Assessment Tool for CAC Self-Study Report

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Dedicated to my Parents and Sister Parul.

Without their love and support I wouldn’t have been able to reach this far…

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Abstract

Accreditation Board for Engineering and Technology, Inc. (ABET) is the primary organization responsible for monitoring, evaluating and certifying the quality of engineering, engineering technology, computing and applied sciences education in the United States. In 2000, ABET changed the way computer science (and engineering) programs are accredited from a 'checklist' approach to an 'outcomes-based' approach.

This approach is more flexible in that it allows the program to set its own objectives including expected outcomes that its graduates will meet. Although this approach gives more freedom to the program to establish its own set of objectives, it has also created considerable anxiety among people who are responsible for preparing their programs for accreditation. The primary reason for this anxiety is that ABET provides a set of guidelines for interpretation of these criteria; however they are not detailed leaving room for much ambiguity and subjectivity.

A program will be initially evaluated based on the data submitted in the Self-Study Report that describes how the program satisfies the criteria. This is followed by an on-site visit by a team of evaluators. This visit is required to gauge various factors that can't be adequately covered in Self-Study report. Further it provides an opportunity to look at the facilities and other required criteria in more detail. Based on the recommendations of the team, ABET decides on whether or not to accredit the program.

The Self-Study Report plays major role in the ABET accreditation process. However, preparation of the Report has become more difficult with the change to an outcomes-based approach. We have developed model of ideal program based on CAC guidelines and standards. Using the model, we have come up with a tool that assesses the thoroughness and completeness of the Report compared to the model. The tool outputs a report pointing out possible problem areas. Programs seeking accreditation can use the tool prior to submitting the Report to the evaluation team.

Chapter 1

Introduction

1.1 Background

Accrediting a degree program is a mission of many universities across the world. There is certainly much to be gained if the mission succeeds. For one, the stamp of accreditation gives creditability to the school's claim that the program is of high quality. Accreditation helps school attract high caliber students since they prefer an accredited program to the one that is not. Also, industry prefers to hire graduates from an accredited program. Finally, it lends prestige to a school thereby improving the school's chance of getting funds from various government and other agencies.

Accreditation Board for Engineering and Technology, Inc. (ABET) is the primary organization responsible for monitoring, evaluating and certifying the quality of engineering, engineering technology, computing and applied sciences education in the United States. It is recognized by the Council on Higher Education Accreditation (CHEA). ABET is a Federation of 31 technical and professional societies representing over 1.8 million practicing professionals. [2]

Computer Science Accreditation Board (CSAB) serves as a participating body of ABET with two members on the ABET Board of Directors. CSAB is the lead society within ABET for accreditation of programs in computer science, information systems, and software engineering, and is a cooperating society for accreditation of computer engineering. In this capacity, CSAB has responsibility for the development of accreditation criteria and for the selection and training of program evaluators.

Computing Accreditation Commission (CAC) is responsible for accreditation of programs in the field of Computer Science and Information Systems. CAC recommends accreditation criteria to ABET. CAC also conducts the accreditation process. It is responsible for assigning Team Chairs to visits. The CAC has the authority to make the final decision on accreditation of a program. Accreditation activities previously conducted by the Computer Science Accreditation Commission (CSAC) are now conducted by the Computing Accreditation Commission (CAC) of ABET.

A program seeking accreditation first makes a request to ABET. ABET then via CAC forms an assessment team. In the meantime, the program seeking accreditation begins to prepare the required materials. A major part of the preparation is a self-study report. This report contains information about the program and supporting documentation describing as to how it fulfills all the accreditation criteria. As part of the accreditation process the assessment team visits the institution to confirm the validity of the information in the self-study report and to monitor intangible factors that cannot be documented in the report. Before the actual visit, the Team Chair communicates with the program chair

about who all they want to interview and in what order. The program must demonstrate compliance with the criteria and the onus lies on the program. The main objective of the visit is to assess qualitative factors, examine facilities and inform the program about its strengths and deficiencies. Once the visit is over, all parties are given a chance to clarify their position before a decision is made. Based on its findings, the team gives its recommendations to CAC which then makes a final decision on whether or not to accredit the program.

If the team is fully satisfied the program is accredited for 6 years. If the team finds some issue not fully addressed, a program is accredited for two years and after two years there is an interim visit or an interim report is submitted. This interim visit or report focuses on the issues raised in the prior visit. If this interim visit/report finds that all the shortcomings have been taken care, then the program is accredited for an additional 6 years. Only a 'Not to Accredit' decision can be appealed. [3].

1.2 Problem

In 2000, CSAB (and ABET) changed the way computer science (and engineering) programs are accredited from a 'checklist' approach to an 'outcomes-based' approach. For the checklist- based approach, to receive accreditation a program needed to fulfill a list of requirements set by CSAB. These requirements included fulfilling certain standards such as offering courses in given areas with sufficient frequency, providing a particular level of laboratory support, etc. If an institution met all the requirements, it was accredited. This approach ensured that the program and evaluators knew exactly what was needed for accreditation. Even now, the ABET outcomes based approach still has a checklist-based component. However in 2000, it added a 'Program Outcomes and Assessment' that lists 11 criteria (a through k) that graduates of the program need to fulfill before the program gets accredited. [5]. However, these criteria are not as specific as they were in the checklist-based system.

Starting in 2000, CAC has moved to an outcomes-based approach for accrediting Computer Science Programs. This approach is more flexible in that it allows the program to set its own objectives including expected outcomes that its graduates will meet. Although this approach gives more freedom to the program to establish its own set of objectives, it has also created considerable anxiety among people who are responsible for preparing their programs for accreditation. [6] The primary reason for this anxiety is the subjectivity in this approach. ABET provides a set of guidelines for interpretation of these criteria; however they are not detailed leaving room for much ambiguity and subjectivity.

As mentioned earlier, before the actual evaluation team's visit takes place, the program must prepare a self-study report. This report contains detailed description as to how the program fulfills the standards set by CAC for accreditation. The self-study report is a key part of the team's recommendation. However, the new outcomes based approach has made preparing the self-study report more difficult. Therefore there is a need for aid in

evaluating the thoroughness and completeness of self-study report before the visit. The problem is how to ensure that none of the standards are skipped or not properly addressed.

1.3 Proposed Solution

We propose a tool to aid in assessing the completeness and thoroughness of the self-study report prior to it being submitted to CAC. By assessing how well the self-study report addresses the criteria, the program can identify areas of deficiencies and work to correct them prior to the team visit, thereby improving its chances of success.

Of the 7 criteria categories, the Program Objectives are the most subjective part of the self-study report; therefore our assessment has paid special attention to the Programs Objectives as we felt that was the most important factor for accreditation and also the most confusing for a program facing the new process for the first time. [7][8] The guidelines provided by ABET for Program Objectives seem vague and unclear. Also, since the process was new for the assessors as well, even they had problems in interpretation of the guidelines. [Private conversation with Dr. Cherri Pancake] [6] We talked with people who were involved in getting their programs accredited and people who have served as program evaluators to figure out what the assessors are really looking for. We have tried to incorporate all that knowledge into our tool and believe that it captures criteria standards and what the assessors are actually looking for.

The model containing the practices of an “ideal program” as envisioned by CAC serves as the basis for our assessment tool. An assessment questionnaire’s responses are used to compare the program being evaluated with the model. Persons responsible for self-study report complete the questionnaire and based on their answers the tool provides them with a report that informs them of any deficiencies with respect to the standards set by CAC for accreditation. Our tool assesses all 7 criteria categories and the standards in each of these categories. Our tool helps in ensuring that everything is in order and no requirement, no matter how small is overlooked.

Like all process assessment models, the report can only point out the problem areas and it is up to the institution to come up with ways to overcome problem and to allocate resources to implement these.

Chapter 2 discusses the accreditation process and the change to an outcome - based approach and the problems related to the change. Chapter 3 describes the meta-model framework for our model and assessment tool. It describes the development of the model and practices. Chapter 4 elaborates on the questionnaire developed for the assessment. In addition it discusses the assessment report and the Rating Scale used. In Chapter 4 we also cover the automated online system that we have developed. A program can use this system to fill our questionnaire online and get feedback. Finally, in Chapter 5, we discuss the experiences and the results that we obtained on applying the tool to various programs. These results are used for the validation of the model and the tool. We provide conclusions of our work and suggestions for future work and extensions.

Chapter 2

The Accreditation Process

2.1 ABET

Accreditation Board for Engineering and Technology, Inc. (ABET) is the recognized accrediting body for college and university programs in applied science, computing, engineering and technology. It is a federation of 31 professional and technical societies representing these fields. Currently ABET accredits some 2,500 programs at over 550 colleges and universities nationwide. It is recognized by the Council on Higher Education Accreditation (CHEA). ABET strives to promote quality and innovation in education. It also consults and assists in the development and advancement of education worldwide in a financially self-sustaining manner. [1]

The structure of ABET is given in Figure 1. At the helm are the participating societies. These societies work in different disciplines and are responsible for maintaining standards in their fields. For example American Nuclear Society deals with Nuclear Engineering and Nuclear Engineering Technology, CSAB deals with Computer Science, National Institute of Ceramics Engineers looks after Ceramic Engineering etc. These societies are located all over the United States. Below these societies is the Board of Directors and then the various accreditation commission and committees.

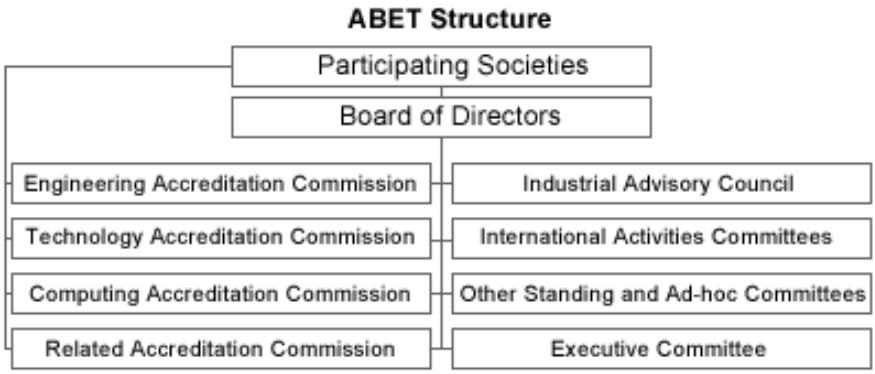

Figure 1 ABET Structure [ABET Website. www.abet.org/organization.html]

2.2 CSAB

Computer Science Accreditation Board (CSAB) is one of the 31 participating societies that constitute ABET. CSAB functions as a professional computing federation drawing from various member societies. The member societies are the Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers, Inc – Computer Society (IEEE-CS) and Association for Information Systems (AIS). It is the lead society for Computer Science, Software Engineering and Information Systems accreditation. [1] In addition, CSAB is the cooperating society for Computer Engineering and Information Engineering Technology. CSAB has responsibility for developing Computer Science specific Program Evaluator and Program Criteria (PEPC). It selects, trains and evaluates program evaluators for CS, IS and SE accreditation. CSAB is governed by a board of directors whose members are appointed by the member societies. The board consists of the following members: Past President, Executive Director, Directors representing ACM (4), Directors representing IEEE-CS (4), Director representing AIS (1), Alternate Directors representing ACM (4), Alternate Directors representing IEEE-CS(4) and Alternate Director representing AIS(1).

