.
- SLO_ISW2: … design and manage software projects.
- SLO_ISW3: … apply adequate computing technologies for the development and implementation of a software product.

The Academy of Computer Science and Software Engineering analyzed the three original learning outcomes and re-defined them into the following three Program Level Learning Outcomes that apply specifically to the Software Engineering program:

The student of the Bachelor in Computer Science Engineering program will…

- SLO_ISW1: … ... Create software products based on the quality models and apply software engineering when solving problems.

- SLO_ISW2: ... Plan, run, monitor, control and finish any software project.

- SLO_ISW3: ... Design the quality plan and introduce the processes that control and guarantee the quality of any software product.

This re-definition also allows a more clear identification of the learning outcomes expected for the Software Engineering program, and updated them, taking into account assessment considerations.

The program level learning outcomes that are specific to Software Engineering and have to do with the complementary areas of knowledge (also known as Complementary Formation Lines, or Emphasis options) remain the same:

The student of the Bachelor's in Software Engineering with an Emphasis in Animation and Video Game Design will…

- SLO_AVG: … design and build graphics and animated software that can be applied to videogame design.

The student of the Bachelor's in Software Engineering with an Emphasis in Business Processes and Applications will…

- SLO_BPA: … integrate and implement software business applications package to business processes.

The curricular mapping for the program level learning outcomes, in their redefined versions according to section 3 of this document, considers the following levels:

- DEVELOPMENT (DE): *"At the end of the course, the students know, understand, comprehend and are familiar with the course topics".* It is expected that students have little or no knowledge of the course topics previous to the course. Knowledge and abilities acquired from previous courses may be used to develop students in the solution of problems of low to mid-level complexity. New topics are introduced with a basic application level, sufficient enough for the student to comprehend implications for further applications. It is expected for the student to relate previous concepts and integrate them to his or her new base of knowledge, identifying applications via the identification and solutions of problems and cases at a basic level.

- SATISFACTORY (SA): "At the end of the course the students are able to analyze and apply course topics in various contexts, which present diverse levels of difficulty". Knowledge, skills and abilities acquired from previous courses are used to develop solutions to application problems, of mid to high level complexity, relating to the area of knowledge of the profession. It is expected that the student develop a higher level of analysis skills and learn to use in a more efficient manner the tools and methodologies relating to the area of knowledge of the profession.

- EXEMPLARY - (EX): *"At the end of the course, the students exhibit an integrated understanding of the course topics and their application, knowing when and how to apply them".* Knowledge, skills and abilities acquired throughout previous courses are used to identify and solve problems, where the student is expected to design, integrate and evaluate tools and methodologies relating to the area of knowledge of the profession.

It is important to note that the curricular mapping of the Institutional Level Learning Outcomes for all academic programs uses a three level scale that is consistent with the above levels, using different nomenclature (Development, Satisfactory and Exemplary).

The following table presents the curricular mapping for the Software Engineering program (Program Level Learning Outcomes):

			PROGRAM LEVEL LEARNING OUTCOMES FOR ENGINNERING PROGRAMS			PROGRAM LEVEL LEARNING OUTCOMES OF SOFTWARE ENGINEERING			PROGRAM LEVEL LEARNING OUTCOMES WITH EMPHASIS	
CURRICULAR ELEMENTS			SLO_ENG1	SLO_ENG2	SLO_ENG3	SLO_ISW1	SLO_ISW2	SLO_ISW3	SLO_AVG	SLO_BPA
CODE	COURSE	SEMESTER	NIVEL	NIVEL	NIVEL	NIVEL	NIVEL	NIVEL	NIVEL	NIVEL
MA400	Matemathics	1	DE	DE	DE					
CC400	Programming Methods I	1	DE	DE	DE	DE	DE	DE		
MC400	Computer Aided Draw	1	DE	DE	DE					
MA401	Differential Calculus	1	DE	DE	DE					
CC402	Programming Methods II	2	DE	DE	DE	DE	DE	DE		
FI400	Phisics I	2	DE	DE	DE					
MA402	Integral Calculus	2	DE	DE	DE					
FI401	Phisics II	3	DE	DE	DE					
MA403	Numerical Methods	3	DE	DE	DE	DE	DE	DE		
MA404	Probability	3	DE	DE	DE					
FI402	Phisics III	4	SA	SA	SA					
MA405	Statistics Inference	5	SA	SA	SA	DE	DE	DE		
MA406	Multivariable Calculus	5	SA	SA	SA					
CC089	Introduction to software engineering	1	DE	DE	DE	DE	DE	DE	DE	DE
CC403	Computationals Systems and Components	2	DE	DE	DE	DE	DE	DE	DE	DE
CC404	Data Structures	3	DE	DE	DE	SA	SA	DE	SA	SA
CC082	Software Engineering I	4	SA	SA	SA	SA	SA	SA	SA	SA
SI400	Database Design	4	SA	SA	SA	SA	SA	SA	SA	SA
CC084	Software Engineering II	5	SA	SA	SA	SA	SA	SA	SA	SA
CC406	Operating Systems	5	SA	SA	SA	SA	SA	SA	SA	SA
CC083	Programming and mobil computing	5	SA	SA	SA	SA	SA	SA	SA	SA
CC090	Software project management	6	SA	SA	SA	EX	EX	EX	SA	SA
CC409	Database Systems	6	SA	SA	SA	SA	SA	SA	SA	SA
CC084	Ingeniería de software III	6	SA	SA	SA	EX	EX	EX	EX	EX
CC087	Business Intelligence Systems	7	EX	EX	EX	EX	EX	EX	EX	EX
CC091	Agile Systems Development	7	EX	EX	EX	EX	EX	EX	EX	EX
CE401	Computer Networks	7	EX	EX	EX	SA	SA	SA	SA	SA
CC092	Information Technology Management	8	EX	EX	EX	EX	EX	EX	EX	EX
CE066	Network management and Security	8	EX	EX	EX	EX	EX	EX	EX	EX
CC088	Distributed Computing Technology	8	EX	EX	EX	EX	EX	EX	EX	EX
	Elective I	7	EX	EX	EX	DE,SA,EX	DE,SA,EX	DE,SA,EX	DE,SA,EX	DE,SA,EX
	Elective II	8	EX	EX	EX	DE,SA,EX	DE,SA,EX	DE,SA,EX	DE,SA,EX	DE,SA,EX
	Emphasis Elective I (AVG, BPA)	5	SA	SA	SA	SA	SA	SA	SA	SA
	Emphasis Elective II (AVG, BPA)	6	SA	SA	SA	SA	SA	SA	SA	SA
	Emphasis Elective III (AVG, BPA)	7	EX	EX	EX	EX	EX	EX	EX	EX
	Emphasis Elective IV (AVG, BPA)	8	EX	EX	EX	EX	EX	EX	EX	EX

It is important to note that, in the case of SLO_ENG3 (“Clear and effective communication in English”), there are curricular elements such as the Advanced Communications in English course (5th semester), and also program level courses offered in English beginning in 5th semester. The development of clear and effective communication in English is developed primarily via the co-curricular ESL program that all students must go through, and which is managed by the English Language Center.

Once the curricular mapping was concluded, the lessons learned during the process are as follows:

- Clarity with which each subject relates to each Learning Outcome.
- There is an important amount of involvement and engagement, as well as ownership by faculty members of the Academy that participated in the process.
- Subject content and evaluation criteria were unified.
- Discussion on how students learn and should learn throughout the academic program was achieved among faculty.
- Key moments for the assessment of student learning throughout the academic program were identified.
- Experience was obtained for further program review processes.

3.3 Faculty participating in the program

The program has a chair who is faculty is in charge of the program, and is involved in enrollment and promotional activities; student guidance and graduate follow-up, program review, accreditation projects, etc.:

- M.A. Lucía Beltrán Rocha

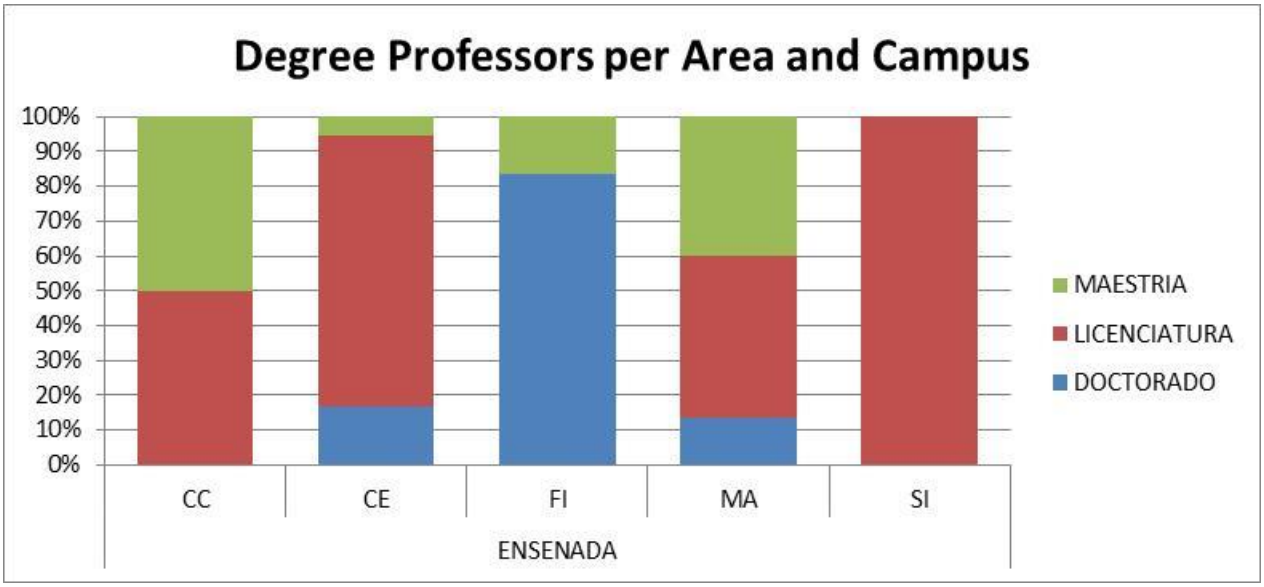
The Professors that are associated with the program are:

