Lean Program and Course Assessments for Quality Improvement

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Abstract

Process Education™ is founded on two basic beliefs: that no learner should be marginalized, and that educators have a responsibility to create and improve the quality of learning environments. Lean thinking, a systems approach used to improve quality in industrial and organizational settings, is also founded on two basic beliefs of respect for people and the importance of continuous improvement. The similarities between these two philosophies could be leveraged in facilitating the implementation of some of the well developed and tested aspects of lean thinking in Process Education. One of the core principles of Process Education is the importance of assessment of performance: its purpose is to continuously improve the educational process. This paper focuses on the utilization of lean principles to guide the development of educational program and course assessment processes. It discusses the flow process in designing educational objectives and outcomes from the program level down to course learning objectives and outcomes, and the additional processes of establishing performance criteria and targets for assessment. Some illustrative examples are presented to demonstrate concepts at play during the development and implementation of the assessment process.

Introduction

The success of any educational program depends ultimately on the value it adds to the learning of its graduates, the satisfaction of its stakeholders, and the advancement of society. The degrees to which these outcomes are achieved indicate the intrinsic and perceived quality of the program. Quality, in general, depends on the inputs, the development, measures and controls, and the continuous striving for perfection. Quality in education follows the same principles (Madu & Kuei, 1993; Owlia & Aspinwall, 1996); in other words the intrinsic and perceived quality of the program is ultimately determined by the individual entering the process, the educational process itself, the assessment process and feedbacks, and the institution's never-ending drive for perfection.

For an educational program, the *learner outcomes* can be viewed as the desired attributes or abilities that the learner will have attained at the successful completion of the program, while the *educational objectives* are the desired attributes in terms of knowledge, skills, and attitudes to be realized three to five years after graduation. Therefore, the program itself is the process through which these attributes are cultivated in the matriculating student. Each course in the program is a sub-process with its learning outcomes and objectives incrementally contributing to the final learner outcomes and educational objectives of the program. While the development is continuous in each of the sub-processes, the validation for the course and the program is distributed across the course's duration or increments. Of equal importance are the additional processes of course and program assessments to monitor the development and validation processes (Terenzini, 1989).

Since the publication of *The Machine That Changed the World* (Womack, Jones, & Roos, 1993), lean thinking has provided a systematic approach to enterprise improvement. This systems-based thinking focuses on processes that create value, and, due to the proven success of this model, has been applied to other areas such as software development and health care services (Hibbs, Jewett & Sullivan, 2009; Chalice, 2007). The following discussion will describe assessment as a process for quality improvement derived from lean thinking principles.

Assessment as a Process

Process Education principles are founded on two basic beliefs. First, no one should be marginalized: all learners have the capacity to improve the quality of their learning. Every learner can learn to learn better, regardless of his or her current level of achievement; one's potential is not limited by current ability. Second, educators have a responsibility to "raise the bar" in their profession: learning is enhanced and achieved for all learners when educators help build learning skills, create and improve quality learning environments, design solid coherent curricula, and serve as effective facilitators of learning (Burke, Lawrence, El-Sayed, & Apple, 2009; Beyerlein, Holmes, & Apple, 2007). Since all learners have the capacity to improve the quality of their learning and educators have a responsibility to "raise the bar," assessment is regarded as a process that facilitates the educational process; assessment of performance is a core

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principle in Process Education. In Process Education thinking, evaluation is a snapshot in time for validation, and is considered a product of a continuous assessment process at the specific time when it is conducted.

There is a clear similarity between the principles, foundations, and aims of both lean thinking and Process Education in terms of the use of assessment as a process and its role in continuous improvement.

Lean Principles

Lean thinking has been utilized in industrial and organizational settings to stimulate growth and maximize performance (Cohen & Apte, 1997). These principles are founded on respect for people and continuous improvement. There are five basic principles of lean thinking. Understanding of these five principles is fundamental to any lean implementation. These principles are:

- Value
- Pull
- Value Stream
- Flow
- Perfection

Figure 1 shows the five lean principles and their relationships starting from defining value to striving for perfection.