2.3 CAC

ABET has various agencies that help in its smooth functioning. Computing Accreditation Commission (CAC) is one such agency that recommends Computer Science accreditation criteria to ABET and is responsible for the accreditation of computer science programs. It is responsible for assigning teams for each program requesting accreditation, doing the evaluation and providing recommendations to ABET. CAC consists of a Chair, Executive Committee, and the team chairs. (See Figure 2)

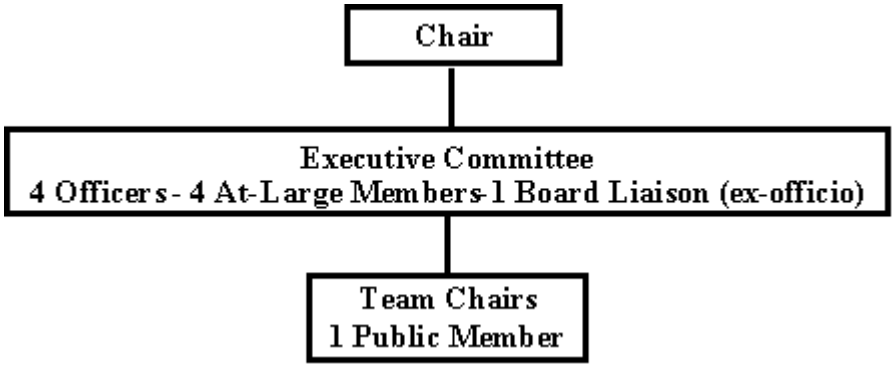

Figure 2 CAC Structure [CSAB Newsletter]

2.4 ABET Policy and Procedure for Accreditation

ABET accredits educational programs leading to degrees rather than institutions, departments or degrees. In order for a program to be accredited, all routes to completion of the program must satisfy the specified criteria. [12]

Only 4-year college programs in the field of engineering, computing or applied science can be considered for accreditation by ABET.

CAC accredits Bachelor level programs leading to professional practice in the field of Computer Science. Any institution wanting their Computing program(s) accredited must directly contact ABET. The accreditation process is completely voluntary and CAC will evaluate any program that appears likely to satisfy the prescribed criteria. A program will be initially evaluated based on the data submitted in the Self-Study Report that describes how the program satisfies the criteria. This is followed by an on-site visit by a team of evaluators. This visit is required to gauge various factors that can't be adequately covered in Self-Study report. For example, qualitative factors like intellectual atmosphere, morale of faculty and students, stability and continuity of the program etc. Further it provides an opportunity to look at the facilities and other required criteria in more detail. At the end of the visit, the team provides the program with a report listing the strengths and deficiencies. The team's factual findings are presented orally to the program's chief executive; this gives the program an opportunity to correct any factual errors in the team's observation. The evaluation team reports its preliminary findings and recommendations to CAC. CAC gives the program an opportunity to submit further clarifying material. However, additional material can only be used for correcting factual errors in the findings of the visiting team. ABET then decides on whether or not to accredit the program. It must be noted that CAC or ABET doesn't rank programs. A program is either accredited or not accredited. The duration of accreditation varies from 2 to 6 years. An accreditation for full 6 years implies that the program fulfills all the published criteria. On the other hand if there are some noted deficiencies in the program, CAC may grant accreditation for a shorter period after which there is an interim evaluation. If the deficiencies are serious, the program is not accredited.

However, if during the period of accreditation ABET has reason to believe that the program is no longer in compliance with the criteria it may ask the program to provide a clarification. In case ABET isn't satisfied with the clarification, it may withdraw the accreditation as per set procedure.

For a program to be continuously accredited, a comprehensive review consisting of all the above mentioned steps must be conducted at an interval no longer than 6 years. In addition, interim reviews may also occur between comprehensive reviews if deficiencies are noted in a prior review. An interim review can only focus on the shortcomings noted in the previous review.

2.5 Outcomes – based approach

Previously ABET used a 'checklist' based approach to accreditation. In that approach, a program requesting accreditation was required to fulfill the list of requirements provided by ABET. The checklist consisted of a list of courses and facilities that a program should provide to the students. As long as the program satisfied these requirements it was accredited. However, in 2000, CAC (and ABET) moved to an outcomes based approach.

This approach requires the program to set its own objectives that it wants to achieve and then has to show via outcomes that it fulfills them. While, this approach provides the program with the freedom to specify its own objectives, it makes the task of getting accredited more difficult since both the objectives and outcomes and how they are satisfied are evaluated.

The new outcomes based approach has the following 7 criteria categories that the program needs to fulfill in order to get accredited.

1. **Objectives and Assessments:** Describes the program objectives and outcomes set by program.
2. **Student Support:** Specifies the level of student support provided by the program and includes course frequency, faculty-student interaction, guidance provided to the students, etc.
3. **Faculty:** Describes the number of faculty, their involvement in teaching, their interests and their competency to teach the in the program.
4. **Curriculum:** Ensures that the curriculum is consistent with the program's documented objectives. It combines technical requirements with general education requirements to prepare students for a career in Computer Science or for further education in the field.
5. **Laboratories and Computing Facilities:** Ensures that adequate laboratory and computing facilities are available to the students for completing their program and for the faculty to perform their teaching duties and conducting research.
6. **Institutional Support and Financial Resources:** Ensures that sufficient finances are available to allow the program to meet its objectives. In addition, enough funds are available to assure that the program will retain its strength throughout the period of accreditation.
7. **Institutional Facilities:** Shows that institutional facilities including library and other information retrieval systems are adequate to support the objectives of the program.

Figure 3 shows standards for criteria category 1 and Figure 4 shows standards for a part of criteria category 4 (Curriculum). Figure 4 shows that those standards can be quantified and measured without much difficulty. This is because these standards are stated in measurable terms. For instance the guidelines specifies the minimum number of credits required in each area of study, like Computer Science, Mathematics and Science. Similarly, for criteria 3 (Faculty) the guidelines mentions the percentage of faculty that must have a PhD, minimum number of faculty members etc. However as can be seen in Figure 3, criterion 1 standards are different from the rest in the sense that it is very subjective in nature and hence difficult to quantify. While on one hand the outcomes based approach provides freedom for the program to set up its own goals and direction, on the other hand it creates problem since it is hard to distinguish a good set of objectives and outcomes from a bad set. Hence, making such a decision may involve a lot of subjectivity.

I. Objectives and Assessments

Intent

The program has documented, measurable objectives, including expected outcomes for graduates. The program regularly assesses its progress against its objectives and uses the results of the assessments to identify program improvements and to modify the program's objectives.

Standards

I-1. The program must have documented, measurable objectives.

I-2. The program's objectives must include expected outcomes for graduating students.

I-3. Data relative to the objectives must be routinely collected and documented, and used in program assessments.

I-4. The extent to which each program objective is being met must be periodically assessed.

I-5. The results of the program's periodic assessments must be used to help identify opportunities for program improvement.

I-6. The results of the program's assessments and the actions taken based on the results must be documented.

Figure 3 ABET Standards for Criteria 1[Criteria for Accrediting Computing Programs]

Computer Science

IV-5. All students must take a broad-based core of fundamental computer science material consisting of at least 16 semester hours.

IV-6. The core materials must provide basic coverage of algorithms, data structures, software design, concepts of programming languages, and computer organization and architecture.

IV-7. Theoretical foundations, problem analysis, and solution design must be stressed within the program's core materials.

IV-8. Students must be exposed to a variety of programming languages and systems and must become proficient in at least one higher-level language.

IV-9. All students must take at least 16 semester hours of advanced course work in computer science that provides breadth and builds on the core to provide depth.

Figure 4 ABET Standards for Criteria 4[Criteria for Accrediting Computing Programs]

Since the introduction of the new outcomes based approach there have been many attempts to come up with effective ways to accomplish this. Much attention has been paid

to the Programs Objectives part since it is the new and most difficult part of the assessment. CAC criteria specify the program must have 'documented measurable objectives' that includes expected outcomes for its graduates. The criteria also require that the program regularly assess its progress against the objectives that it has set and uses these measurements to improve the program. [13] This approach to program accreditation is totally different from the previous check-list based approach, where to gain accreditation the program needed to offer certain courses and provide certain level of facilities and faculty. Many schools have encountered problems in coming up with the set of objectives and methods of evaluating them that lead to a continual process of improving the program. Therefore there have been several efforts aimed at coming up with a solution to this problem. For example, there have been forums in which participants from various institutions discussed their experience with outcomes based assessments [10]. There also have been proposed approaches for developing the program objectives and how can faculty be involved in the process. [7]. A survey, gathered information on the different ways institutions collect information on the quality of their programs. Some of the common ways are senior exit survey, external advisory panel, alumni survey, employer survey, written and oral survey, etc. This information provides some insight into the performance of the program.

From the discussion above we can see that the change from checklist–based to outcomes-based has been a big one. Programs going for accreditation are still trying to come to terms with the new system in general and with criteria 1 in particular. Our tool is aimed at assessing how well they are addressing issues that are associated with this change.

2.6 The Self -Study Report

The Self-Study report plays a very important role in the overall accreditation process. As mentioned earlier, the report gives the program an opportunity to document how well it meets all the criteria required for gaining accreditation. On the other hand it gives the evaluation team a chance to know beforehand what to expect during their evaluation.

The self – study report consists of a detailed description of how the program meets the various criteria and standards set by CAC. The structure of the Self - Study report is strongly influenced by the criteria and standards of CAC since it attempts to show how the program fulfills them. Therefore, it is prudent at this point to delve a little into the structure of CAC criteria and standards. CAC requires the program to comply with 7 criteria. These criteria are:

i. Objectives and Assessments
ii. Student Support
iii. Faculty
iv. Curriculum
v. Laboratories and Computing Facilities
vi. Institutional Support and Financial Resources
vii. Institutional Facilities

Each of these criteria has a number of standards that describe in detail what is expected of the program. Some of the standards are given in Figures 3 and 4. On comparing Figure 3 standards that show sample of Objectives and Assessments with those of Curriculum that are shown in Figure 4, it can be noticed that Curriculum standards are specific and therefore easily quantifiable where as those for Objectives and Assessments are subjective in nature. For instance the standards for Curriculum mentions course contents in General area, Computer Science, Mathematics and Science and Additional Areas that the program must cover.

The self – study report consists of a section on each criterion. For instance, a self – study report section on Faculty (Criteria 3) profiles of the entire faculty. This information will help the assessment team judge if the program fulfills the requirements of Criteria 3. They will check the qualifications of the faculty's educational background and experience, scholarly activity, workload, courses taught etc. Similarly, a section on Curriculum will elaborate on various courses being offered by the program, course objective of each of them, frequencies of course offering and other such issues.