Name	Degree	Area of Expertise	Institution	Type
Lucía Beltrán	Master in Business Administration	Software Engineering, Administration	CETYS	Part-time
Luis Aguirre	Master of Science in Computer and Network Technology	Database and Software development	CETYS	Associate* Professors who are part of the administrative staff
Laura Ornelas	Bachelor in Computer Technology Engineering	Software Engineering	ITESM	Adjunct
Majahide Payan	Master of Science in Engineering	Mobile computing and distributed computing	CETYS	Adjunct
Cruz Encalada	Bachelor in Computer Systems Engineering	Database	Instituto Tecnológico de Mérida	Adjunct

The following table shows the course distribution for the Software Engineering Program:

CODE	COURSE	SEMESTER	PROFESSOR(S)		
MA400	Mathematics	1	Nadia Nieblas		
CC400	Programming Methods I	1	Ariel Parra	Lucia Beltran	Martin Marmolejo
MC400	Computer Aided Draw	1	Gerardo Sierra	Mayanin Aburto	
MA401	Differential Calculus	1	Mario Quintero	Dalia Chavez	
CC402	Programming Methods II	2	Luisa Aguirre	Lucia Beltran	
FI400	Physics I	2	Isaac Azuz		
MA402	Integral Calculus	2	Dalia Chavez		
FI401	Physics II	3	Isaac Azuz		
MA403	Numerical Methods	3	Luisa Rosas		
MA404	Probability	3	Socorro Lomeli		
FI402	Physics III	4	Gerardo Romo	Josue Lopez	
MA407	Statistics Inference	5	Isaac Azuz		
MA406	Differential Ecuations	5	Socorro Lomeli		
CC089	Introduction to software engineering	1	Lucia Beltrán	Amanda Valenzuela	
CC403	Computer Systems and Components	2	Karla Gonzalez	Sergio Robles	Alejandro Ramos
CC404	Data Structures	3	Gabriel Fuentes	Martin Marmolejo	Majahide Payan
CC082	Software Engineering I	4	Lucia Beltrán	Laura Ornelas	
SI400	Database Design	4	Fidel Camacho	Cruz Encalada	
CC084	Software Engineering II	5	Laura Ornelas		
CC406	Operating Systems	5	Ariel Parra	Martin Marmolejo	
CC083	Programming and mobile computing	5	Majahide Payan	Ariel Parra	
CC090	Software project management	6	Adrian Garces	Lucia Beltran	
CC409	Database Systems	6	Fidel Camacho	Cruz Encalada	
CC084	Software Engineering III	6	Laura Ornelas	Eva Longoria	
CC087	Business Intelligence Systems	7	Adrian Garces	Lucia Beltran	
CC091	Agile Systems Development	7	Majahide Payan		
CE401	Computer Networks	7	Rodolfo Castañeda		

CC092	Information Technology Management	8	Ariel Parra	Amanda Valenzuela	
CE066	Network management and Security	8	Rodolfo Castañeda		
CC088	Distributed Computing Technology	8	Majahide Payan		



3.4 Research lines of the program.

CETYS UNIVERSITY's System has many years of research in the fields stated on its Mission: Engineering, Administration and Social Sciences and Humanities. The research is primarily of the applied type, and with a focus on solving problems of the region of Baja California. The cases are reported in the documents that have been delivered to CONACYT to endorse the RENIECYT registration. It has also been documented in the applications and endorsements made by the Institution to belong to the National Register of Quality Postgraduate Programs.

The institution's strategic plan towards the year 2020 (CETYS 2020 PLAN) has several strategies defined in order to strengthen its faculty and research in the institution in order to ensure that this activity is an essential part of their academic functions, and in turn, take this ability to assist in the economic, social and cultural development of the region of Baja California. The three strategies are defined as follows:

(1) Strengthening its faculty through support to develop research activities in some cases, and obtaining doctoral degrees in others.
(2) Recruitment of faculty with doctoral degree and with experience in research and publication of results.

(3) Creation of three Centers of Excellence to conduct research and technology development projects that will significantly impact on the productive, social and cultural sectors of Baja California.

To properly align all research efforts, and in turn, coexist in harmony with the teaching activities, the Institution took on the task of defining a research plan which sets out the guidelines and policies that describe the operational framework of this activity. This plan also sets targets and indicators to be achieved in the short, medium and long term. It stands as one of them, for example, that our faculty members are members of the National Researchers System of CONACYT.

(1) **Information and Multimedia Technology.** This research line addresses the problems related to the design and development of computer systems applied to process automation and information management using the internet platform and associated technologies. It also addresses design problems of electronic systems required in specialized processes, mainly of control. Nine full-time professors are working on this LGAC (4 Doctors and 4 in doctoral training). You can find the following academic programs in this line:

1. Electronic Cybernetics Engineering
2. Computer Science Engineering
3. Digital Graphic Design Engineering
4. Software Engineering
5. Master of Science in Engineering with emphasis in Information and Multimedia Technology.

Design and manufacturing processes. This research addresses the problems related to the design and engineering of products, considering the selection of materials, structural analysis, product testing, as well as the processes required for its manufacture. Six full-time proffessors are working on this LGAC (one Doctor and three in doctoral training). The following academic programs are in this line:

1. Mechanical Engineering
2. Mechatronics Engineering
3. Master of Science in Engineering with emphasis in Design and Manufacture.

Systems and industrial processes. This research addresses the problems related to the analysis and improvement of processes in the field of production of goods and services, using statistical techniques and operation research, as well as methods for quality improvement. Nine full-time

professors are working on this LGAC (five doctors and one in doctoral training). In this line are the following academic programs:

1. Industrial Engineering
2. Master of Science in Engineering with emphasis in Industrial Systems and Processes

These lines were defined according to the needs found in the different sectors of the region in which the institution desires to make an impact with the formation of high-level human resources and with research and technological development. According to the indicators of our Strategic CETYS 2020 Plan, significant progress has been made in strengthening its faculty and considering these LGAC and its specific topics for the hiring and doctoral training of our faculty.

Academic bodies are created for each line of research at a system-level, so that professors are integrated to develop research and teaching activities with its respective academic group in both undergraduate and graduate studies. Likewise, there are collegiate bodies in the institution for reviewing and monitoring each of its academic programs. The purpose of these groups is the learning assessment, student assessment and periodic review of academic programs.

On these terms the Master of Science in Engineering is covering all the lines with its three areas of emphasis, it means that the program is completely aligned with the lines of research defined by the College of Engineering.

The strategy for doing research is based in all the students are forced to conduct an applied research project with the tutoring and advisory of professors from CETYS in accord with the emphasis area they selected.

3.5 Facilities, laboratories and book collection of the program.

All classrooms have projector equipment and wireless Internet connection. Some classrooms have sound equipment. Faculty cubicles have computer and Internet connection.

The library has carried out considerable improvements, especially in the acquisition of electronic books and data bases.

Within the supporting programs we have departments that manage their own resources and strengthen the student's holistic education, such as:

- Student Life is a department that carries out sporting, cultural, and social activities and supports integration and the student body operation.
- Entrepreneurial Development Center promotes the student body participation in the Management and Economic Simulation Exercise program (MESE in Spanish) which strengthens the training for business decision making process through simulators. Coupled to this, the Center promotes the visits to companies and seminars in the institution.
- Student Development Center supports students since before the enrollment process through vocational guidance services, and it accompanies them throughout their undergraduate studies with tutorials, workshops, and psychological guidance.
- English Language Center supports students in the accreditation of TOEFL-equivalent test.
- Computer Services is provided by Information Services who manages computer resources in both software and hardware, as well as the necessary multimedia resources for course instruction, Blackboard platform, secure Internet access, local network connections, databases, e-mail and videoconference services.
- General Computer Laboratories provide computer resources for general hardware and software use:
    - CRAI Lab with 32 Dell computers
    - University Lab with 9 Dell and 5 MAC computers
    - Lab “A” with 16 Dell computers
    - Two addition engineering labs with 15 computers

In addition, the engineering programs offered by the College of Engineering have the following laboratories at Ensenada campus:

- Physics, General Electronics, Chemistry, Production Systems, Industrial Computer labs.