VALUE — The first principle in lean thinking is to understand what value is, as seen from the customer's perspective, and to ask, What adds to that value? Second, one asks, what activities and resources are necessary to create the desired value during the development process? Any features in the product or in the steps or resources used in the process that do not add value are considered waste (Cohen & Apte, 1997). Applying this principle to assessment as a process, the following can be considered assessment process wastes:
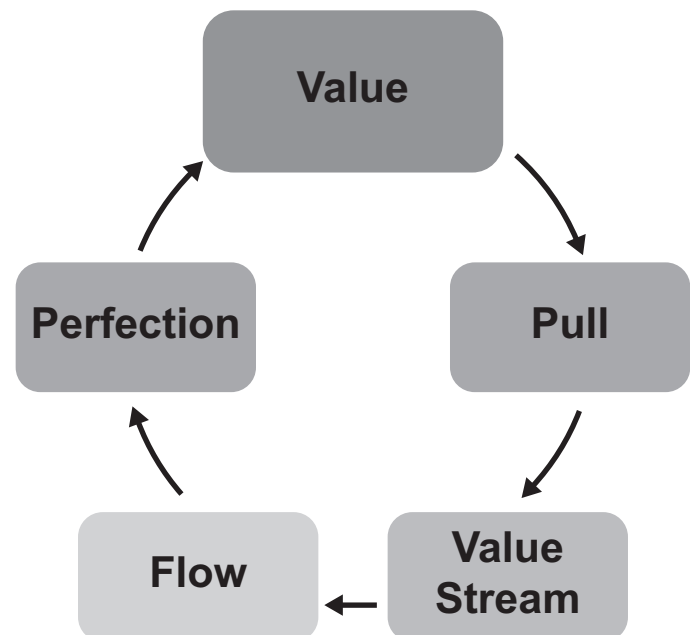
- Over-assessment
- Lengthy assessment processes and steps
- Collecting too much assessment data
- Ill-defined performance criteria and targets
- Unclosed assessment processes; absence of corrective or improvement action based on assessment results
- Misinterpreted assessment results
- Misalignment

PULL — According to this second principle, nothing should be done unless it is needed or demanded by a downstream process. If this principle is applied to the process of assessment, we would say that the main value of assessment is its potential to improve the course or educational program: the periodic and timely pull of course and program assessment is the key for achieving the desired improvement. When assessment is pulled only for accreditation purposes, timely corrective actions will be missed. In addition, corrective action, if any, will be externally imposed based on a generalized set of standards arrived at with limited knowledge of the particular program in question.

VALUE STREAM — This term describes the steps and activities needed for creating value through the process. Since the main objective of any assessment process is adding value to the course or program all the steps and activities should be focused on growth and movement towards continuous improvement. In Process Education thinking, there is no limit to growth and continuous improvement. One of the most effective assessment tools used by Process Educators is the Strength, Improvement, and Insights (SII) method for assessment reporting (Beyerlein & Apple 2007).

FLOW — By adding nothing but value, the process should flow as rapidly as possible. The assessment process should flow naturally with the education process itself. The value of the education process is the learning, so the assessment process should be focused on assessing the learning, and all of the resources, steps, and activities that add to learning.

Figure 1 Schematic of Lean Principles

By optimizing the assessment steps and eliminating all of the assessment process wastes discussed previously, the assessment process could naturally integrate with the educational process and flow organically with it.

PERFECTION — The point of this principle is to continuously strive for perfection to satisfy the customer. It should be the main attitude, guide, and motivation for any assessment process in order to realize its full value. Instead of being forced through accreditation pressures, assessment should be a way of being throughout the entire educational institution. In Process Education thinking, striving for perfection through assessment is built into all processes, from classroom activities to course and program design.