It is essential that the program address all criteria and standards the guidelines in the report. It is easy to miss one of the standards or to assume that the program fulfills a particular requirement whereas that might not be the case. Such oversight could easily lead to interim accreditation or not being accredited. It is at this point that our assessment tool comes in handy as it evaluates the self-study report and points out potential shortcomings that the department can rectify before the visit. Since it is better to discover that part of criteria has been overlooked or not fully addressed prior to evaluation team visit rather than during or after the visit.

Chapter 3

Model and Practices

Our goal was to come up with a tool to help computer science programs going for accreditation by assessing their Self Study report and pointing out the deficiencies in their report. To fulfill this goal, we used the process improvement meta-model framework to develop a model for the set of practices for an ideal program. The meta-model helped us in defining a set of practices for this process. We then used these practices to come with a questionnaire and a rating scale. We use questionnaire responses to indicate shortcomings and suggestions for improvement of the program. This chapter describes software process improvement, the meta-model, practices, questionnaire, assessment report and scoring.

3.1 Process Improvement

Software Process Improvement (SPI) is a philosophy that aims at improving the quality of the software process believing that this in turn will improve the quality of the software produced using this process. SPI is strongly influenced by general process quality improvement techniques proposed by W. Edwards Deming, Joseph M. Juran, Philip B. Crosby, and Masaaki Imai. [14]. Proponents of process improvement believe that the most effective way to improve the quality of the final product is to improve the process that produced it.

In 1970, it was noted that software started becoming larger and more complex, problems like delays, higher than estimated costs and low quality products were becoming more pervasive. The industry discovered that it needed to take some steps to reduce these problems. By early 1980s most of the people realized that technology alone isn't the solution to this problem because of the human factor involved in software production. By late 1980s the focus shifted to improving software process since quality of the product depends on the process that produced it.

The SEI IDEAL model of the entire software process improvement process is an excellent framework for understanding the cycle of ongoing process improvement. The IDEAL model has five phases i.e. Initiating, Diagnosing, Establishing, Acting and Learning. [15] The Initiating phase deals with identifying the reasons for improvement, getting funding/support and establishing the infrastructure. The Diagnosing phase deals with assessing the current process and recommending areas of improvement. Establishing phase deals with setting priorities, establishing an action team and constructing an action plan. Acting phase deals with implementing the plans developed in the previous phase. In the Learning phase, all the knowledge accumulated from the previous steps is assimilated and plans for organizational development are formed. The cycle then repeats.

There are two basic approaches to Software Process Improvement: the Analytic Approach and the Benchmarking approach. The analytic approach relies on quantitative evidence to determine the deficiencies and whether or not the changes to the process have been successful in improving the process. Shewhart Cycle is an example of analytic approach. The benchmarking approach relies on comparing the process against a model. The model consists of ideal practices for that process and comparing the organization's practices against those of the model will help in identifying deficiencies. An example of the benchmarking approach is the SEI's Capability Maturity Model (CMM).

The first step in process improvement is to come up with a model for the process. The model consists of ideal practices for that particular process. Practices cover all the aspects of the process under review. These practices are either the ideal practices or practices followed by the organization that is considered to be the leader in that field. Once the model and corresponding set of practices is ready, the process is compared against these practices to check whether or not the process implements all the practices and if so to what extent. This check helps in pointing out the practices that are not implemented by the process or those practices that are partially implemented. These practices are the candidates for improvement.

Process assessment fits in the Diagnosing phase of this model. It is in this phase that we assess the process in order to find the deficiencies in the current way of doing things and to come up with recommendations for improvement of the process. One way to assess the current process is to first develop a set of practices for the ideal model of the process. These practices form a benchmark against which we'll compare the process under scrutiny. They cover all the facets of the process under scrutiny and list the actions that are needed to complete the process successfully. Next we need to assess the degree to which each particular practice is satisfied. This includes setting benchmarks and finding appropriate measures. Once that is done then the process can be observed or compared with these practices. This assessment of the process helps in identifying the areas in which the process is deficient. In our case, the CAC Self-Study report is the product under scrutiny. Directly monitoring the generation of self-study report is not feasible for us due to time, money and other constraints. Therefore, we assess the self-study report against our model using an assessment questionnaire. People who are involved with the process of producing the Self-Study report fill out the questionnaire and their responses are used to evaluate it.

The next step in Process Improvement involves recommending changes to the process to help it overcome the deficiencies identified in the previous step. These changes are essentially to implement practices that were identified earlier as partially implemented or not implemented at all. Once the changes have been suggested, it is up to the process owners to implement these changes in the way that best suits them. Once these changes have been implemented, it is time to evaluate these changes to measure their effectiveness and recommend further changes. Thus the cycle continues leading to an improved process after each iteration.

3.2 The Meta Model Framework

We used meta-model framework to come up with a model and set of practices. This meta-model was developed by Visconti and Cook [16]. The framework aims at identifying practices to initiate and sustain a software process improvement effort focused on a single process area. In determining process practices the framework considers both the process, and quality and usability/costumer satisfaction of the products produced or services provided by the process. The meta-model framework helps in identifying practices which will drive assessment and improvement of the process. Its structure is given in the Figure 5 below. As shown in the figure, the Meta Model defines four major action phases (Identify, Monitor, Measure, Feedback) for the three dimensions: core process, quality assurance and usability/customer satisfaction. The Identify phase defines the product or service, its importance to the organization, the practices in the process and the components of the process. The Monitor phase checks for evidence of organizational support, and checks to see whether the practices and components of the Identity phase are being done. The Measure phase defines measures for each of the three dimensions, and activities to collect and analyze these measures. Finally, the Feedback phase generates recommendations for improvements from the measurements, evaluates and prioritizes them, and generates plans to incorporate them into the process. To aid in the development of practices (and sub practices) the refined version of the framework gives suggested types of practices and useful questions and hints for constructing these practices.

Although this meta-model framework was initially developed for processes related to software engineering, we felt that it was general enough that it can be used for process improvement of non-software processes. Therefore we tried to apply it to assessing the CAC self-study report to derive benchmark-model and practices for a model of the process. We felt that if we can come up with a good set of benchmark then using them we can build a tool to help computer science programs that are applying for accreditation by pointing out their strengths and deficiencies well in time.

Phase	Meta Practices for each Dimension		
	Core Process	Quality Assurance	Usability/Customer Satisfaction
Identify	Define important practices of process for generating product or providing service	Define important quality assurance practices for product or service	Define important practices for product usability or customer satisfaction
Monitor	Monitor adherence to process	Monitor quality assurance activities	Monitor usability/customer satisfaction activities
Measure	Define, collect and analyze measures		
Feedback	Generate, evaluate, prioritize and incorporate recommendations		

Figure 5 Meta Model [A Meta Model Framework for Software Process Modeling]

3.3 Model and Practices of Self – Study Report

We applied the meta-model framework to Self-Study Report for CAC's Criteria for Accreditation of Computer Science program [13] and the guidelines for interpretation of those criteria [4] to develop a model and then used that model to come up with a set of practices (and sub-practices). The practices (and sub-practices) cover all the criteria for getting a program accredited. For each criterion and standard of CAC, our model has at least one practice/sub practice. Thus, our model is based on the criteria and guidelines of CAC guidelines.

We started off by trying to fit the Criteria for Accreditation to standard the Meta Model. The product that we are trying to improve is the department's self-study report. However, we soon realized that the model needed to be modified to fit our needs. In particular, it seemed like there was considerable overlap between Quality Assurance and Customer Satisfaction. We therefore decided to merge the two in Identify phase. Identify – Core Process consisted of all seven criteria required by ABET for accrediting Computer Science programs. The Identify – Quality Assurance covered issues like program's consistency with the mission statement of the institution and ensuring that the objectives are satisfied. In the monitor phase, we merged all three dimensions. Monitor included tangible factors like frequency of course offerings, TA:Student ratio, frequency of assessment of program objectives, etc. Numbers were attached to each of these tangible factors in the Measures phase such as the acceptable frequency of course offering, TA:Student Ratio etc. These numbers were derived mostly from the Guidelines for interpreting the Criteria for accreditation, but we had to come up with certain numbers ourselves such as the frequency of measuring program objectives. To come up with numbers in such scenarios we consulted various sources such as asking people who are involved in accreditation. Our final model is provided in Appendix D. We found the

model to be flexible enough to allow us to do that. From that model, we derived practices for the 7 critical assessment areas that ABET is looking into before granting accreditation.

For instance, in Criterion 1 (Objectives and Assessments), Standard 5 states “The results of the program’s periodic assessments must be used to help identify opportunities for program improvement.” This standard essentially implies that the assessment data for program objectives and outcomes is used to assess the program and to come up with recommendation for changes, there should be a mechanism in place to select and implement at least some of the recommendations and the results of assessment, recommended changes and actions taken to implement them are properly documented so that the visiting team can evaluate the effectiveness of the process.
As can be seen by reading the standard above, not all of these goals are immediately clear in first reading of the standard. Therefore, we came up with a set of three key practices to make the intention of ABET explicit. These key practices are:

1. Evaluate assessment data for program objectives, program outcomes and/or course learning objectives and generate recommended changes for program improvement.
2. Process or mechanism to select set of recommended changes and implement these changes to program objectives, program outcomes and/or course learning objectives.
3. Results of assessments, recommended changes, and actions taken are documented.

Each one of the key practice deals with one part of the standard. As can be seen from this example, we specified more than what the standard said in order to clarify the standard’s intent.

On the other hand, an example of a direct standard is in Curriculum, Standard IV – I states “The curriculum must include at least 40 semester hours of up-to-date study in Computer Science topics.” This standard can directly be mapped to a key practice. The key practice for this standard is “The curriculum includes at least 40 semester hours (60 quarter hours) of up-to-date study in computer science topics.” For a complete listing of mapping of criteria and practices, see Appendix A.

We used these practices (and sub-practices) to come up with a questionnaire to compare organization’s practices with those of the model. We measure the performance of the organization against our practices and sub practices and then map the results to the CAC criteria and standards. This is made possible because of the direct mapping between the standards and criteria and our practices (and sub practices). The questionnaire is described in the next section.

Chapter 4

Questionnaire and Scoring

4.1 The Questionnaire

There are various methodologies that can be used for assessing a process. Such as directly monitoring a process, interviewing people involved in the process, case studies of the process, etc. However, all these methods are time consuming from the evaluator's point of view. Most of them also require the evaluator to be physically present to monitor the process. Due to these aforementioned constraints, it was not possible for us to adopt one of these methods for our tool for evaluation of Self – Study Report. Instead we decided to use the questionnaire as our primary assessment tool to assess the quality of the self-study report. The questionnaire does not require physical presence and requires much less effort from the evaluator. We use the program's responses to the questionnaire as a basis for the assessment report.

Each question in our questionnaire is related to at least one sub-practice and each sub-practice has one or more questions associated with it. The questionnaire consists of around 140 questions in electronic format and around 100 questions in paper version. These questions are grouped into sections, each section covering a particular area of the program i.e. Program objectives, Outcomes and Course learning objectives, Course Offerings, Teaching Assistance, Advising, Faculty, Graduation Requirements, Facilities and Support, Faculty support and Institutional Support and Resources.