4. Revision of the program's educational effectiveness.

4.1 Graduates of the Program.

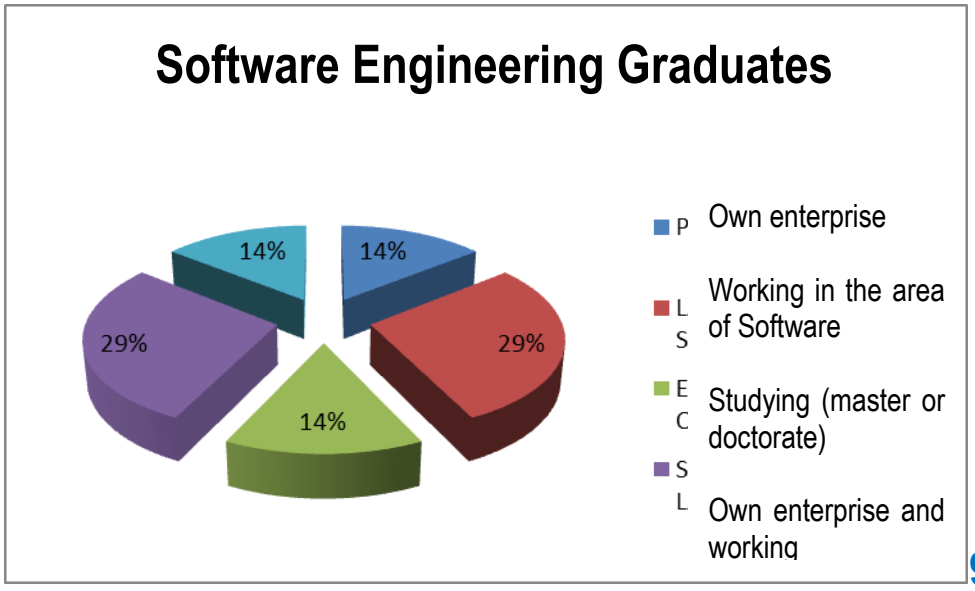
There are 7 graduates of the program.

The first one graduated in summer of 2011; he finished his master in Computer Science at CICESE and is waiting for a scholarship to do his doctorate in Georgia.

The second one graduated in summer of 2012; he is working at the Ensenada City Council and formed his own business developing mobile applications along with other Software Engineering senior students.

Three graduated in December of 2012:
- one of them is working at Softtek in the Quality Insurance area,
- one is in a relevant project at CICESE for the area of Network and Telecommunication,
- another is working at Nativo Digital in Mexico City as a Web Developer and will start his Master in Software at Universidad Autónoma de México,

The last two graduated in summer of 2013:
- One is working at Empresa Navico, S.A. de C.V. as software developer,
- The other is working at Softtek as software developer.



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4.2 Student Population.

The following table presents the student population for the Software Engineering Program from 2004 to 2012.

Students		2007-2	2008-2	2009-2	2010-2	2011-2	2012-2	Average 2007-2012
	New enrolled	6	7	3	7	7	**8**	6
	Re-enrolled	0	7	8	11	15	**17**	10
	Total	6	14	11	18	22	**25**	16

As shown, the student population is increasing, but there has been desertion mainly due to economic causes.

The student population is stable, even though is below institutional metric. Ensenada campus is the smallest campus of the institution and it always has a small population.

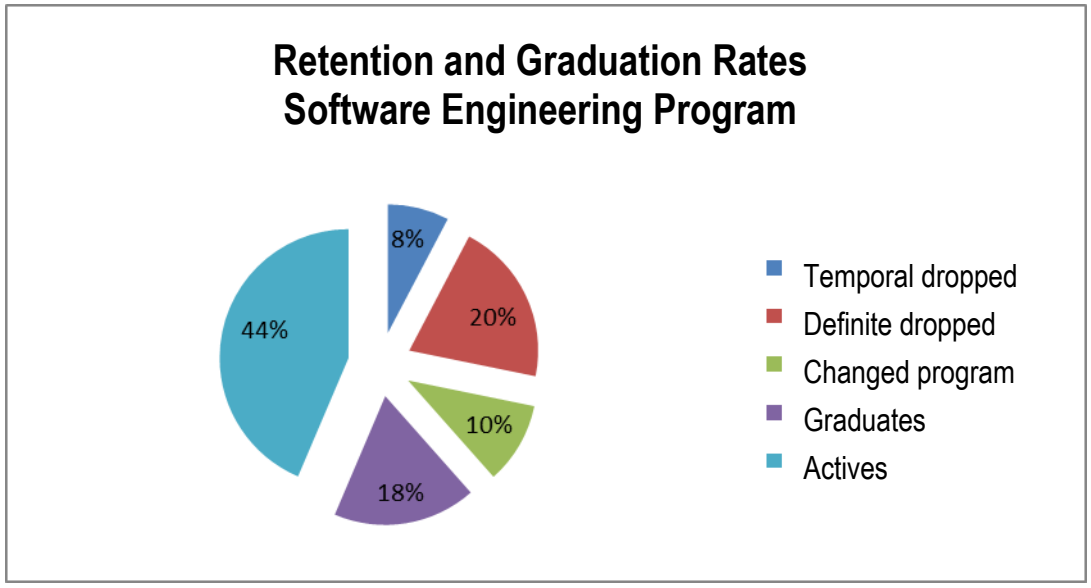
One of the differentiating factors of the program is student mobility. We currently have a double degree program with City University of Seattle, and national and international exchange program. The following table provides information regarding these factors:

	2010	2011	2012	TOTAL
EXCHANGE				
Nationwide				
*** México**		1	1	
International				
Finland	1			
USA	1			
TOTAL	**2**	**1**	**1**	**4**

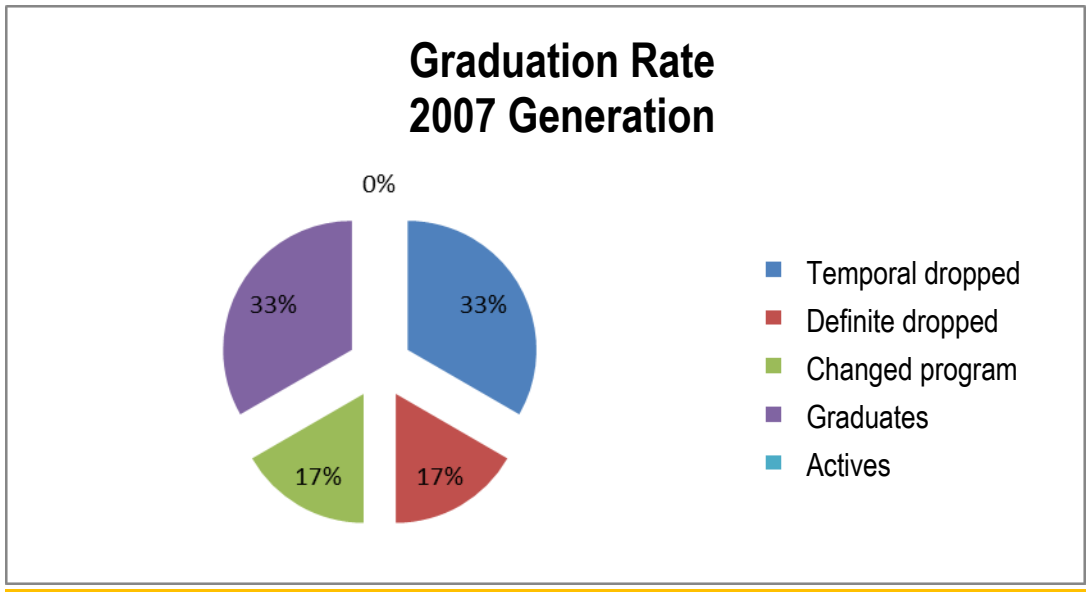
*Two exchanges by the same student

4.3 Analysis of retention and graduation rate.

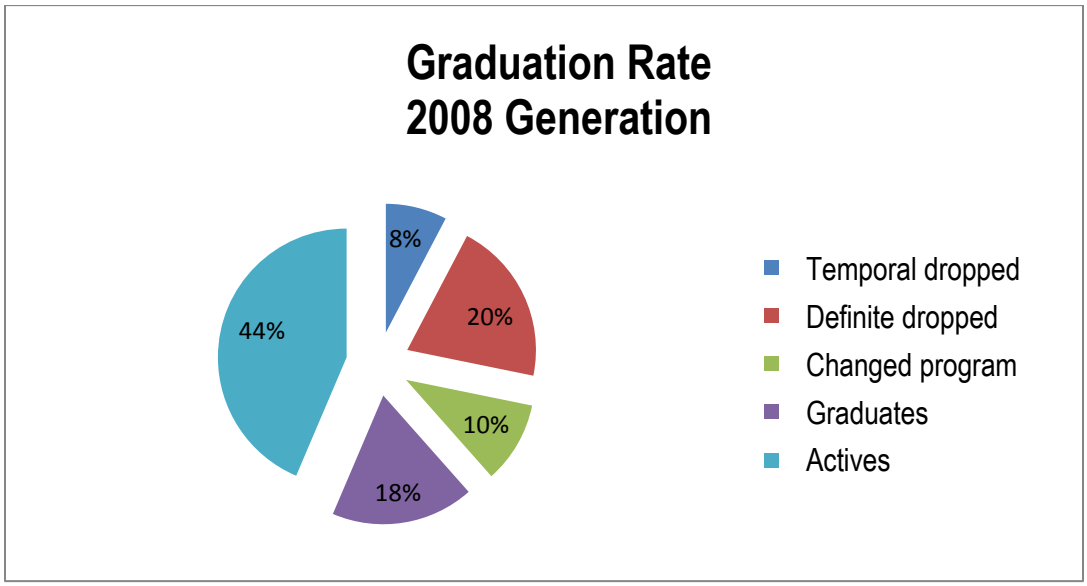
Since 2007 the program admitted 38 students, 7 (18%) have graduated. 17 are actives (44% of the population); the rest representing 38% of the population enrolled has dropped or changed program within CETYS due to economic situation, vocational or academic issues.