Lean Assessment Process

To achieve a lean assessment process the five principles of lean thinking, discussed earlier, should be the foundation of every phase of the entire process. As discussed previously, the assessment process could be naturally integrated with the educational process and flow organically with it. Lean principles should be implemented in the educational program as well. While the main value of assessment is quality improvement, it is important to differentiate between the value of the educational program and the value of the assessment.

1. Defining Value in Education

In lean thinking, defining value starts with the voice of the customer. Defining the customer is somewhat complicated in the educational context since the receiver is not the only customer or client, as it may seem. At the receiving end, the educational process is a service to students. The impact, however, doesn't stop there. Students' future employers, their professions, and ultimately the society at large are all impacted as shown in Figure 2 (El-Sayed, Zgorzelski, Berry, & Zang, 2005).

In Figure 2, the outer provider circle represents the institution as a whole while the middle circle represents the academic departments providing the educational services. The inner and core circle represents the faculty who are designing, delivering, and assessing the educational services provided to the students. While the provider circles can be viewed as concentric with the faculty at the center, the receiver circles are tangential at the point of contact or exchange between faculty and students. The educational service provided to students by the faculty, during their exchange, can be viewed as being simultaneously delivered to potential and current employers as well as to the society at large.

Figure 2 Schematic of the Educational and Receiving Domains (El-Sayed et al., 2005)
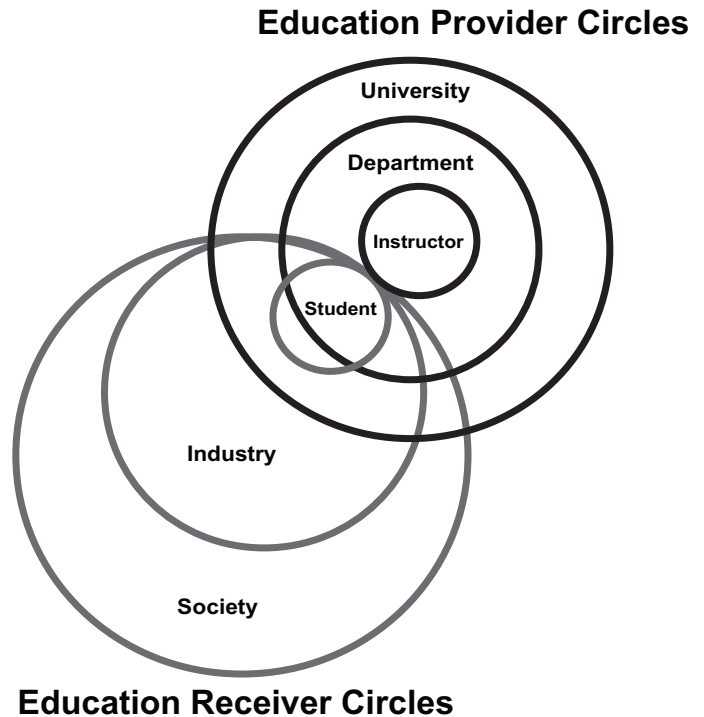
The provider and receiver circles in Figure 2 represent the stakeholders who collectively provide the voice of the customer. The educational program's mission, vision, and educational objectives should be obtained from the voice of the stakeholders through direct or indirect assessment methods such as interviews, surveys, or focus groups, etc.

Example 1:

In a professional degree program the following two program objectives were selected from a set of five objectives developed by the department faculty and advisory board:

PEO 1: Graduates will make professional decisions with an understanding of their global, economic, environmental, political, and societal implications.

PEO 2: Graduates will be committed to professional and ethical practices, continuous improvement, and life-long learning.

Figure 3 shows a sample of results for the perceived importance of these two program educational objectives from a survey of stakeholders, namely graduating seniors and alumni.