The questionnaire consists of various types of questions. There are binary questions that have a Yes/No answer such as Question 2 in Figure 6. Then there are multiple choice questions. Typical example of this type of questions is Question 7 and 10 in Figure 6. There are many questions that provide a scale and the respondent is required to select the value that best represents the program's status. Question 22 in Figure 6 provides an example of such a question. It requires the respondent to select the frequency with which the program offers lower division courses. Finally there are some questions that require the user to input absolute numbers, such percentage of faculty that holds PhD degree, ratio of students to advisor etc. One such question is Q49 in Figure 6.

We have provided a 'Don't Know' response for all the questions. We figured that it might be possible for the people answering the questionnaire to have little knowledge of the particular area to which the question pertains. In such a scenario it would be impossible for them to provide an intelligent answer. To illustrate this, consider the questions in Figure 6. It might be the case that the person answering the questionnaire is not aware whether the program objectives are documented or how student achievement is measured or who all are involved in assessing program objectives. Although, a 'Don't Know' is not helpful in determining the level of satisfaction the practice, it does acts as a

caution about an area that they may have overlooked in the self – study report and thus will be indicated in the assessment report.

We have also provided the option of 'Others' wherever we thought that we could not provide an exhaustive list of possible responses. This occurs in questions, where the option they picked is not as important as long as they have selected at least one option. We are keen on knowing whether the program satisfies a particular standard, the option selected by them provides additional information on what method they are using to implement the standard. Since in certain cases we can not predict in advance all the methods, we list the most common ones and then provide the option of 'Others' to let the program indicate the method they use in case it is not listed. For instance, Questions 7 and 10 of Figure 6, it is important is that there is some mechanism of measuring student achievement or that a process of assessing program objectives is in place and someone is accountable for that. It is also possible that there is more than one answer for a particular question, again we have provided for such a scenario in this tool. For example, referring to Figure 6 again, Questions 7 and 10 provide for a scenario where multiple options can be chosen. We have also allowed for individual differences such as schools on semester or quarter system. Such questions are mostly in course offering and faculty work load sections. Question 22 in Figure 6 is an example of this.

2. Are the program objectives documented? Yes No Don't know
7. What methods are used to collect data that may be used to measure degree of student achievement for each program outcome (Circle all that apply)? Senior exit survey Senior exit interview Alumni survey Employer survey Local written exam National written exam Oral exam Industrial advisory panel Capstone course(s) Other _____ Don't know
10. Who is involved in assessing program objectives? (Circle all that apply) Department head Single Faculty Faculty Committee Industry representatives Student representatives Alumni Other _____ Don't know
22. How often are required lower division courses offered during the regular academic year?

For schools following quarter system Every quarter Twice each year Once each year Every other year Don't know For schools following semester system Twice each year Once each year Every other year Don't know
49. Approximately, what percentage of full-time tenure-track faculty has a Ph.D. in computer science? _____% Don't know

Figure 6 Sample Questions

4.2 Scoring and Assessment Report

Assessment compares the benchmarks set in the model with the self study report to make the program aware of the strengths and deficiencies in its Self – Study Report. In particular the program is interested in knowing which standards they didn't fully address in the Self-Study Report. To achieve this goal we analyze their responses to the questions and generate a report that provides the program feedback as to how they are doing on various standards set by CAC for accreditation. The basis for our assessment, are the practices and the sub practices as described in Section 3.2. However, since each of these practices and sub practices are linked to a standard, by looking at the practice or sub practices for that standard we can inform them of how well they satisfy each standard. The assessment report informs the program on where they stand on the standards on which they lack and in most cases what is the minimum requirement recommended by CAC to satisfy them. By comparing the two values the program can determine how much more it needs to improve on that standard. For categories II to VII there is almost a 1-1 mapping between the standards and the practices and sub practices. This is because most of the practices and sub practices in criteria II to VII try to measure tangible facets of the programs such as the qualification of the faculty, frequency of course offering, institutional support, etc. However, the association between standards and sub practices for criteria I is more complex. The mapping is shown in Figure 7. This additional complexity occurs because criteria I deal with program objectives and outcomes. Defining program objectives and outcomes is open to subjective interpretation and therefore, we provided for one or more practices (or sub practices) for each standard to define the criteria concretely. Since all the practices and sub practices are tied to a criteria or standard the scores for the practices and sub practices can be directly translated into scores for the criteria and standards as required by CAC.

Based on the answers provided to the questionnaire, we rate the level of satisfaction of each sub practice. Since there is a direct mapping between sub practices and standards, we are able to figure out the level of satisfaction of each standard. The level of satisfaction of each standard determines how well the program fulfills each of the criteria

laid out by CAC for accreditation. We have one or more questions addressing each of the sub practices. For generating the report, we take in to account all responses that they provide on the questionnaire. Based on the responses, each question is then given a rating. Then the ratings of all the questions pertaining to a particular sub practices are grouped together to come up with a rating for that sub practice. This process is carried up one more level and ratings of all the sub practices dealing with a particular practice are combined to get the rating for that practice. We then convert the ratings of practices (and sub practices) in to the ratings for criteria and standards using the mapping defined above for generating the report. The report indicates the criteria and standards that are not fully satisfied.

To come up with a rating for the practices we first classify all possible answers to a question as Satisfied, Possibly Satisfied, Not Satisfied or Undecided. A 'Satisfied' rating means that the program meets or exceeds the standards set by ABET/CAC for the area addressed by the question. A 'Possibly Satisfied' rating indicates that the program may or may not satisfy the standard set by ABET/CAC and may or may not pass the scrutiny of the visiting team. Rating of 'Not Satisfied' means that the program doesn't meet the standards set by ABET/CAC in that area and is almost sure to fail during the accreditation process. We also assign a Rating of 'Undecided' if the information provided is insufficient to decide the level of satisfaction. This primarily occurs due to 'Don't Know' responses since they do not provide any information on the level of satisfaction of a standard. When such a situation arises, it indicates that the department may have overlooked the practice to which that question pertains and that they must look into it. This is one of the most important features of the tool, since it is able to point out anything that the department has overlooked. This might happen more frequently than one might think, since there are so many things to take care of its quite plausible that something minor might get overlooked.

To start the scoring process, we first assign each question a rating of 'Satisfied', 'Possibly Satisfied', 'Not Satisfied' or 'Undecided' based on their response to that question. Next we group the questions addressing a particular sub - practice and use the rating of those questions to come up with the rating for that sub – practice. To determine the rating for a sub – practice from the rating of the questions pertaining to it, we use the following method. We give the sub - practice a rating of 'Satisfied' if all questions pertaining to it have a rating of 'Satisfied'. Similarly, if all the questions have a rating of 'Satisfied' or 'Possibly Satisfied' then we assign the sub practice a rating of 'Possibly Satisfied'. However, if even one of the questions has a rating of 'Not Satisfied', then the corresponding sub - practice also gets a rating of 'Not Satisfied'. In case some questions pertaining to a sub-practice have a rating of Undecided and the others have rating of either Satisfied or Possibly Satisfied, then we assign that sub-practice a rating of Undecided. However, if some questions are rated as Not Satisfied then we assign that sub - practice Not Satisfied rating.

Once rating for all the sub – practices pertaining to a particular practice are determined, they are used for coming up with the rating of that practice. The method used is very similar to that used for determining the rating of sub-practices.

Standard I-1. The program must have documented, measurable objectives.
Sub Practices:

a. The program objectives are stated in terms of documented measurable outcomes.
b. Each course has documented course learning objectives.

Standard I-2. The program's objectives must include expected outcomes for graduating students.
Sub Practices:

c. Course learning objectives cover the program outcomes for graduating students.

Standard I-3. Data relative to the objectives must be routinely collected and documented, and used in program assessments.
Sub Practices:

d. Data relative to the program objectives is collected and documented on a regular basis.

Standard I-4. The extent to which each program objective is being met must be periodically assessed.
Sub Practices:

e. Program objectives, program outcomes, and course learning objectives are assessed on a regular basis.

Standard I-5. The results of the program's periodic assessments must be used to help identify opportunities for program improvement.
Sub Practices:

f. Evaluate assessment data for program objectives, program outcomes and/or course learning objectives and generate recommended changes for program improvement.
g. Process or mechanism to select set of recommended changes and implement these changes to program objectives, program outcomes and/or course learning objectives.
h. Results of assessments, recommended changes, and actions taken are documented.

Figure 7 Mapping between Standards of Criteria 1 and Sub practices

Next, all the sub practices dealing with a particular practice are grouped together and same procedure is followed to come up with a rating for the practice. We give the practice a rating of 'Satisfied' if all sub - practices pertaining to it have a rating of 'Satisfied'. Similarly, if the entire sub - practices have a rating of 'Satisfied' or 'Possibly Satisfied' then we assign the practice a rating of 'Possibly Satisfied'. However, if even one of the sub - practice has a rating of 'Not Satisfied', then the corresponding practice also gets a rating of 'Not Satisfied'. Like the scheme for assigning rating for sub-practices, in case some sub-practices pertaining to practice have a rating of Undecided and the others have rating of either Satisfied or Possibly Satisfied, then we assign that practice a rating of Undecided. However, if some sub-practices are rated as Not Satisfied then we assign that practice Not Satisfied rating.

Next we convert the ratings of practices and sub – practices to the ratings of Criteria and Standards as prescribed by ABET. This is possible because there is a mapping between the practices (and sub – practices) and ABET's Criteria and Standards as described earlier in the section.

4.3 Scoring and Report Implementation

To compute these levels of satisfaction we have set up a spreadsheet in MS Excel that takes as input the rating of all the questions and outputs the ratings for all the sub practices and practices. The score on these practices (and sub practices) are then mapped to CAC guidelines and criteria and based on this a report is prepared listing all the CAC guidelines and criteria that are not fulfilled by the program.

By analyzing these scores, the report is able to point out the criteria and standards that are not up to the mark and are potential sources of problem during accreditation. Figure 8 shows a sample of the Evaluation Report.

In order to facilitate the usage of this questionnaire, we have implemented an online version of it at
http://surveys.bus.oregonstate.edu/BsgSurvey2_0/main.aspx?SurveyID=531&cmd=survey

Using this tool, the user can fill the survey online instead on paper; we receive the program's response and then process them at our end. We then generate the evaluation report and mail it back to the program. This system also helps us in keeping all the data at one place. We can then use this data for statistical purposes.

Conversion from paper to online version required some minor changes in the format of the questionnaire. For instance, the tool that we used for generating the questionnaire doesn't support follow up questions for a question, therefore we had to put those questions as separate questions and asked the subject to answer them only if they gave a particular response to the previous questions. Such an example is shown in Figure 9. If the program does not require course in Discrete Mathematics for graduation then its not possible to provide an intelligent answer to the next question that asks for the number of such courses required for graduation.

We are currently working on making the process of generation of evaluation report automated so that the user can get an instant evaluation. Since report generation is not a totally mechanical process and does require some subjective interpretation, we believe that the final report can only be generated manually. However, we can provide them with an online preliminary report initially.