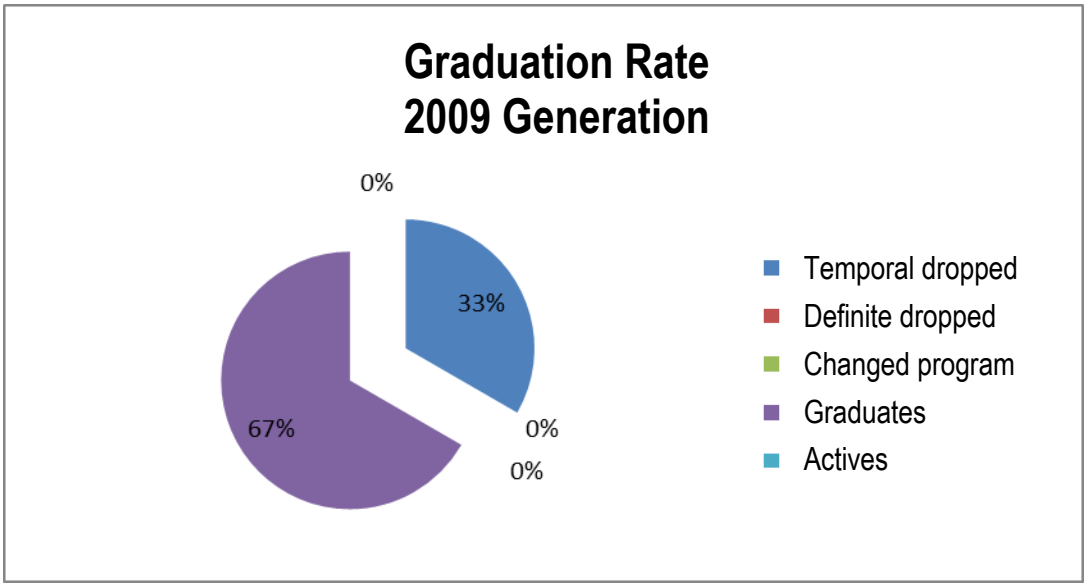
For the first generation, the students that dropped temporarily did it due to economic issues, having passed 80% of their course works.



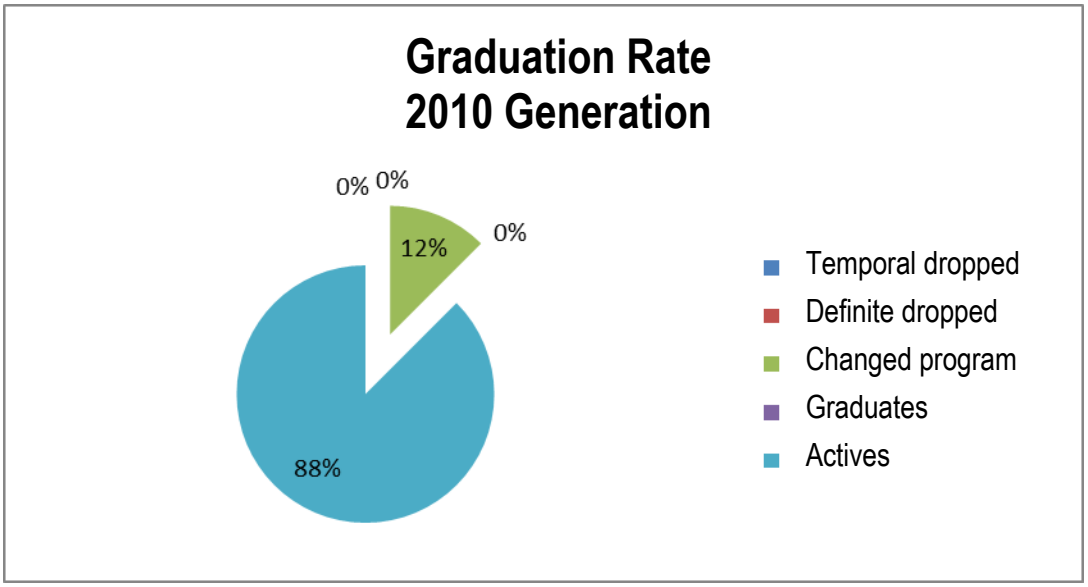
The 2008 generation had the most definite dropped; half of them had wrong vocation and the others were foreign who could not adapt themselves living out of home.



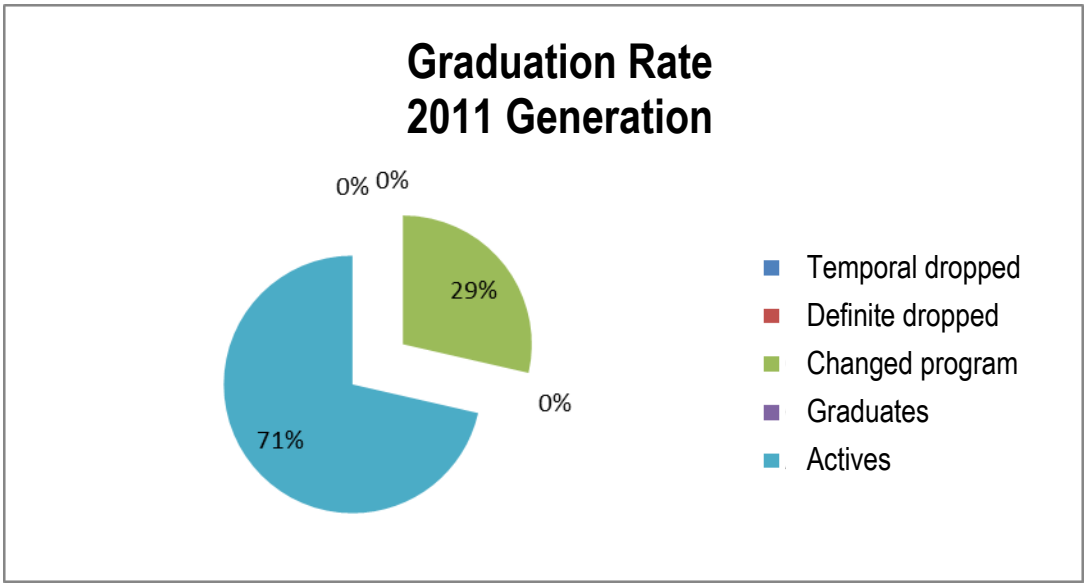
The 2009 generation is the smallest up to date; one of the students is temporal dropped due to economic issues and the rest graduated in summer 2013.



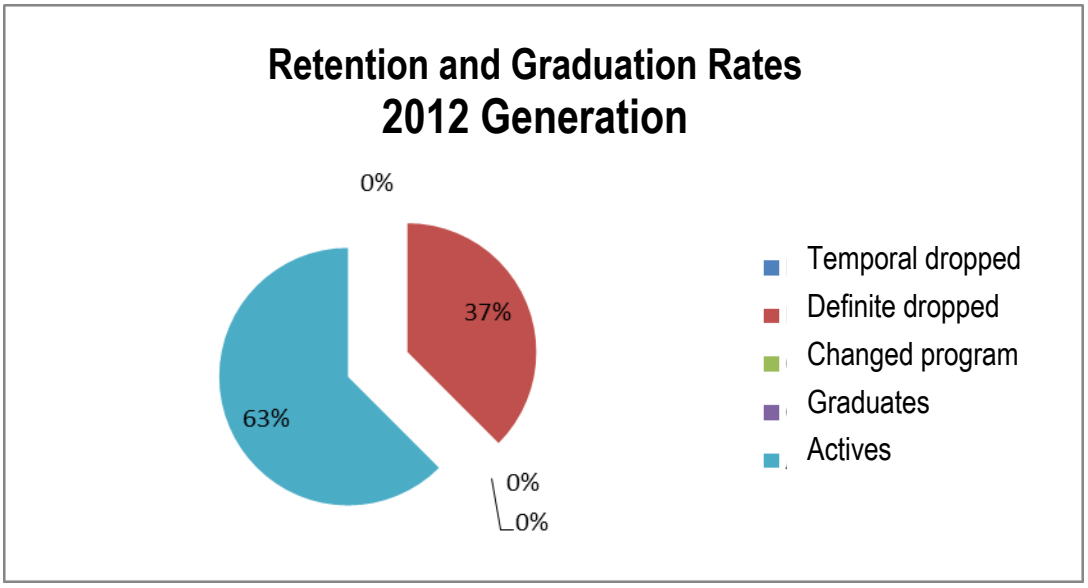
The 2010 generation is the most consistent in their program; only one student decided to change to the IDGD program.



The 2011 generation presented various program changed, within the CETYS, to other campus.



The 2012 generation has the most number of definite dropped; due to a great vocational confusion, only one had economic issues.