From the stakeholders' perspective, the *program educational objectives* are usually defined as desired attributes of graduates three to five years
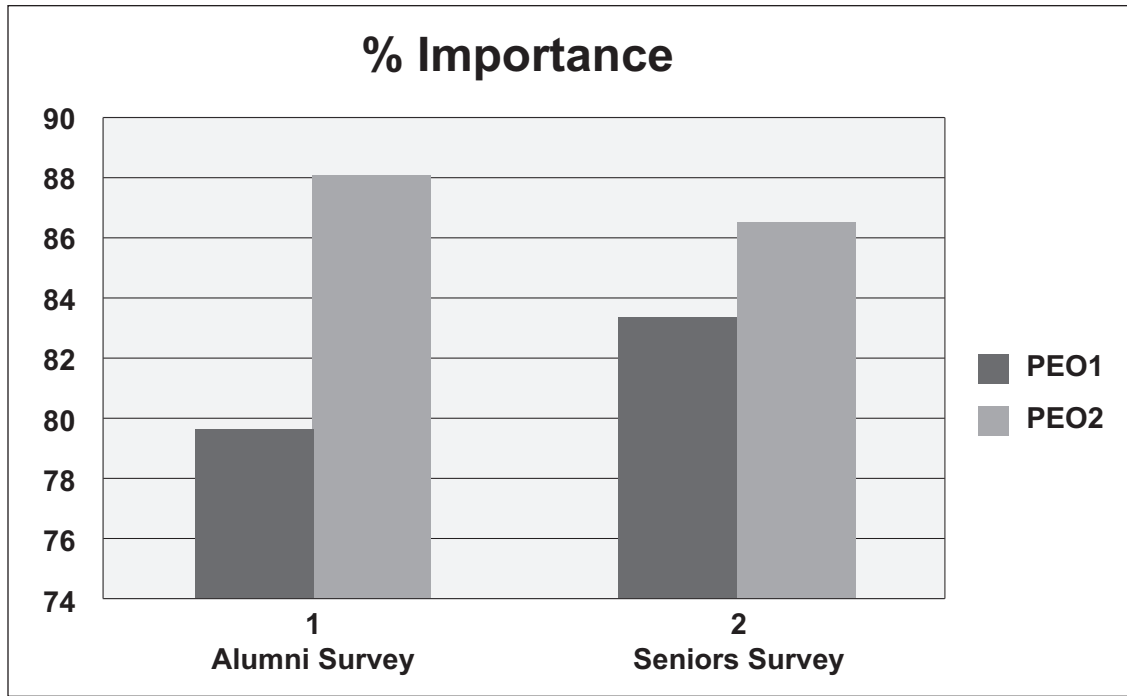
% Importance

Figure 3 Sample of Program Educational Objectives Survey

after graduation. Any accreditation and discipline outcomes (program outcomes) should be integrated into the program educational objectives.

The program educational objectives, which form the desired attributes of the graduate, should be the main drivers of the program educational and assessment processes. Any program or course assessment activity that does not address these desired attributes should be considered waste.

2. Program-Level Value Streaming

To achieve the required value stream the selected objectives meeting the stakeholders' desired attributes should be defined and further specified by identifying the set of program outcomes (POs) for each attribute. For this step, the mapping between the program educational objectives and program outcomes can be used as a guide. In addition, the mapping between the program educational objectives (PEOs) and program outcomes (POs) should be used to assure that all accreditation and other discipline-specific POs are covered by the PEOs. The following example can provide some guidance for the execution of this most important phase:

Example 2:

Table 1 shows a sample of the mapping of four program outcomes into the two program educational objectives discussed in Example 1.

PO 1: An understanding of professional and ethical responsibility

PO 2: The broad education necessary to understand the impact of their solutions in a global and societal context

PO 3: A recognition of the need for, and an ability to engage in, life-long learning

PO 4: A knowledge of contemporary issues

3. Program-Level Objectives and Outcomes Flow

The program outcomes are further specified by identifying a set of program performance criteria (PPC) necessary to achieve each outcome (Rogers, 2009). Figure 4 shows how for every program performance criterion a program performance target (PPT) is established.