Evaluation of CAC Self Study Report

Given below is the listing of the CAC standards that are not fully addressed or satisfied in the self study report based on your responses to the questionnaire. For each such standard, rating and the reason for that rating are provided.

I. Objectives and Assessments

I-3. Data relative to the objectives must be routinely collected and documented, and used in program assessments.

Rating: Mostly Satisfied
Reason for rating: Following practices are not satisfied:
Sub practices go here
Q. The corresponding questions are here?
Your response: Seldom
Acceptable response: Every year, Every two years.

Figure 8 Sample Evaluation Report

75. Does the required course work in mathematics include discrete mathematics? (If your answer is NOT Yes, go to Question 77)

- ☐ Yes
- ☐ No
- ☐ Don't know

76. How many required courses include discrete mathematics?

_____ *(format: any numeric value)*

Figure 9 Sample Follow up Questions from Online Questionnaire

Chapter 5

Results, Conclusions and Future Work

5.1 Results

We assessed a couple of Computer Science programs and have got interesting results. The shortcomings pointed out by our tool were similar to those that were found by the visiting team from ABET. However, we'll need to assess a few more programs before claiming that our tool is able to point out all the shortcomings.

One of the programs that we assessed had many 'Don't Know' responses for questions pertaining to standard I-5. "The results of the program's periodic assessments must be used to help identify opportunities for program improvement." that indicated the program has overlooked this area. Also the class size frequently exceeded the limit set by ABET.

Another program didn't fulfilled the minimum course credits required for graduation in science, and the class size frequently exceeded the limit recommended by ABET. After submitting our report to the program, we asked them to send us feedback on how accurate we were in pointing out the problem areas. They said that the biggest problems that they faced with the accreditation were: "i) oversized upper division classes, ii) a weak Science requirement in addition to Physics, and iii) Computing ethics." So, it can be seen that our assessment was very close to what the visiting team found.

Despite the deficiencies, both the programs have been accredited. This implies that ABET doesn't adhere to the standards strictly or uniformly.

5.2 Conclusions and Future Work

Our tool including the set of practices, questionnaire and rating scale provides a comprehensive package for analyzing the Self Study Report of Computer Science program preparing for accreditation by ABET. Although we have gone through a lot of revisions of the model, practices and questionnaire, still we expect that there will be further revisions once the questionnaire is used by more people and we get their feedback.

Another area of future work is to completely automate the process of Evaluation Report generation. Currently, we have to consult the Rating Scale and then come up with the corresponding degree of satisfaction. This is then input into the Excel spreadsheet to get the results. The entire process can be automated by writing a script that parses the responses and then come up with the results.

The concept assessing a Computer Science program can be broadened to encompass the various engineering programs such as Computer Engineering, Electrical Engineering, Chemical Engineering, etc that are accredited by ABET. We have done an initial study of Criteria of Accreditation of Engineering Programs and found it to be similar to CAC's criteria. Like CAC, other Engineering programs also have criteria like Program Educational Objectives, Program Outcomes and Assessments, Professional Component, Faculty, Facilities, Institutional Support and Financial Resources and Program Criteria. Engineering program's Program Outcomes and Assessment is more structured then that of CAC. It consists of 11 standards (a through k). We believe that the meta-model can be used to come up with a tool to assess the Self Study report of various engineering programs. The similarity between the two criteria also means that the tool for engineering programs can be developed with much less effort by using our experience in coming up with the current tool. Further, our model can be modified and used for accreditation of academic programs outside the scope of ABET both within the United States and in foreign countries since the factors to judge the competency of an academic program are similar globally.

Glossary

ABET: Accreditation Board for Engineering and Technology, Inc.
ACM : Association of Computing Machinery
AIS: Association for Information Systems
CAC: Computing Accreditation Commission
CHEA: Council on Higher Education Accreditation
CMM: Capability Maturity Model
CMU: Carnegie Mellon University
CSAB: Computer Science Accreditation Board
CSAC: Computer Science Accreditation Commission
IEEE-CS: Institute of Electrical and Electronics Engineers, Inc – Computer Society
MS: Microsoft Corporation
PEPC: Program Evaluator and Program Criteria
SPI: Software Process Improvement
SEI: Software Engineering Institute

References

1.[CSAB 2002] CSAB, CSAB e-Newsletter http://www.csab.org/newsletter_v1n1/fall2002-newsletter.html. Vol 1, No.1, Fall 2002.

2.[ABET 2003] ABET, www.abet.org

3.[ABET 2002] ABET, ABET Computing Accreditation Commission, 2002 Summit.

4.[ABET 2003] ABET, "Guidance for Interpreting the Criteria for Accrediting Computing Programs (2003-2004)", ABET.

5.[ABET 2003] ABET, "Criteria for Accrediting Engineering Programs. Effective for Evaluations During the 2003-2004 Accreditation Cycle", ABET.

6.[Jones et al 2002] L. Jones, A. Price "Changes in Computer Science Accreditation", Communications of the ACM, Volume 45, Issue 8 (August 2002).

7.[Crouch et al 2003] D. Crouch, L. Schwartzman, "Computer Science Accreditation The Advantage of Being Different", SIGCSE February 2003.

8.[Blandford 2003] D. Blandford, D. Hwang, "Five Easy but Effective Assessment Methods", Proceedings of the 34th SIGCSE technical symposium on Computer science education, 2003.

9.[McDonald et al 1999] M. McDonald, G. McDonald, "Computer Science Curriculum Assessment", 30th SIGCSE technical symposium on Computer science education, 1999.

10. [Fitzgerald 2000] S. Fitzgerald, M. McDonald, N. Kubilus, M. Fienup, D. Lopez "Student Outcomes Assessment What Works and What Doesn't", 31st SIGCSE Technical Symposium, 2000.

11. [Sanders 2003] K. Sanders, R. McCartney, "Program Assessment Tool in Computer Science: A Report from the Trenches", SIGCSE February 2003.

12. [ABET 2003]ABET, "Accreditation Policy and Procedure Manual, Effective for Evaluation during the 2003-2004 Accreditation Cycle".

13. [ABET 2003] ABET, "Criteria for Accrediting Computing Programs, Effective for Evaluations During the 2003-2004 Accreditation Cycle", ABET.

14. [Ibrahim 1995] R. Ibrahim, I. Hirmanpour, "The Subject Matter of Process Improvement: A Topic and Reference Source for Software Engineering Educators and Trainers", Technical Report CMU/SEI-95-TR-003 ESC-TR-95-003, 1995.

15. [McFeely 1996] R. McFeely, "IDEAL: a user's guide for software process improvement." Technical Report CMU/SEI-96-HB-001 (CMU/SEI, Pittsburgh, Pennsylvania, 1996).

16. [Visconti] M. Visconti, C. Cook, "A Meta Model Framework for Software Process Modeling."

Appendix A

CAC Key Practices

I. Definition and assessment of program objectives and expected outcomes

a. The program objectives are stated in terms of documented measurable outcomes.
b. Each course has documented course learning objectives.
c. Course learning objectives cover the program outcomes for graduating students.
d. Data relative to the program objectives is collected and documented on a regular basis.
e. Program objectives, program outcomes, and course learning objectives are assessed on a regular basis.
f. Evaluate assessment data for program objectives, program outcomes and/or course learning objectives and generate recommended changes for program improvement.
g. Process or mechanism to select set of recommended changes and implement these changes to program objectives, program outcomes and/or course learning objectives.
h. Results of assessments, recommended changes, and actions taken are documented.

II. Appropriate level of student support

a. Courses are offered with sufficient frequency for students to complete the program in a timely manner.
b. Computer science courses are structured to ensure effective interaction between faculty/teaching assistants and students in lower division courses and between faculty and students in upper division courses.
c. Guidance on how to satisfy program graduation requirements is documented and available to all students.
d. Students have access to qualified advising when they need to make course decisions and career choices.
e. There are established standards and procedures to ensure that graduates meet the requirements of the program.

III. Faculty qualifications and support

a. There are enough full-time faculty members with primary commitment to the program to provide continuity and stability.
b. Full-time faculty members oversee all course work.
c. Full-time faculty members cover most of the total classroom instruction.
d. The interests and qualifications of the faculty members are sufficient to teach the courses and to plan and modify the courses and curriculum.
e. All faculty members remain current in the discipline.

f. All faculty members have a level of competence that would normally be obtained through graduate work in computer science.
g. Some full-time faculty members have a Ph.D. in computer science.
h. All full-time faculty members have sufficient time for scholarly activities and professional development.
i. Advising duties are recognized part of faculty members' workloads.

IV. Curriculum consistent with program objectives

a. The curriculum includes at least 40 semester hours (60 quarter hours) of up-to-date study in computer science topics.
b. The curriculum contains at least 30 semester hours (45 quarter hours) of study in mathematics and science.
c. The curriculum includes at least 30 semester hours (45 quarter hours) of study in humanities, social sciences, arts and other disciplines that serve to broaden the background of the student.
d. The curriculum is consistent with the documented objectives and outcomes of the program.
e. All students take a broad-based core of fundamental computer science material consisting of at least 16 semester hours (24 quarter hours).
f. The core materials provide basic coverage of algorithms, data structures, software design, concepts of programming languages, and computer organization and architecture.
g. Theoretical foundations, problem analysis, and solution design are stressed within the program's core materials.
h. Students are exposed to a variety of programming languages and systems and must become proficient in at least one higher-level language.
i. All students take at least 16 semester hours (24 quarter hours) of advanced course work in computer science that provides breadth and builds on the core to provide depth.
j. The curriculum includes at least 15 semester hours (22.5 quarter hours) of mathematics.
k. Course work in mathematics must include discrete mathematics, differential and integral calculus, and probability and statistics.
l. The curriculum includes at least 12 semester hours (18 quarter hours) of science.
m. Course work in science includes the equivalent of a two-semester sequence in a laboratory science for science or engineering majors.
n. Science course work in addition to that specified in (m) above that enhances the student's ability to apply the scientific method.
o. The oral communications skills of the student are developed and applied in the program.
p. The written communications skills of the student are developed and applied in the program.
q. There is sufficient coverage of social and ethical implications of computing to give students an understanding of a broad range of issues in this area.

V. Adequate level of laboratory and facility support to meet program objectives

a. Each student has adequate and reasonable access to the systems needed for each course.
b. Documentation for hardware and software is readily accessible to faculty and students.
c. All faculty members have access to adequate computing facilities for class preparation and scholarly activities.
d. There are adequate support personnel to install and maintain the laboratories and computing facilities.
e. Instructional assistance is provided for the laboratories and computing facilities.

VI. Appropriate level of institutional and financial support to meet program objectives

a. Support for faculty is sufficient to enable the program to attract and retain high quality faculty capable of supporting the program's objectives.
b. There is sufficient support and financial resources to allow all faculty members to attend national technical meetings with sufficient frequency to maintain competence as teachers and scholars.
c. There is support and recognition of scholarly activities.
d. There is office support consistent with the type of program, level of scholarly activity, and needs of the faculty members.
e. Adequate time is assigned for the administration of the program.
f. Upper levels of administration provide the program with the resources and atmosphere to function effectively with the rest of the institution.
g. Resources are provided to acquire and maintain laboratory facilities that meet the needs of the program.
h. Resources are provided to support library and related information retrieval facilities that meet the needs of the program.
i. There is evidence that the institutional support and financial resources will remain in place throughout the period of accreditation.