4.4 Learning Assessment Process.

The rest of this section will focus on the assessment plan and program developed to assess program level learning outcomes.

Assessment at the program level is something new, due to the fact that the focus has been on developing an infrastructure of knowledge and resources, as well as culture, to support assessment at the institutional level. The result of these efforts, as well as the information that has been generated is just now being used to obtain indicators for program review.

At the program level, the College of Engineering decided to designate an Assessment Officer to design a pilot assessment plan and program for the August-December 2010 semester for all Engineering Programs offered by the College. The responsible for this process was M.S. Jorge Sosa López, with the collaboration of the Deans of the Schools of Engineering and Chairs of each Academy.

This pilot project is divided in two stages; the first was deployed during the second semester of 2010 focuses on program level learning outcomes common to all engineering programs. The second stage focuses on program level outcomes specific to the academic program, in this case the Bachelor in Software Engineering, as well as external assessment data relating to the EGEL exit test administered by CENEVAL.

This assessment plan has the goal to not only define a structure and methodology for assessment at the program level for the College of Engineering, that can be integrated as seamlessly as possible to the academic dynamic of the courses offered by the College of Engineering, but also with a strong faculty participation in the design of the assessment plan and process, providing a case study that not only integrates what has been achieved by the institutional process, but builds upon it. The complete documentation regarding the Assessment Plan for the College of Engineering may be found in the corresponding document, separate from this program review document

To assess the program level specific outcomes the following stages were defined:

1. Definition of rubrics.
   Faculty defines a proposal of the type and format for the rubrics to be applied during the semester. These proposals are analyzed by the Academy as a group and validated for use.

2. Definition of period for assessment.
   At the beginning of each semester, the Academy will define which rubrics will be applied during the semester.

3. Identification of courses where assessment will be applied.
   Based upon the curricular mapping for the academic program, courses are selected for assessment.

4. Notification to faculty involved in assessment activities.
   Faculty is notified and trained in the use of the rubric if necessary.

5. Definition of learning activities and evidence.
   Faculty selects learning activities and evidence for assessment, according to the selected course and curricular mapping.

6. Students upload their work to the electronic portfolio during the semester.
   Students do the assigned learning activity and upload their work to the electronic portfolio.

7. Faculty evaluates and provides feedback to students.
   Faculty evaluates student work using the previously designed rubrics and provides feedback to the students, as well as a general summary of assessment results.

8. Faculty generates a summary of assessment results.
   Each faculty member generates a summary of assessment results for student learning based upon the selected course and rubric.

9. The Academy analyzes the summary of assessment results.
   The Academy analyzes assessment results as a group, identifying areas of opportunity and improvement. If expected learning is not achieved, then an action plan is defined. The analysis of assessment results seeks to answer the question: what does this data mean with regards to student learning?

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The College of Engineering began implementing the program review process in 2010 with all its academic programs. However, the Software Engineering program was selected in the revision process of the Academy of Computer Science and Software Engineering to apply as a learning-pilot of the ICC program in 2011-1 and 2012-1. The SLO_ENG1 was applied in the second half of 2012, being common for all engineering programs.

For the first semester of 2013 (January-June 2013):

1) Selection of the Learning Outcomes: The Academy decided that, for this cycle, learning assessment SLO_ISW1 will be applied.

2) Selection of the courses for evaluation: Five subjects from the Software Engineering program were selected based on the curricula for the semester from January to June 2013 for evaluation.

CODE	SUBJECT	SEMESTER	PROFESSOR
CC402	Programming Methods II	2	Lucía Beltrán
CC082	Software Engineering I	4	Laura Ornelas
CC085	Software Engineering II	6	Laura Ornelas
CC090	Software Project Management	6	Lucía Beltrán
CC088	Distributed Computing Technology	8	Majahide Payán

3) Training of professors: a group of professors who teach the subjects were trained to participate in the evaluation during the cycle.

4) The assessment during the semester: The assessment cycle was deployed during the semester from January to June 2013 and the results, including evidence of learning, were uploaded to the Electronic Portfolio. The coordinator has the summary of the results of student learning.

5) Analysis of the results: The results were analyzed by each academy during the second half of 2013 and have been integrated into the documentation of the program review.

4.5 Learning Assessment Outcomes

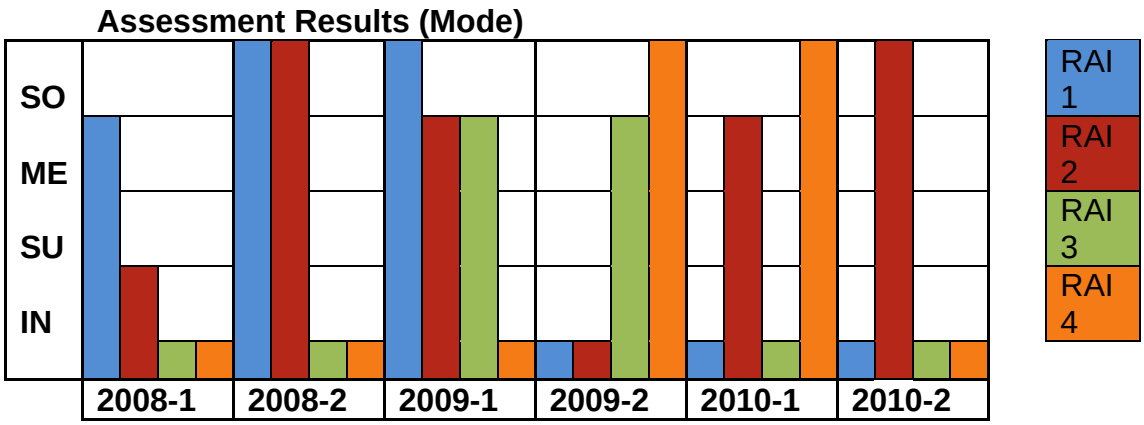
Much work has been done at the institutional level with regards to Assessment. An assessment plan and program began in 2008 with a focus on the gradual and systematic assessment of all institutional level learning outcomes for all academic programs. This has been a work in progress, in which areas of improvement have been identified and addressed, such as faculty participation and the integration and use of the electronic portfolio.

The institutional assessment process now gathers and stores information via the electronic portfolio, which is a custom design, developed by the Information Technologies Department of CETYS University.

The results of the assessment of institutional learning outcomes are delivered to the Deans of the Schools of Engineering at the end of each assessment cycle, which are by semester. The academies use this information as general input for the program review process.

INSTITUTIONAL ASSESSMENT RESULTS.

The results presented to the Academy by the CDMA (Center for Academic Development and Improvement) in the "Institutional Assessment Report Summary" are as follows:



Where: IN = Insufficient
SU = Sufficient
ME = Improvable
SO = Outstanding

RAI1 = Clear and effective communication in Spanish
RAI2 = Continuous learning
RAI3 = Critical thinking
RAI4 = Cultural diversity.

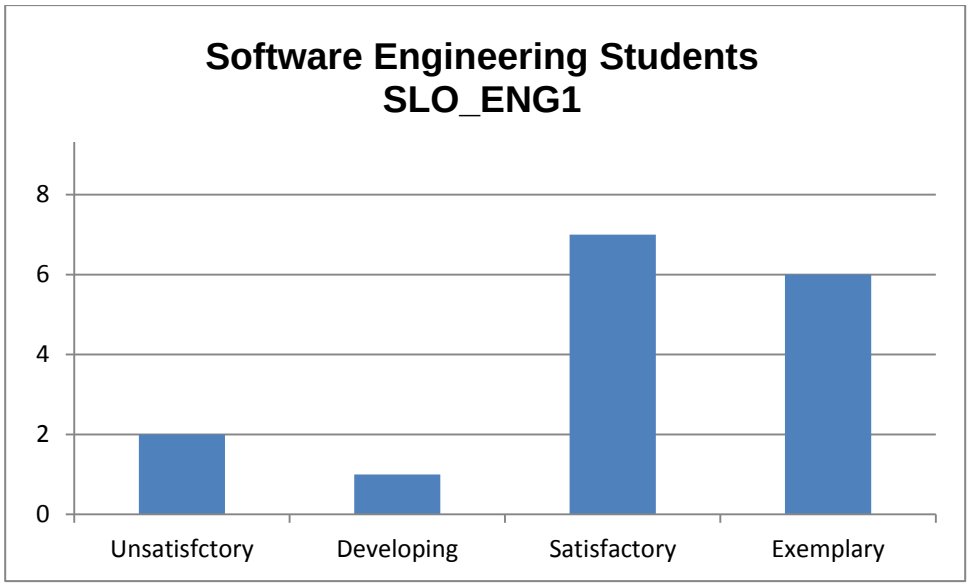
In general terms, the assessment results show a variation in learning achievement levels in each of the four institutional learning outcomes, without achieving outstanding or improvable levels consistently. This may be due to various factors that should be analyzed in conjunction with the Centers for Student Development (CEDEs) of each Campus.

Work has been done to support student development through the CEDEs of each Campus, due to the diverse academic achievement profiles of our students. This is done via workshops and student monitoring in conjunction with the academic coordinators. However, the academy identifies the importance of the course offering and content for fundamental areas relating to the four institutional learning outcomes.

Also, the Academy identifies a need to disaggregate data for each academic program to provide program specific information regarding institutional assessment for program review purposes.