PO / PEO	PEO 1	PEO 2
PO 1		X
PO 2	X	
PO 3		X
PO 4	X	

Table 1
Sample of Mapping Program Outcomes
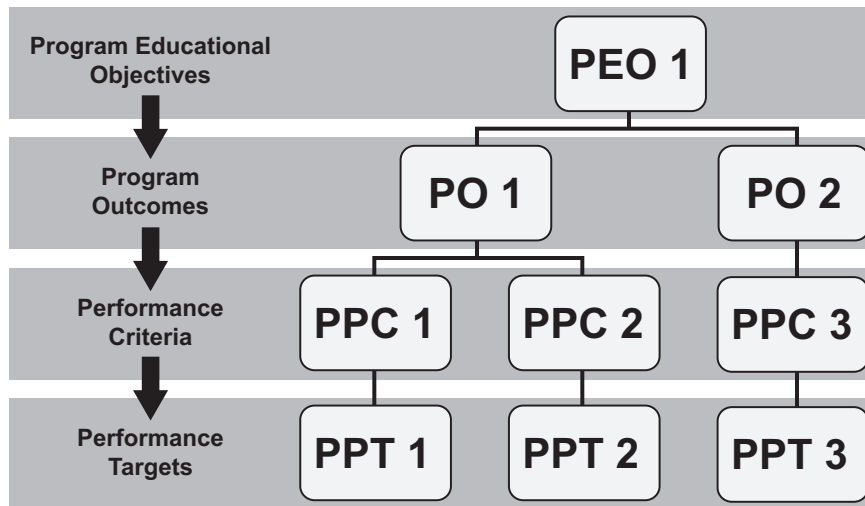into Program Educational Objectives
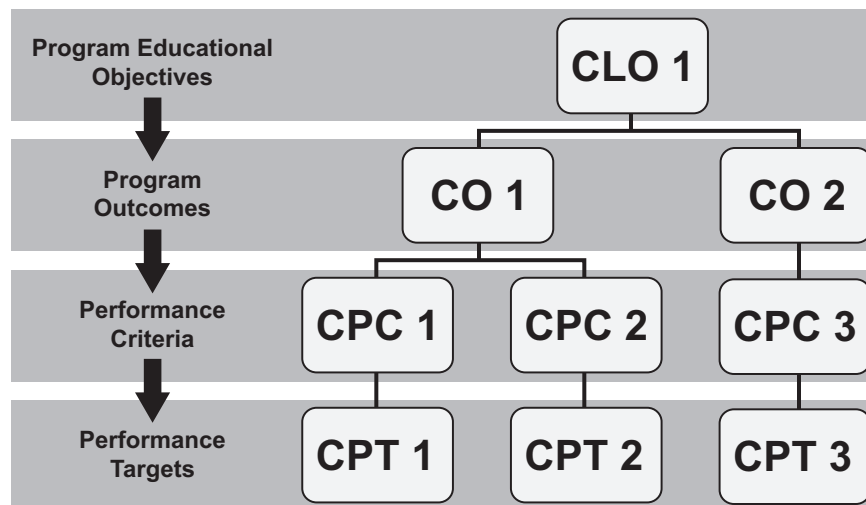
Figure 4 Program-Level Specifications

Figure 5 Course-Level Specifications

4. Course-Level Specification and Flow

The program educational objectives and outcomes are then used to set the appropriate course learning objectives (CLOs), course outcomes (COs), course performance criteria (CPCs), and course performance targets (CPTs) as shown in Figure 5. This flow process starts from the last courses at the senior level to the entry level courses at the freshmen level. The course learning objectives, outcomes, and performance criteria for all of the courses should be aligned with the program educational objectives, outcomes, and performance criteria respectively. The course performance target levels, attained in a sequence, should lead to meeting the program performance target upon graduation.

Besides flowing from the program-level objectives and outcomes of Figure 4, the course-level objectives and outcomes are also specified using discipline-spe-

cific content as well as content needed to meet performance targets during previous assessment cycles.