VII. Adequate level of institutional facilities to meet program objectives

a. The library that serves the computer science program is adequately staffed with professional librarians and support personnel.
b. The library's technical collection includes up-to-date textbooks, reference works, and publications of professional and research organizations such as the ACM and the IEEE Computer Society.
c. A system for locating and obtaining electronic information is available.
d. Classrooms are adequately equipped for the courses taught.

e. Faculty offices are adequate to enable faculty members to meet their responsibilities to students and for their professional needs.

Appendix B

Questionnaire

Pre-Assessment CAC Questionnaire

Answer the following questions about your CAC Accreditation Report. Please circle your response(s).

Program objectives, outcomes and course learning objectives

1. How many **program objectives** are there? _____ Don't know

2. Are the program objectives documented?

Yes No Don't know

If Yes, are the objectives readily accessible to all faculty and appropriate staff?

Yes No Don't know

If Yes, where are they located? (Circle all that apply)

Web page Main office Faculty offices Other _____

If Yes, how are they accessed? (Circle all that apply)

Electronically By request Other _____

3. How many of the program objectives are stated in terms of one or more measurable **program outcomes**?

None Some Most All Don't know

4. How many of the program outcomes are measurable?

None Some Most All Don't know

5. Do all courses have documented **learning objectives**?

Yes No Don't know

6. Is each program outcome associated with at least one course learning objective?

Yes No Don't know

If Yes, how is the association documented? (Circle all that apply)

Table List Other _____

7. What methods are used to collect data that may be used to measure degree of student achievement for each program outcome (Circle all that apply)?

Senior exit survey Senior exit interview Alumni survey

Employer survey Local written exam National written exam

Oral exam Industrial advisory panel Capstone course(s)

Other _____ Don't know

8. How often is this data in Question 7 collected?

Every year Every 2 years Seldom Never Don't know

9. How often are program objectives assessed?

Every year Every 2 years Seldom Never Don't know

10. Who is involved in assessing program objectives? (Circle all that apply)

Department head Faculty Industry representatives

Student representatives Alumni Other _____

Don't know

11. Are the assessment results evaluated and recommendations made for changes to documented program objectives?

Yes No Don't know

If Yes, how many of these recommendations have led to changes in program objectives?

None Some Most All Don't know

12. Is there a process or mechanism to select which recommended changes to program objectives will be implemented?

Yes No Don't know

13. How often is the impact of changes to program objectives evaluated?

Every year Every 2 years Seldom Never Don't know

14. Degree to which the curriculum as a whole is consistent with the documented objectives of the program?

Low Medium High Don't know

15. How often are program outcomes assessed?

Every year Every 2 years Seldom Never Don't know

16. Who is involved in assessing program outcomes? (Circle all that apply)

Department head Faculty Industry representatives

Student representatives Alumni Other _____

Don't know

17. Are the assessment results evaluated and recommendations made for changes to documented program outcomes?

Yes No Don't know

If Yes, how many of these recommendations have led to changes in program outcomes?

None Some Most All Don't know

18. Is there a process or mechanism to select which recommended changed to program outcomes will be implemented?

Yes No Don't know

19. How often is the impact of changes to program outcomes evaluated?

Every year Every 2 years Seldom Never Don't know

20. How often are course learning objectives assessed?

Every time it is taught Every year Every 2 years

Seldom Never Don’t know

21. Who is involved in assessing course learning objectives? (Circle all that apply)

Course instructor Students in course Faculty committee

Student committee Other _____ Don’t know

22. Are the assessment results evaluated and recommendations made for changes to documented course learning objectives?

Yes No Don’t know

If Yes, how many of these recommendations have led to changes in course learning objectives?

None Some Most All Don’t know

23. Is there a process or mechanism to select which recommended changes to course learning objectives will be implemented?

Yes No Don’t know

24. How often is the impact of changes to course learning objectives evaluated?

Every year Every 2 years Seldom Never Don’t know

Course Offerings

25. How often are required lower division courses offered during the regular academic year?

For schools following quarter system

Every quarter Twice each year Once each year Every other year Don’t know

For schools following semester system

Twice each year Once each year Every other year Don’t know

26. How often are required upper division courses offered during the regular academic year?

For schools following quarter system

Every quarter Twice each year Once each year Every other year Don't know

For schools following semester system

Twice each year Once each year Every other year Don't know

27. How often are required upper division core computer science courses offered?

For schools following quarter system

Every quarter Twice each year Once each year Every other year Don't know

For schools following semester system

Twice each year Once each year Every other year Don't know

28. How often do upper division class sizes exceed 30?

Never Seldom Frequently Always Don't know

Teaching Assistance

29. Is there a mechanism to ensure effective interaction in lower division course?

Yes No Don't know

If Yes, how is the effective interaction in lower division courses ensured?

TA assigned Other_____ Don't know

30. When teaching assistants or graders are used in a large lower division course, approximately what is the ratio of students to teaching assistants or graders?

_____: 1 Don't know

31. Is there a mechanism to ensure effective interaction in upper division courses?

Yes No Don't know

If Yes, how is effective interaction in upper division courses ensured?

TA assigned Other_____ Don't know

32. When teaching assistants or graders are used in a large upper division course, approximately what is the ratio of students to teaching assistants or graders ?

_____: 1 Don't know

Advising

33. How is student advising handled? (Circle all that apply)

Centralized advising office All faculty advise Some faculty advise

Staff advises Other_____ Don't know

If faculty does advising, approximately what is the ratio of students to advisors?

_____: 1 Don't know

34. When the number of advisees exceeds what threshold will a faculty receive released time for advising?

_____ Never Don't know

35. How is an advisor made available to each student?

Each student is assigned an advisor Other _____

Don't know

If advisors are assigned to each student, for how long is the advisor assigned?

Each year Multiple years Other _____ Don't know

36. Are students required to see an advisor?

Yes No Don't know

If Yes, how often?

Every term Once each year Other _____ Don't know

37. How is quality of advising ensured?

Advisors receive training Other _____ Don't know

38. How is student career and placement advising handled?

University Career Center Department Career Center Faculty Advisors

Staff advises Other _____ Don't know

Faculty

39. Number of full-time faculty (tenure-track and instructors)?

_____ Don't know

40. Is a full-time tenure-track faculty member assigned to oversee each course?

Yes No Don't know

41. What is the maximum teaching load per term for full-time instructors?

For schools following quarter system

6 hours 9 hours 12 hours Don't know

For schools following semester system

4 hours 6 hours 8 hours Don't know

42. What is the maximum teaching load per term for full-time tenure-track faculty?

For schools following quarter system

6 hours 9 hours 12 hours Don't know

For schools following semester system

4 hours 6 hours 8 hours Don't know

43. Approximately, what percentage of courses is taught by full-time faculty (tenure-track and instructors)?

_____% Don't know

44. Approximately, what percentage of courses is taught by faculty with graduate coursework or practical experience in the course content?

_____% Don't know

45. Approximately, what percentage of full-time faculty (tenure-track and instructors) has a graduate degree in computer science?

_____% Don't know

46. Approximately, what percentage of full-time tenure-track faculty has a Ph.D. in computer science?

_____% Don't know

Graduation Requirements

47. Is there a mechanism to check that the graduates fulfill the program requirements?

Yes No Don't know

If Yes, is the mechanism documented?

Yes No Don't know

If Yes, how is the student notified of his status on the Program Requirements?

_____

If Yes, how long before graduation are the students informed of these requirements?

One term One year Other_____ Don't know

If Yes, does the mechanism provide for handling exceptions (e.g. transfer students, recent changes in program requirements)?

Yes No Don't know

48. Is there documentation that describes graduation requirements?

Yes No Don't know

If Yes, does the documentation cover exceptions such as transfer courses or who will be impacted by changes in graduation requirements?

Yes No Don't know

49. Is the documentation describing graduation requirements available to students?

Yes No Don't know

If Yes, how do students access it? (Circle all that apply)

Web page Main office Student advisor Other _____

50. How many hours of computer science courses are required for graduation?

For schools following quarter system

<40 40 or more Don't know

For schools following semester system

<27 27 or more Don't know

51. How many hours of mathematics and science courses are required for graduation?

For schools following quarter system

<30 30 or more Don't know

For schools following semester system

<20 20 or more Don't know

52. How many hours of mathematics courses are required for graduation?

For schools following quarter system

<23 23 or more Don't know

For schools following semester system

<15 15 or more Don't know

53. How many hours of science courses are required for graduation?

For schools following quarter system

<18 18 or more Don't know

For schools following semester system

<12 12 or more Don't know

54. Does the required course work in mathematics include discrete mathematics?

Yes No Don’t know

55. Does the required course work in mathematics include differential and integral calculus?

Yes No Don’t know

56. Does the required course work in mathematics include probability and statistics?

Yes No Don’t know.

57. How many hours of humanities, social science and arts course work are required for graduation?

For schools following quarter system

<45 45 or more Don’t know

For schools following semester system

<30 30 or more Don’t know

58. How many hours in the core of fundamental computer science course work?

For schools following quarter system

<24 24 or more Don’t know

For schools following semester system

<16 16 or more Don’t know

59. Does fundamental computer science core include coverage of data structures and algorithm?

Yes No Don’t know

60. Does fundamental computer science core include coverage of software design?

Yes No Don’t know

61. Does fundamental computer science core include coverage of concepts of programming languages?

Yes No Don’t know

62. Does fundamental computer science core include coverage of computer organization and architecture?

Yes No Don’t know

63. Are theoretical foundations stressed in the fundamental computer science core?

Yes No Don’t know

If Yes, in how many courses is it stressed?

None Some Most All Don’t know

64. Are problem analysis and solution design stressed in the fundamental computer science core?

Yes No Don’t know

If Yes, in how many courses is it stressed?

None Some Most All Don’t know

65. Are students exposed to several different programming languages and systems?

Yes No Don’t know

66. Do students become proficient in at least one higher-level programming language?

Yes No Don’t know

67. How many hours of advanced computer science course work are required for graduation?

For schools following quarter system

<24 24 or more Don’t know

For schools following semester system

<16 16 or more Don’t know

68. Does the course work in science include the equivalent of a two-semester sequence in a laboratory science for science or engineering majors?

Yes No Don’t know

69. Do the required science courses in addition to two-semester course sequence in Question 64 enhance the student's ability to apply the scientific method?

Yes No Don’t know

70. How many oral communications courses are required?

_____ Don’t know

71. How many written communications courses are required?

_____ Don’t know

72. How are the students prepared for writing specifically for Computer Science?

Computer Science courses Writing Courses Others_____

Don’t know

73. Are the students required to take course work in social and ethical implications of computing?

Yes No Don’t know

If Yes, how are the students taught this topic? (Circle all that apply)

Parts of several courses Entire course(s)

Other _____ Don’t know

Facilities and Support

74. Do students have access to workstations with all the software and compilers needed for completing all computer science courses?