PROGRAM ASSESSMENT RESULTS.

With regards to SLO_ENG1 (Solve problems relating to the improvement of diverse systems, correctly applying the knowledge and tools provided by the basic sciences and/or software technologies) in general, for the second semester of 2012 (August-December) 81% of software engineering students obtained learning achievement levels of 2 or 3 (Satisfactory, Exemplary):



The rubric applied for SLO_ENG1 was as follow:

Rubric to Assess SLO_ENG1: Solve problems relating to the improvement of diverse systems, correctly applying the knowledge and tools provided by the basic sciences and/or software technologies.				
TEAM MEMBERS:			**DATE:**	
	Unsatisfactory	**Developing**	**Satisfactory**	**Exemplary**
Problem Definition/Problem Statement	Problem not defined or stated. No objectives defined.	Problem is vaguely defined or unclear, with lack of justification. Hypothesis or scope of project or problem statement is vague or unclear.	Problem is clearly identified and stated. Elements for justification and scope of project are defined. Hypothesis or problem statement and scope of project are clearly defined.	Problem identification and definition are very clear. Justification is well developed; project objectives are very precise and measurable. Hypothesis or problem statement and scope are very precise and measurable.
Points	**0**	**8**	**15**	**20**
Application of basic science's tools	No theoretical framework presented. Did not collect meaningful data. Process description is not developed. Tools and methods were completely misapplied or absent.	Theoretical framework unclear, vaguely presented. Collected some meaningful data. Little detail on process description. Some tools and methods were applied but with significant errors or omissions.	Theoretical framework developed and clear. Collected most of the data needed. Process description is detailed. Most tools and methods were correctly applied but more could have been done.	Theoretical framework well developed and relevant. Collected all the appropriate data. Process description is detailed and used for improvement. Tools and methods were fully and correctly applied.
Points	**0**	**8**	**15**	**20**

Analysis and Interpretation of results	Little or no attempt to interpret results. No insight. Entirely missed the point of the analysis.	Interpreted some results correctly. Significant errors, omissions. Little insight. Very basic interpretation. Very vague analysis.	Analysis presented is clear, but not enough based on the tools and methods used. Interpreted most results correctly. Adequate insight. Missed some important points.	Outstanding analysis presented based on the tools and methods used. Results completely correct and appropriately interpreted. Excellent insight.
Points	**0**	**10**	**20**	**30**
Conclusions and recommendations.	No verification of conclusions was performed. No recommendations proposed.	Limited verification of conclusions. Very vague recommendations proposed.	Adequate verifications of conclusions, helping on improving the system.	Detailed verification of conclusions with several tools. High confidence and support of recommendations proposed for improving the system.
Points	**0**	**5**	**10**	**15**
Supporting documentation	No references presented. Tables, graphs and/or photos are not presented.	Only 1 reference presented is related to the project. Some of the tables, graphs and/or photos are not related to the project's objectives.	2 or 3 references presented are related to the project. Some of the tables, graphs and/or photos are related to the project's objectives.	More than 3 references presented are strongly related to the project. Several tables, graphs and/or photos strongly related to the project's objectives are presented.
Points	**0**	**5**	**10**	**15**
Assessment Result for SLO ENG1: UN, DE, SA, EX:				**Total Points:**

The two students who were assessed with "Unsatisfactory" are been followed up: they are being given special tutoring, taking courses un-enrolled and restricted from enrolling into higher courses.

For the January-June cycle of 2013, the learning measuring process focused on assessing Learning Outcome Program designed as SLO_ISW1 and was measured in four courses as shown in the following table:

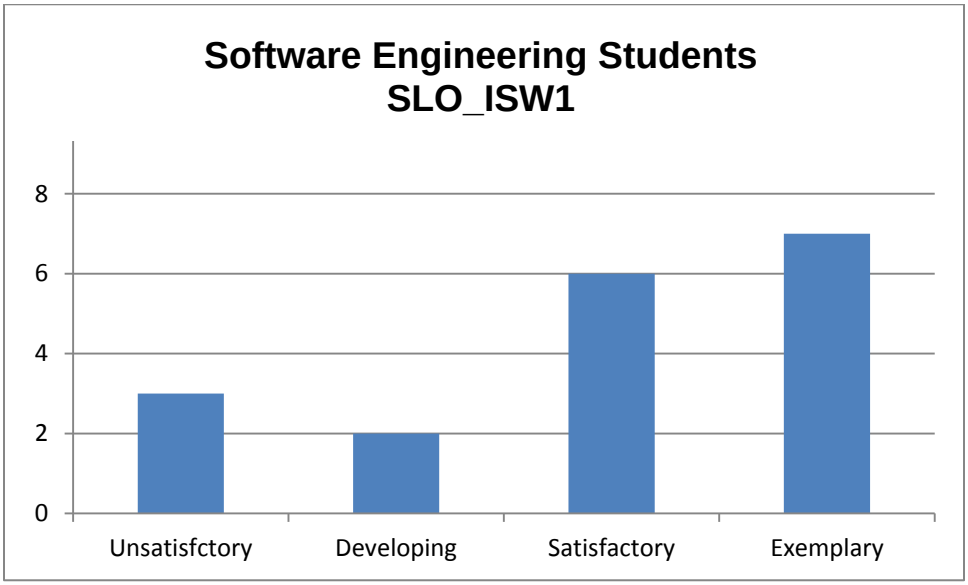
Course	Course Name	Semester
CC402	Programming Methods II	2
CC082	Software Engineering I	4
CC085	Software Engineering III	6
CC412	Distributed Computing Technology	8

The rubric applied for SLO_ISW1 was as follow:

SLO_ISW1 – HOLISTIC RUBRIC – SOFTWARE DEVELOPMENT	
SLO_ISW1: The student of the Bachelor's in Software Engineering program of CETYS University will create software product based on quality models and applying software engineering in solving diverse problems.	
Level	**Criteria for student learning**
0 **INSUFFICIENT (achieved if most criteria apply)**	The student: ❒ Cannot identify the problem, opportunities and/or objectives. ❒ Cannot determine information requirements. ❒ Cannot analyze system requirements. ❒ Cannot generate system models. ❒ Cannot consider any quality metric. ❒ Cannot develop or document the system. ❒ Cannot apply testing or maintenance techniques on the system. ❒ Cannot implement or evaluate the system.
1 **INTRODUCTORY (achieved if most criteria apply)**	The student: ❒ Only partially identifies the problem, opportunities and/or objectives. ❒ Determines some of the information requirements. ❒ Analyzes some of the system requirements. ❒ Can only partially design the system. ❒ Design some software quality metrics without strictly applying them. ❒ Develops the system using software and technologies and tools, however does not know how to use them efficiently. ❒ Only documents the system partially. ❒ Applies testing techniques; however these are not necessarily the most adequate or appropriate. ❒ Only implement the system partially.
2 **IN DEVELOPMENT (achieved if most criteria apply)**	The student: ❒ Correctly identifies the problem, opportunities and/or objectives. ❒ Determines the primary information requirements. ❒ Analyzes the system requirements, not necessarily using a specified tool. ❒ Designs the system, not necessarily in the most adequate manner, or using a well-defined technique. ❒ Applies some software quality metrics; not necessarily from a defined model. ❒ Develops the system using software tools and technologies, however does not know how to use them in the most efficient manner ❒ Documents the system in an empirical manner and not using a defined technique. ❒ Applies testing and maintenance techniques to the system. ❒ Implements the system, however, not in the most adequate or efficient manner.
3 **DEVELOPED (achieved if most criteria apply)**	The student: ❒ Correctly identifies the problem, opportunities and/or objectives. ❒ Appropriately determines all system information requirements. ❒ Completely analyzes the system requirements. ❒ Correctly applies design techniques to the system. ❒ Applies software quality metrics and model. ❒ Develops the system using current technology and documents the system in a consistent and defined manner. ❒ Applies system testing and maintenance techniques in a correct and efficient manner. ❒ Implements and evaluates the system in an objective and correct manner.

The trend of the results obtained in each subject for all students who were tested, are shown in the following table and graph:

Course	Assessment Results (MODE)
Programming Methods II	Level 2 = In Development (It is equivalent to Improvable (ME) scale based on Institutional measurement)
Software Engineering I	Level 3 = Developed (It is equivalent to Outstanding (SO) scale based on Institutional measurement)
Software Engineering III	Level 3 = Developed (It is equivalent to Outstanding (SO) scale based on Institutional measurement)
Distributed Computing Technology	Level 3 = Developed (It is equivalent to Outstanding (SO) scale based on Institutional measurement)



4.6 Improvement actions derived from the learning assessment

As a result of the analysis of the global summary of assessment results, the academy came to the following conclusions and areas of opportunity:

- The results are acceptable and are consistent with student learning expectations according to the current curricular mapping done for the academic program.
- We found the need to standardize the measurement process of learning outcomes of the program.
- Based on the need found, the Academy developed a learning measurement plan that will begin in August 2013.

- The plan provides that each program learning outcome should be measured considering subjects that develop that result in different levels: *In process* (DE-en DESARROLLO), satisfactory (SA-SATISFACTORIO) and exemplary (EX-EJEMPLAR).
- To comply with the above, the academy agreed that each learning outcome should be measured in at least one course for each level.
- The program measurement plan will be carried out in parallel with institutional and engineering measurement plans, in order to obtain short-term feedback and establish improvement actions.