Example 3:

The first two program outcomes of Example 2 were used as outcomes for the capstone course, the last course in the program (El-Sayed, 2008):

CO 1: An understanding of professional and ethical responsibility

CO 2: The broad education necessary to understand the impact of their solutions in a global and societal context

The performance criteria selected for these two outcomes are:

CPC 1: Applying the code of ethics during the projects
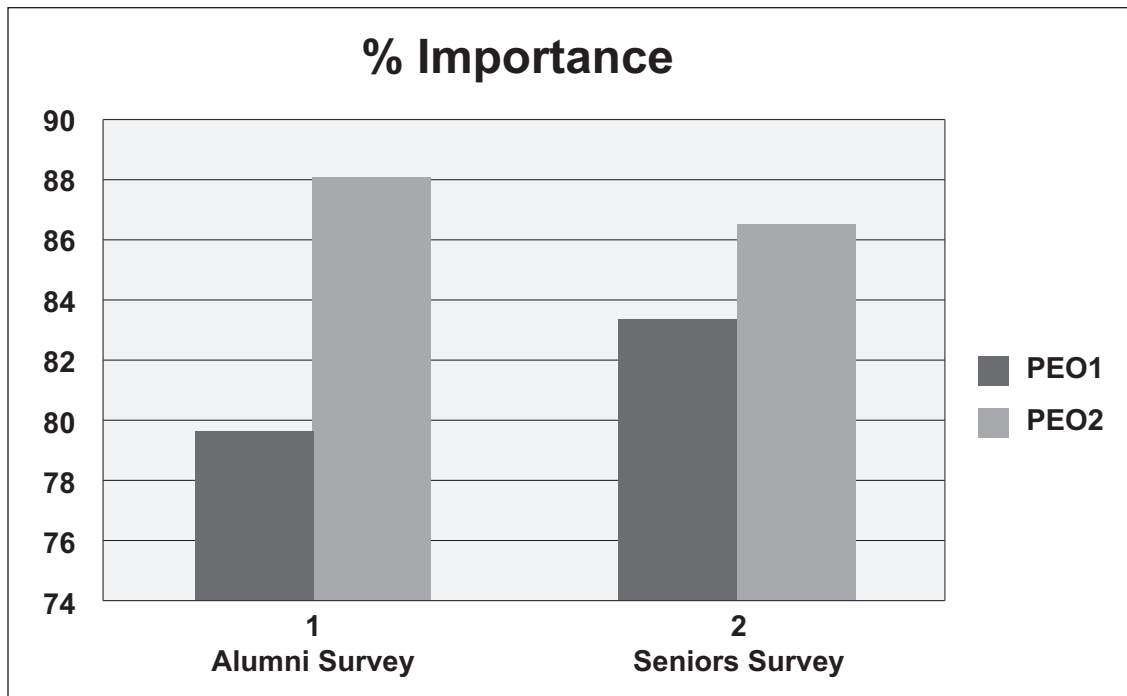
CPC 2: Understanding the impact of the decisions