Yes No Don’t know

75. Rate the support for software and hardware available to faculty and students.

Doesn’t meet needs Meet needs Exceed needs Don’t know

76. Rate the degree to which instructional assistance is provided for the laboratories and computing facilities.

Doesn't meet needs Meet needs Exceed needs Don't know

77. How often is support staff available when computer laboratories are open?

Never Sometimes Most of the time Always Don't know

78. How many FTE of support personnel are available to install and maintain the department laboratories and computing facilities?

_____ Don't know

79. Does each faculty member have at least one workstation in their office that is connected to the university network and the Internet?

Yes No Don't know

80. Rate the overall computing facilities provided to each faculty member for their scholarly activities.

Doesn't meet needs Meet needs Exceed needs Don't know

81. Rate the overall computing facilities provided to each faculty member for their teaching.

Doesn't meet needs Meet needs Exceed needs Don't know

Faculty support

82.Is the compensation package and other benefits provided to faculty comparable to the national average for CS/Engineering faculty member?

Yes No Don't know

83. How many full-time tenure-track faculty attend at least one conference in their research area each year?

None Some Most All Don't know

84. How many full-time tenure-track faculty present at least one paper at a conference in their research area each year?

None Some Most All Don't know

85. How many full-time tenure-track faculty publish at least one paper in a journal in their research area each year?

None Some Most All Don't know

86. How many full-time tenure-track faculty are supported by at least one grant?

None Some Most All Don't know

87. Do faculty receive institutional/department support to attend national technical meetings?

Yes No Don't know

88. How is faculty supported for a conference?

Institutional Support Research Grant Personal Funds

Others_____ Don't know

89. Are scholarly activities recognized by the department?

Yes No Don't know

If Yes, how are they recognized? (Circle all that apply)

Publicized Reduced teaching Salary increase

Others_____ Don't know

Institutional Support and Resources

90. Rate the secretarial staff and services available support for faculty?

Poor Below average Above average Excellent Don't know

91. Is there a full time department head with at least 0.5 FTE allocated for administration?

Yes No Don't know

92. Are the resources allocated for the program by the administration in line with the national average for CS programs in comparable universities?

Yes No Don’t know

93. Rate the resources provided to acquire and maintain laboratory facilities for the program.

Poor Below average Above average Excellent Don’t know

94. Rate the resources provided to support library and related information retrieval facilities for the program.

Poor Below average Above average Excellent Don’t know

95. Rate the professional librarians and support personnel resource of the library that serves the computer science program.

Poor Below average Above average Excellent Don’t know

96. Does the library’s technical collection include up-to-date textbooks, reference works, and publications of professional and research organizations such as the ACM and the IEEE Computer Society?

Yes No Don’t know

97. Is a system for locating and obtaining electronic information available?

Yes No Don’t know

98. How well equipped are the classrooms used for teaching computer science courses?

Doesn’t meet needs Meet needs Exceed needs Don’t know

99. How well do faculty offices accommodate for meeting with students?

Doesn’t meet needs Meet needs Exceed needs Don’t know

100. Rate the adequacy of offices for faculty professional needs.

Doesn’t meet needs Meet needs Exceed needs Don’t know

101. Is there a history of evidence that the institutional support and financial resources will remain in place throughout the period of accreditation?

Yes No Don’t know

Appendix C

Rating Scale

Question	Level of Satisfaction			
	Fully Satisfied	Possibly Satisfied	Not Satisfied	Undecided
1. How many **program objectives** are there?	3-7	0-2 or >7	0	Don't know
2. Are the program objectives documented?	Yes		No	Don't know
2.a. If Yes, are the objectives readily accessible to all faculty and appropriate staff?	Yes		No	Don't know
2.b. If Yes, where are they located? (Circle all that apply)	At least one option		No option selected	
2.c. If Yes, how are they accessed? (Circle all that apply)	At least one option		No option selected	
3. How many of the program objectives are stated in terms of two or more measurable **program outcomes**?	Most, All	Some	None	Don't know
4. How many of the program outcomes are measurable?	Most, All	Some	None	Don't know
5. Do all courses have documented **learning objectives**?	Yes		No	Don't know
6. Is each program outcome associated with at least one course-learning objective?	Yes		No	Don't know
6.a. If Yes, how is the association documented? (Circle all that apply)	At least one option		No option selected	
7. What methods are used to collect data that may be used to measure degree of student achievement for each program outcome (Circle all that apply)?	At least one option		No option selected	Don't know
8. How often is this data in Question 7 collected?	Every year, Every 2 years	Seldom	Never	Don't know
9. How often are program objectives assessed?	Every year,	Seldom	Never	Don't know

	Every 2 years			
10. Who is involved in assessing program objectives? (Circle all that apply)	At least one option		No option selected	Don't know
11. Are the assessment results evaluated and recommendations made for changes to documented program objectives?	Yes		No	Don't know
11.a. If Yes, how many of these recommendations have led to changes in program objectives?	All, Most	Some	None	Don't know
12. Is there a process or mechanism to select which recommended changes to program objectives will be implemented?	Yes		No	Don't know
13. How often is the impact of changes to program objectives evaluated?	Every year, Every 2 years	Seldom	Never	Don't know
14. Degree to which the curriculum as a whole is consistent with the documented objectives of the program?	High	Medium	Low	Don't know
15. How often are program outcomes assessed?	Every year, Every 2 years	Seldom	Never	Don't know
16. Who is involved in assessing program outcomes? (Circle all that apply)	At least one option		No option selected	Don't know
17. Are the assessment results evaluated and recommendations made for changes to documented program outcomes?	Yes		No	Don't know
17.a. If Yes, how many of these recommendations have led to changes in program outcomes?	All, Most	Some	None	Don't know
18. Is there a process or mechanism to select which recommended changed to program outcomes will be implemented?	Yes		No	Don't know
19. How often is the impact of changes to program outcomes evaluated?	Every year, Every 2 years	Seldom	Never	Don't know
20. How often are course learning objectives assessed?	Every time it is taught, Every year	Every 2 years, Seldom	Never	Don't know

21. Who is involved in assessing course learning objectives? (Circle all that apply)	At least one option		No option selected	Don't know
22. Are the assessment results evaluated and recommendations made for changes to documented course learning objectives?	Yes		No	Don't know
22.a. If Yes, how many of these recommendations have led to changes in course learning objectives?	All, Most	Some	None	Don't know
23. Is there a process or mechanism to select which recommended changes to course learning objectives will be implemented?	Yes		No	Don't know
24. How often is the impact of changes to course learning objectives evaluated?	Every year, Every 2 years	Seldom	Never	Don't know
25. How often are required lower division courses offered during the regular academic year?	Quarter system: Every quarter, Twice each year, Sem. system Twice each year	Once each year	Every other year	Don't know
26. How often are required upper division courses offered during the regular academic year?	Quarter system: Every quarter, Twice each year, Sem. system Twice each year	Once each year	Every other year	Don't know
27. How often are required upper division core computer science courses offered?	Quarter system: Every quarter,	Once each year	Every other year	Don't know

	Twice each year, Sem. system Twice each year			
28. How often do upper division class sizes exceed 30?	Never, Seldom	Frequently	Always	Don't know
29. Is there a mechanism to ensure effective interaction in lower division course?	Yes		No	Don't know
29.a. If Yes, how is the effective interaction in lower division courses ensured?	Any option		No option	Don't know
30. When teaching assistants or graders are used in a large lower division course, approximately what is the ratio of students to teaching assistants or graders?	Any number		No number	Don't know
31. Is there a mechanism to ensure effective interaction in upper division courses?	Yes		No	Don't know
31.a. If Yes, how is effective interaction in upper division courses ensured?	Any option		No option	Don't know
32. When teaching assistants or graders are used in a large upper division course, approximately what is the ratio of students to teaching assistants or graders?	Any number		No number	Don't know
33. How is student advising handled? (Circle all that apply)	At least one option		No option selected	Don't know
33.a. If faculty does advising, approximately what is the ratio of students to advisors?	Any number		No number	Don't know
34. When the number of advisees exceeds what threshold will a faculty receive released time for advising?	Any number		Never	Don't know
35. How is an advisor made available to each student?	Each student is assigned an advisor Other			Don't know
35.a. If advisors are assigned to each	Any		No	Don't

student, for how long is the advisor assigned?	option		option selected	know
36. Are students required to see an advisor?	Yes		No	Don't know
36.a. If Yes, how often?	Any option		No option selected	Don't know
37. How is quality of advising ensured?	Any option		No option	Don't know
38. How is student career and placement advising handled?	Any option		No option	Don't know
39. Number of full-time faculty (tenure-track and instructors)?	>5		<5	Don't know
40. Is a full-time tenure-track faculty member assigned to oversee each course?	Yes		No	Don't know
41. What is the maximum teaching load per term for full-time instructors?	Quarter system: 6 hours Sem. System: 4 hours	Quarter system: 9 hours Sem. System: 6 hours	Quarter system: 12 hours Sem. System: 8 hours	Don't know
42. What is the maximum teaching load per term for full-time tenure-track faculty?	Quarter system: 6 hours Sem. System: 4 hours	Quarter system: 9 hours Sem. System: 6 hours	Quarter system: 12 hours Sem. System: 8 hours	Don't know
43. Approximately, what percentage of courses is taught by full-time faculty (tenure-track and instructors)?	>70		<70	Don't know
44. Approximately, what percentage of courses is taught by faculty with graduate coursework or practical experience in the course content?	>threshold		<threshold	Don't know
45. Approximately, what percentage of full-time faculty (tenure-track and instructors) has a graduate degree in computer science?	>50%		<50%	Don't know
46. Approximately, what percentage of full-time tenure-track faculty has a Ph.D. in computer science?	>50%		<50%	Don't know
47. Is there a mechanism to check that the graduates fulfill the program requirements?	Yes		No	Don't know
47.a. If Yes, is the mechanism	Yes		No	Don't

documented?				know
47.b. If Yes, how is the student notified of his status on the Program Requirements?	Any answer		No answer	
47.c. If Yes, how long before graduation are the students informed of these requirements?	One term	One year	>One year	Don't know
47.d. If Yes, does the mechanism provide for handling exceptions (e.g. transfer students, recent changes in program requirements)?	Yes		No	Don't know
48. Is there documentation that describes graduation requirements?	Yes		No	Don't know
48.a. If Yes, does the documentation cover exceptions such as transfer courses or who will be impacted by changes in graduation requirements?	Yes		No	Don't know
49.Is the documentation describing graduation requirements available to students?	Yes		No	Don't know
49.a. If Yes, how do students access it? (Circle all that apply)	Any answer			
50. How many hours of computer science courses are required for graduation?	Quarter system: >=40 hours Sem. System: >=27 hours		Quarter system: <40 hours Sem. System: <27 hours	Don't know
51. How many hours of mathematics and science courses are required for graduation?	Quarter system: >=30 hours Sem. System: >=20 hours		Quarter system: <30 hours Sem. System: <20 hours	Don't know
52. How many hours of mathematics courses are required for graduation?	Quarter system: >=23 hours Sem. System: >=15		Quarter system: <23 hours Sem. System: <15	Don't know

	hours		hours	
53. How many hours of science courses are required for graduation?	Quarter system: >=18 hours Sem. System: >=12 hours		Quarter system: <18 hours Sem. System: <12 hours	Don't know
54. Does the required course work in mathematics include discrete mathematics?	Yes		No	Don't know
55. Does the required course work in mathematics include differential and integral calculus?	Yes		No	Don't know
56. Does the required course work in mathematics include probability and statistics?	Yes		No	Don't know
57. How many hours of humanities, social science and arts course work are required for graduation?	Quarter system: >=45 hours Sem. System: >=30 hours		Quarter system: <45 hours Sem. System: <30 hours	Don't know
58. How many hours in the core of fundamental computer science course work?	Quarter system: >=24 hours Sem. System: >=16 hours		Quarter system: <24 hours Sem. System: <16 hours	Don't know
59. Does fundamental computer science core include coverage of data structures and algorithm?	Yes		No	Don't know
60. Does fundamental computer science core include coverage of software design?	Yes		No	Don't know
61. Does fundamental computer science core include coverage of concepts of programming languages?	Yes		No	Don't know
62. Does fundamental computer science core include coverage of computer organization and architecture?	Yes		No	Don't know