4.7 Student performance in CENEVAL's EGEL

It is necessary to identify additional objective metrics to include in the design and deployment of assessment plans and programs. Currently, last-year students present an undergraduate exit test (EGEL) administered by CENEVAL (an organization in México that offers various examination services), and designed by academics from different universities all over Mexico.

The Academy analyzed the results of the EGEL test for Software Engineering, as an external source for assessment information, and the results are presented as a summary in this document.

CENEVAL (National Center for Evaluation of Higher Education) in México has developed a series of instruments to evaluate basic knowledge for professionals that have concluded their academic programs. The instrument is called EGEL (Undergraduate Exit Test) and has specific versions designed for various academic programs, using a scale that measures professional requirements established by industry and government, for new professionals.

In CETYS, graduating undergraduate students take the EGEL test in their last semester of studies, and the results obtained are an external indicator that provides important information for program review, and specifically learning outcomes and educational objectives analysis, as well as modifications to the curriculum.

The first generation of the Software Engineering Program graduated in summer of 2011. The EGEL exam accessed four main areas in Software Engineering:

1. System Analysis
2. Development and Implementation of Computer Applications
3. Project Management in Information Technologies
4. Infrastructure Technology Implementation

The global CENEVAL index was evaluated using three levels of achievement: ANS (Unsatisfactory Achievement), DS (Satisfactory Achievement) and DSS (Outstanding Achievement).

The academy came to the following observations:

- The first generation of one student: he obtained DSS (Outstanding Achievement).
- The second generation obtained DSS. One of the students obtained the CENEVAL Award's *Excellence Achievement* for obtaining Outstanding Achievement in all the areas accessed.
- The third generation obtained DSS.
- The fourth generation obtained DS.
- The average of all students is: DSS.

Year	# Students	Average	Levels of Achievement			Area 1	Area 2	Area 3	Area 4
			ANS Unsatisfactory	DS Satisfactory	DSS Outstanding				
2010	1	1114	0	0	1	1200	1063	1084	1107
2012	3	1180	0	0	3	1150	1199	1197	1172
2013	3	1127	0	2	1	1121	1138	1155	1093
Average	7	1140	0	1	2	1157	1133	1145	1124

The academy observed the areas of opportunity: Area 2: Development and Implementation of Computer Applications and Area 4: Infrastructure Technology Implementation.

4.8 Program accreditations and recommendations

The Software Engineering program was not eligible for accreditation from the Accreditation Board of Engineering Teaching CACEI (*in Spanish: "Consejo de Acreditacion de la Enseñanza de la Ingenieria"*) and the academy is recommending to initiate the process for this accreditation.

4.9 Follow up on the accrediting bodies' recommendations

4.10 Faculty productivity

Faculty of the College of Engineering, in addition to their work as professors, carry out various scientific researches related to research lines in: manufacturing, aerospace design, renewable energy, software development. These research areas have been defined as part of the needs identified in the 20-20 plan of CETYS University System. The results of these research projects are published in articles by professors in conferences, articles in journals and books.

Another important activity of the faculty is industry-related projects which most times are funded through the stimulus for innovation awarded by organizations such as CONACYT. These projects arise from innovation needs of the Industry to improve their products and / or manufacturing processes, these Companies go to CETYS asking for support in the specialty areas of the University.

The services required to the Institution are basically giving technical consultancy to develop engineering projects such as making an innovation. The results of these investments are documented as technical reports, which describe that participation involved with the company, main activities and results obtained.

It is important for CETYS that professors are continually conducting research, publishing and participating in projects linked to the industry. For this reason, CETYS supports and recognizes professors for their productivity. The support provided to professors, who conduct research and publish, consists in giving a balance in the quantity of subjects assigned, one less subject than normal (four instead of three subjects); so professors have the time to publish and conduct research.

Each year CETYS University launches a call with different categories to invite professors to participate in the award given to those with more publications, research and partnership activities with the industry.

The faculty productivity is considered in the following aspects:

-Publications: articles in conferences, articles in journals, books

-Participation in projects in partnership with the Industry

-Certifications and trainings

-Patents

- SNI Level (National System of Researchers).

4.11 Faculty evaluation

Nombre	Ago-Dic 2007		Ene-Jun 2008		Ago-Dic 2008		Ene-Junio 2009		Ene-Junio 2010		Ago-Dic 2010		Ene-Jun 2011		Ago-Dic 2011		Ago-Dic 2012	
AGUIRRE LOERA,LUIS ,LIC.	95.41	57.25	87.12	52.27	88.03	52.82	89.04	53.42	91.88	55.13					94.11	54.46	93.1	55.86
BELTRAN ROCHA,LUCIA	92.82	55.69	82.64	49.59	82.64	49.59	83.63	50.18	81.02	48.61	81.37	48.82	81.37	48.82	82.35	49.41	84.65	50.79
PAYAN HERNANDEZ,MAJAHIDE GERARDO,LIC.															68.62	41.17	79.97	47.98
ORNELAS LUNA,LAURA ,ING.													79.66	47.80	72.56	43.54	84.55	50.73
ENCALADA GONZALEZ,CRUZ PABLO,LIC.																	90.98	54.59
ARMENTA GAXIOLA,IMELDA ,M.C.	94.82	56.89	76.67	46.00	89.80	53.88	89.62	53.77			78.97	47.38			75.69	45.42		
AZUZ ADEATH,ISAAC ANDRES,DR.	93.62	56.18	86.62	51.97	85.62	51.37	90.53	54.32	88.51	53.11			87.38	52.43	90.38	54.23	89.92	53.95
ROMO CARDENAS,GERARDO SALVADOR,PROFR.	89.88	53.93					82.94	49.77	88.24	52.95			79.64	47.78				
SIERRA DIAZ,GERARDO ,ING.	77.78	46.67	76,12	45.67	59.20	35.52	71.80	43.08	77.34	46.40	82.49	49.49	88.30	52.98	88.68	53.21	86.98	52.19
LOMELI SANCHEZ,MA. DEL SOCORRO,ING.	93.02	55.81	86.18	51.71	83.27	49.96	85.67	51.40	85.04	51.02	84.73	50.84	88.32	52.99	84.84	50.91	85.12	51.07
PARRA INUKAI,ARIEL ,ING.			84.20	50.52	74.53	44.72	79.63	47.78	78.03	46.82								
CASTANEDA SEGURA,RODOLFO ,ING.					53.95	32.37	84.53	50.72			71.45	42.87	83.20	49.92	82.64	49.59	85.77	51.46
CHAVEZ GARCIA,DALIA HOLANDA,LIC.									84.64	50.78	81.90	49.14	84.15	50.48	81.66	49.00		
NIEBLAS NUÑEZ,NADIA ,LIC.									80.11	48.07	69.23	41.54	82.20	49.32	80.12	48.07		
GONZALEZ AMADOR,KARLA ,LIC.					70.96	42.57												
CAMACHO FUENTES,FIDEL ,LIC.															75.08	45.05		
MARMOLEJO VARELA,MARTIN GERARDO,ING.															73.12	43.87	80.39	48.23
ROSAS HERNANDEZ,LUISA CAROLINA,ING.									89.72	53.83	79.83	47.90	80.60	48.36	84.26	50.56	71.51	42.91
VALENZUELA BADILLO,AMANDA																	72.78	43.67
CONTRERAS ALDANA,CARLOS ,ING.							80.06	48.03	83.43	50.06			74.05	44.43			83.44	50.06
CARRILLO DEL MORAL,GALO HERMAN,ING.																	82.18	49.31
QUINTERO VALDEZ,MARIO ARTURO,LIC.																	82	49.2
LOPEZ LEYVA,JOSUE AARON,LIC.																	89.14	53.48
PROMEDIO	**91.05**		**71.92**		**76.44**		**83.75**		**84.36**		**78.75**		**82.62**		**81.01**		**83.91**	

The Academy analyzed faculty from the perspective of commitment, evaluation and development, and concluded that the faculty group has a strong commitment with the institution and the program, with high student evaluations (above institutional standards), and also has low rotation. However, an area of opportunity is identified in strengthening the faculty group via faculty development towards the obtainment of doctoral degrees from Universities other that CETYS for full-time and part-time faculty members, as well as a mix of bringing new faculty from other institutions, regional, national and abroad, with a focus on faculty with Doctoral degrees.

5. External revision of the program

5.1 Academic profile of the external reviewers

The Academy held meetings with experts in various fields of knowledge relating to the Software Engineering program to obtain feedback about it. The following experts were consulted:

- Videogame industry/sector.
- Software development industry/sector.
- ANIEI (National Association of Higher Education Institutions in Information Technologies in México).

VIDEOGAME INDUSTRY/SECTOR.