69

% Importance

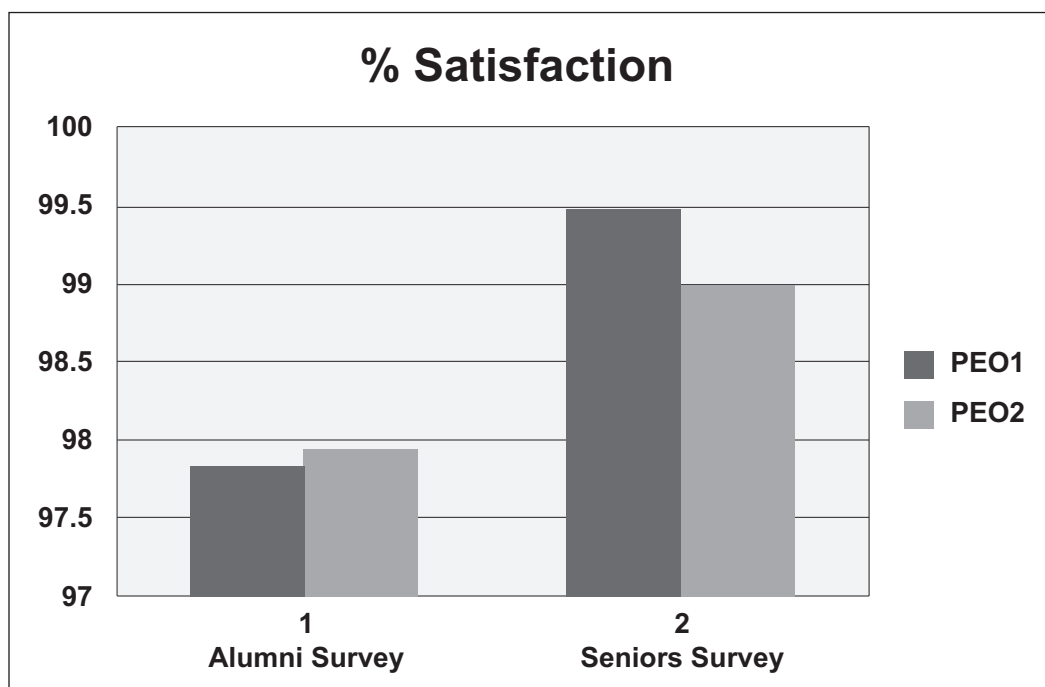**Figure 6** Sample of Performance Targets and Achievements

% Satisfaction

Figure 7 Sample of Program Educational Objectives Satisfaction Survey

The performance targets selected for these two criteria are:

CPT 1: All students should be above 80% based on an established rubric

CPT 2: All students should be above 80% based on an established rubric

Figure 6 shows some assessment results for the two performance criteria of the capstone course. Not only was the individual achievement level above the target level for each student, but also the achievement average for the class was at 95% for both criteria. By consistently gaining similar results, through periodic assessment and validation, the target levels could be raised for even higher levels of achievement.

5. Assessment Pull and Striving for Perfection

The main objective of any educational assessment process is that of improving the quality of the educational process. Therefore, the periodic and timely pull of course and program assessments are essential for continuous improvement. Striving for perfection, however, requires continuously "raising the bar" in course delivery, program integration, and the assessment processes itself. In fact, striving for perfection within the assessment process itself is a clear indicator for striving for perfection in all aspect of the educational program.

Example 4:

For the continuous improvement of a professional degree educational program, the program educational objectives presented were surveyed. Figure 7 shows a sample of the satisfaction level survey results for the two program educational objectives discussed in Example 1 of both graduating seniors and alumni.

Conclusions

Assessment of performance in higher education should be regarded as a process for continuously improving quality rather than a last-minute scramble to meet accreditation requirements. For this reason, assessment of performance is a core principle in Process Education. Since respect for people and continuous improvement are the foundations of both lean thinking and Process Education, it is clear that some of the well-developed lean thinking processes and tools can be used to achieve Process Education goals. This paper focused on using lean principles in developing an assessment process to address quality and continuous improvement issues in higher education.

The first and most fundamental principle in lean thinking is to understand value from the receiver's perspective. Therefore, an educational program's mission, vision, and educational objectives should be obtained by listening to the voices of the stakeholders through direct or indirect assessment methods. In addition, the program objectives should address all accreditation and discipline-specific outcomes. To achieve the required value stream, these outcomes should be further specified through a set of performance criteria and targets. The learning objectives, outcomes, and performance criteria for all of the courses in the program should flow from the program-level specifications and should be aligned with it.

Through the periodic pull of course and program assessments, in addition to eliminating any activity that does not contribute to achieving the specified targets, the rapid flow of the assessment process could be greatly facilitated. Finally, by striving for perfection through the continuous improvement of the educational and assessment processes the main goal of improving quality in higher education can be achieved.

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