63. Are theoretical foundations stressed in the fundamental computer science core?	Yes		No	Don't know
63. a. If Yes, in how many courses is it stressed?	Most, All	Some	None	Don't know
64. Are problem analysis and solution design stressed in the fundamental computer science core?	Yes		No	Don't know
64. a. If Yes, in how many courses is it stressed?	Most, All	Some	None	Don't know
65. Are students exposed to several different programming languages and systems?	Yes		No	Don't know
66. Do students become proficient in at least one higher-level programming language?	Yes		No	Don't know
67. How many hours of advanced computer science course work are required for graduation?	Quarter system: >=24 hours Sem. System: >=16 hours		Quarter system: <24 hours Sem. System: <16 hours	Don't know
68. Does the course work in science include the equivalent of a two-semester sequence in a laboratory science for science or engineering majors?	Yes		No	Don't know
69. Do the required science courses in addition to two-semester course sequence in Question 68 enhance the student's ability to apply the scientific method?	Yes		No	Don't know
70. How many oral communications courses are required?	>0		0	Don't know
71. How many written communications courses are required?	>0		0	Don't know
72. How are the students prepared for writing specifically for Computer Science?	Any option		No option	Don't know
73. Are the students required to take course work in social and ethical implications of computing?	Yes		No	Don't know
73.a. If Yes, how are the students taught this topic? (Circle all that apply)	Any option		No option	Don't know
74. Do students have access to workstations with all the software and	Yes		No	Don't know

compilers needed for completing all computer science courses?				
75. Rate the support for software and hardware available to faculty and students.	Exceed needs	Meet needs	Doesn't meet needs	Don't know
76. Rate the degree to which instructional assistance is provided for the laboratories and computing facilities.	Exceed needs	Meet needs	Doesn't meet needs	Don't know
77. How often is support staff available when computer laboratories are open?	Most of the time, Always	Someti me	Never	Don't know
78. How many FTE of support personnel are available to install and maintain the department laboratories and computing facilities?	>0		0	Don't know
79. Does each faculty member have at least one workstation in their office that is connected to the university network and the Internet?	Yes		No	Don't know
80. Rate the overall computing facilities provided to each faculty member for their scholarly activities.	Exceed needs	Meet needs	Doesn't meet needs	Don't know
81. Rate the overall computing facilities provided to each faculty member for their teaching.	Exceed needs	Meet needs	Doesn't meet needs	Don't know
82.Is the compensation package and other benefits provided to faculty comparable to the national average for CS/Engineering faculty member?	Yes		No	Don't know
83. How many full-time tenure-track faculty attend at least one conference in their research area each year?	Most, All	Some	None	Don't know
84. How many full-time tenure-track faculty present at least one paper at a conference in their research area each year?	Most, All	Some	None	Don't know
85. How many full-time tenure-track faculty publish at least one paper in a journal in their research area each year?	Most, All	Some	None	Don't know
86. How many full-time tenure-track faculty are supported by at least one grant?	Most, All	Some	None	Don't know
87. Do faculty receive institutional/department support to attend national technical meetings?	Yes		No	Don't know
88. How is faculty supported for a	Instituti		Personal	

conference?	onal Support Researc h Grant Other		Funds	
89. Are scholarly activities recognized by the department?	Yes		No	Don't know
89.a. If Yes, how are they recognized? (Circle all that apply)	Any option		No option	Don't know
90. Rate the secretarial staff and services available support for faculty?	Excellen t	Above average	Poor, Below average	Don't know
91. Is there a full time department head with at least 0.5 FTE allocated for administration?	Yes		No	Don't know
92. Are the resources allocated for the program by the administration in line with the national average for CS programs in comparable universities?	Yes		No	Don't know
93. Rate the resources provided to acquire and maintain laboratory facilities for the program.	Excellen t	Above average	Poor, Below average	Don't know
94. Rate the resources provided to support library and related information retrieval facilities for the program.	Excellen t	Above average	Poor, Below average	Don't know
95. Rate the professional librarians and support personnel resource of the library that serves the computer science program.	Excellen t	Above average	Poor, Below average	Don't know
96. Does the library's technical collection include up-to-date textbooks, reference works, and publications of professional and research organizations such as the ACM and the IEEE Computer Society?	Yes		No	Don't know
97. Is a system for locating and obtaining electronic information available?	Yes		No	Don't know
98. How well equipped are the classrooms used for teaching computer science courses?	Exceed needs	Meet needs	Doesn't meet needs	Don't know
99. How well do faculty offices accommodate for meeting with students?	Exceed needs	Meet needs	Doesn't meet needs	Don't know
100. Rate the adequacy of offices for faculty professional needs.	Exceed needs	Meet needs	Doesn't meet	Don't know

			needs	
101. Is there a history of evidence that the institutional support and financial resources will remain in place throughout the period of accreditation?	Yes		No	Don't know

Appendix D
Meta Model for Computer Science Accreditation

Phase	Meta Practices for each Dimension	
	Core Process	Quality Assurance
Identify	I. Define program objectives and expected outcomes II. Define appropriate level of student support III. Define faculty qualifications and support IV. Define curriculum consistent with program objectives V. Define adequate level of laboratory and facility support to meet program objectives VI. Define appropriate level of institutional and financial support to meet program objectives VII. Define adequate level of institutional facilities to meet program objectives	The program's objectives should be consistent with the mission statement of the administrative unit housing the program. Objectives satisfaction Assessment
Monitor	I- I-1. The program has documented measurable objectives. I-2. The program's objectives include expected outcomes for graduating students. I-3. Data relative to the objectives is routinely collected and documented, and used in program assessments. I-4. The extent to which each program objective is being met is periodically assessed. II-1. Courses are offered with sufficient frequency for students to complete the program in a timely manner. II-2. Computer science courses are structured to ensure effective interaction between faculty/teaching assistants and students in lower division courses and between faculty and students in upper division courses. II-3. Guidance on how to complete the program is available to all students. II-4. Students have access to qualified advising when they need to make course decisions and career choices. II-5. There is a established standards and procedures to ensure that graduates meet the requirements of the program. III-1. There are enough full-time faculty members with primary commitment to the program to provide continuity and stability. III-2. Full-time faculty members oversee all course work. III-3. Full-time faculty members cover most of the total classroom instruction. III-4. The interests and qualifications of the faculty members is sufficient to	

	teach the courses and to plan and modify the courses and curriculum. III-5. All faculty members remain current in the discipline. III-6. All faculty members have a level of competence that would normally be obtained through graduate work in computer science. III-7. Some full-time faculty members have a Ph.D. in computer science. III-8. All full-time faculty members have sufficient time for scholarly activities and professional development. III-9. Advising duties is recognized part of faculty members' workloads. Curriculum Requirements General IV-1. The curriculum include at least 40 semester hours of up-to-date study in computer science topics. IV-2. The curriculum contain at least 30 semester hours of study in mathematics and science as specified below under Mathematics and Science. IV-3. The curriculum include at least 30 semester hours of study in humanities, social sciences, arts and other disciplines that serve to broaden the background of the student. IV-4. The curriculum is consistent with the documented objectives of the program. Computer Science IV-5. All students take a broad-based core of fundamental computer science material consisting of at least 16 semester hours. IV-6. The core materials provide basic coverage of algorithms, data structures, software design, concepts of programming languages, and computer organization and architecture. IV-7. Theoretical foundations, problem analysis, and solution design is stressed within the program's core materials. IV-8. Students are exposed to a variety of programming languages and systems and must become proficient in at least one higher-level language. IV-9. All students take at least 16 semester hours of advanced course work in computer science that provides breadth and builds on the core to provide depth. Mathematics and Science IV-10. The curriculum include at least 15 semester hours of mathematics. IV-11. Course work in mathematics must include discrete mathematics, differential and integral calculus, and probability and statistics. IV-12. The curriculum include at least 12 semester hours of science. IV-13. Course work in science includes the equivalent of a two-semester sequence in a laboratory science for science or engineering majors. IV-14. Science course work additional to that specified in Standard IV-13 is

	in science courses or courses that enhance the student's ability to apply the scientific method. Additional Areas of Study IV-15. The oral communications skills of the student is developed and applied in the program. IV-16. The written communications skills of the student is developed and applied in the program. IV-17. There is sufficient coverage of social and ethical implications of computing to give students an understanding of a broad range of issues in this area. V-1. Each student has adequate and reasonable access to the systems needed for each course. V-2. Documentation for hardware and software is readily accessible to faculty and students. V-3. All faculty members have access to adequate computing facilities for class preparation and for scholarly activities. V-4. There are adequate support personnel to install and maintain the laboratories and computing facilities. V-5. Instructional assistance is provided for the laboratories and computing facilities. VI-1. Support for faculty is sufficient to enable the program to attract and retain high quality faculty capable of supporting the program's objectives. VI-2. There is sufficient support and financial resources to allow all faculty members to attend national technical meetings with sufficient frequency to maintain competence as teachers and scholars. VI-3. There is support and recognition of scholarly activities. VI-4. There is office support consistent with the type of program, level of scholarly activity, and needs of the faculty members. VI-5. Adequate time is assigned for the administration of the program. VI-6. Upper levels of administration provide the program with the resources and atmosphere to function effectively with the rest of the institution. VI-7. Resources are provided to acquire and maintain laboratory facilities that meet the needs of the program. VI-8. Resources are provided to support library and related information retrieval facilities that meet the needs of the program. VI-9. There is evidence that the institutional support and financial resources will remain in place throughout the period of accreditation. VII-1. The library that serves the computer science program is adequately staffed with professional librarians and support personnel. VII-2. The library's technical collection includes up-to-date textbooks, reference works, and publications of professional and research organizations such as the ACM and the IEEE Computer Society.

	VII-3. A system for locating and obtaining electronic information is available. VII-4. Classrooms are adequately equipped for the courses taught. VII-5. Faculty offices are adequate to enable faculty members to meet their responsibilities to students and for their professional needs.