On September 3rd 2009, the Academy met with experts from the videogame industry/sector in Mexicali, Baja California with the following participants:

- Guillermo Cheang León, Dania Licea Verduzco, Josefina Becerra Paredes, Lucía Beltrán, Leopoldo Uribe, Miguel Salinas, Alejandro Zendejas (Academy of Computer Science Engineering).
- Jorge Morales (Inmersion).
- Francisco Casanova (Digital Chocolate).
- Jacobo Ríos (IGDA).
- Angélica Lefaspy (Playsoft).
- Adrián Jimate (Gameloft)

The purpose of this meeting was to present the Software Engineering academic program to receive feedback from the videogame industry/sector experts regarding the content and pertinence of the curriculum, as well as software tools used for software development. The following comments were compiled during the meeting:

- Jacobo Ríos from IGDA (International Game Developers Association) mentioned the existence of student chapters of IGDA to involve students in video gaming from a development standpoint.
- The experts agree that the videogame specialization area of the academic program is designed to prepare professionals that wish to work in the video gaming industry, however much additional preparation is required for these professionals once they graduate.
- XNA is a good starting language; however, training in this language should begin earlier in the academic program to allow training on more complex languages further on.
- There are two main professional profiles for video game designers:
  a. Video game art designers, with knowledge of color theory, textures, animation and modeling. These professionals need training not only in the use of software development tools, but also in modeling and

texturing techniques. Modeling may be done using various materials (clay, wire, etc.).

b. Programmers for video games, with knowledge of C++, Java (mobile), computer theory, operating systems, compilers, networks, graphic programming, intelligent systems. These professionals work with graphic interfaces and graphic processors.

- Programmers may be classified in two types: those who are focused on problem solving (analysis and comprehension), and those who elaborate the project from the beginning (mathematical testing).
- Creativity and innovation should be promoted, where learning is conducted in an entertaining and motivating environment.
- Making video games is no game, it is work in multidisciplinary teams of people.
- Sales management is an important area of opportunity, due to the fact that there are needs for professionals with this profile in the video game sector: lawyers, programmers with managerial skills, product designers, international business, etc.
- Planning for the engagement of students from the high school level, via some sort of “ad-hoc” program that promotes and generates enthusiasm for video gaming from the development standpoint.
- “Animation mentor”, offers on-line courses with evaluators direct from the industry.
- There is software called “Alice”, that allows for the creation of virtual 3D, where characters may be created based on mathematics.

Another meeting was held on September 4th 2009 with the following participants:

- Guillermo Cheang León, Dania Licea Verduzco, Josefina Becerra Paredes, Lucía Beltrán Rocha, Leopoldo Uribe, Miguel Salinas, Alejandro Zendejas (Academy of Computer Science Engineering).
- Jorge Morales (Inmersion).
- Francisco Casanova (Digital Chocolate).
- Jacobo Ríos (IGDA).
- Angélica Lefaspy, Miriam Álvarez, Erick Nembil (Playsoft).
- Adrián Jimate (Gameloft)
- Héctor Psatrana (Catapulta)
- Iván Díaz de León (Digital Entertainment)
- Germán Vázquez, Ricardo Villarreal.

The purpose of this meeting was the same as the previous one. The following comments were compiled during the meeting:

- Catapulta mentions that they are seeking to create support so México has a formal and compatible development structure for the video game industry in the country, a 60 billion dollar industry in 2010 (more than the movie industry).

- Catapulta also presents a technology called “VIRTOOLS”, that is developed using a platform that is for all video game platforms (multi-console, mobile, etc.), created to develop products in a short time. The student need not be an expert programmer to use it and is ideal for casual games. They have currently developed a video game for Lorena Ochoa (Mexican golfer).
- C++ language is an important tool for video game design.

SOFTWARE DEVELOPMENT INDUSTRY/SECTOR.

On October 16th 2010, a meeting was held in Ensenada between the Academy and experts from the Software Industry in Baja California. The participants in this meeting were:

- Gabriel Fuentes, Project Manager for Softtek.
- Fernando Torres, Project Leader for Softtek.
- José López, Operations Manager for Hildebrando.
- Félix Rivera, Project Leader for Hildebrando.
- Krishna Tirunagari for Tata Consulting.
- Antonio Silva, Consulting Services for Strategic Businesses Director for Delloite México.
- Lucía Beltrán Rocha, faculty member of the Academy of Computer Science Engineering for CETYS University
- Socorro Lomelí Sánchez, Linkage Director for CETYS University Ensenada Campus

The purpose of this meeting was to present the Software Engineering academic program to receive feedback from the software development industry/sector experts with regards to the content and the pertinence of the curriculum, as well as software tools used for software development.

During the session, the background and history of the academic program was presented, as well as a study done in 2004 via the IT Baja Cluster software companies and the results obtained from this study.

The mission and vision of the academic program was also presented, and the participants were asked to answer a survey relating to the tendencies in the software industry, to gain information for further analysis.

Also, each company shared their business goals and development plans.

The following comments were compiled during the meeting:

- There is a need in the industry for professionals with Software Engineering profiles.

- Specialization areas are important to complete the profile, such as: business systems, software quality engineering and mobile computing.
- Security, quality and the internet are topics that are gaining more relevance in the industry.
- Students must study topics related to Cloud Computing.
- Students must study topics related to knowledge management (i.e. sharepoint).
- Knowledge in finance is important (budgeting and return of investment of software projects).
- Topics relating to best practices in quality are important, such as quality assurance, quality and testing, covering functional testing, volume, unitary, integral, etc.
- For requirements analysis, the use of BPMN (Business Process Management Notation) services/soa, UML, are recommended.
- Regarding the basic sciences, topics in relational and vector calculus, Boolean logic, set theory, Karnaugh maps, should be covered.

ANIEI (NATIONAL ASSOCIATION OF HIGHER EDUCATION INSTITUTIONS IN INFORMATION TECHNOLOGIES IN MÉXICO).

A request was made to the president of ANIEI María de Lourdes Sánchez Guerrero, to provide a peer review of the Software Engineering academic program of CETYS University, and the following feedback was received:

- The academic program complies with the needs México has for the development of highly qualified professionals that satisfy the needs of the information technologies sector and industry in general.
- The specialization areas allow students to graduate with a specific profile that is related to an industry specific type
- The curriculum is aligned with the ANIEI Curricular Model.

On August 16, Dr. Sean Monemi was received as an external reviewer, to whom the mission, vision and objectives, as well as the capacity and educational efficiency of the program in Software Engineering were presented.

Dr. Monemi has the following experience:

Education:

Ph.D., Vanderbilt University, Electrical Engineering, Nashville, TN, December 1999

M.S., Vanderbilt University, Electrical Engineering, Nashville, TN, August 1985

B.S., Alabama A&M University, Electrical Engineering, Huntsville, AL, May 1980

Program Review and Assessment Experience:

- California State University, Fullerton

  Master in Software Engineering (existing program)

- California State University, Bakersfield

  New Bachelor in Electrical Engineering (new program)

- California State Polytechnic University, Pomona

  ABET preparation and program review for Electrical and Computer Engineering

  WASC preparation and study for all programs

Dr. Monemi makes the following observations

- Students from Ensenada Campus were interviewed through video conference. In general, the students expressed their satisfaction with the program.
- Learning evaluation and reesults are detailed, summarized, in place and appropriate
- Results of the student's CENEVAL test are outstanding.
- The professors receive high evaluation.
- Ensenada Campus has a lot of activities in software engineering and does not have a sufficient number of full-time professors for the students. This can be a weakness of the program and requires immediate attention.
- The Software Engineering Program seems mature and eligible for accreditation. Consider increasing the number of eligible and qualified full-time professors to fully support the program.

5.2 **Recommendations of the external reviewers**

CONCLUSIONS OBTAINED FROM EXTERNAL REVIEWS.

The following elements were identified by the Academy as key points for program review and possible modifications to the curriculum:

- Relating to video game development:
  - Increase study and practice in the use of C++ programming language.
  - Focus on the interdisciplinary nature of the video game developer profile.
  - Focus on creativity and innovation.
  - Provide a broad scope of alternatives with regards to development platforms.
- Introduce Cloud Computing topics into the curriculum.
- Integrate best practices in quality as a part of the software development topics.
- Include topics in Project Management and Software Processes from the ANIEI model.

6. Conclusions and long-term goals (4 years) for the program

After reviewing the Software Engineering Program, an analysis of the current situation of the program and conclusions deriving from it in every aspect reviewed were made. The Academy of Engineering in Computer Sciences and Software establishes the following proposals to improve the program and groups it in three big groups, regarding:

1.Students

2.Professors

3.Curriculum

6.1 Goals and capacity challenges

- Look for professors with higher academic degrees and oriented to the area of teaching.

- Continue supporting Promotion area in academic and vocational events.

- Have a full-time professor to be in charge of the program.

- Offer double diploma with City University as the rest of the Engineering Programs.

- Formalize the development of projects within the line of Information Technology and Multimedia research.

6.2 Goals and effectiveness challenges

- About retention and program completionrates, it is necessary to implement the Tutors System so that new entry students do not put their academic scholarships at risk.

- Feedback by the Student Development Center (CEDE) to the coordination and group of tutors about findings in the students.

- Continue with learning evaluation, as well as with design and application of evaluation rubrics of the learning results of the program.

- Ensure that professors attend their workshops and training sessions, and follow up with the professors that are at the limit of the expected evaluation.

- It is recommended to request accreditation with CACEI as soon as the number of students grows to the minimum expected by the institution.

- A revision mechanism to measure operation and effectiveness of the distinctive elements of the CETYS student (EDEC) must be created.

- The Academy observes two areas of opportunity in the CENEVAL results since 2007:
  - Area 2: Development and Implementation of Information Technology Applications
  - Area 4: Infrastructure of technology implementation.