

## **The EC 2000 System in Chemical Engineering at Washington State University**

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In October, 1995 the Chemical Engineering Department at Washington State University had its regularly scheduled ABET visit. After that visit it was apparent that the next ABET general review would be conducted using EC2000. Given that we would have six years to implement and work with this new procedure the faculty in the Chemical Engineering Department decided to start the process immediately so that we could demonstrate full implementation of a EC2000 compatible program by the time of our next general review.

### A. The Initial Stages

As with many departments our first difficulty lay in trying to decide what to do. We knew, or at least felt, that what we were currently doing resulted in a strong program. But how do you demonstrate this to an ABET visitor? As with many in this situation we started by trying to decide what our mission, objectives and outcomes were going to be. This resulted in many lengthy faculty meetings involving debates on the meanings of words and phrases, interpretations of the same, what items could be inferred in our statements, what need to be explicitly stated, and so on. After almost a year of this activity we were further along than when we had started but we still were not making the progress that we wanted.

It was about this time that the revelation hit us. We had been spending all of our time trying to come up with a “perfect” product; one that we could implement and then never have to change. But what we really needed to do was to create a system. This system would start with a number of ill-defined units that would become better defined with time and modifications. But once we had a system to handle inputs, assess their meaning, make changes, and then follow-up on the changes the product would develop on its own.

While our system would involve input from many different constituencies we did feel a need to start with something on paper to help guide the process. Thus, in May, 1997 we started with the cornerstone of our process – an all-day, all-faculty meeting

called solely for the purpose of reviewing data from the prior academic year and recommending actions for the coming year. The date at the end of the semester was intentionally selected because: 1) it occurred after grades had to be submitted but while the faculty academic year contract was still in force, 2) it occurred while most of the data to be assessed were still fresh in our minds, and 3) there was time over the summer to implement some of the recommended changes prior to the start of another academic year.

At that first meeting our goal was to develop our process and to start a draft of our mission, objectives and outcomes. The first major hurdle to overcome was whether to use the outcomes set by ABET and AIChE verbatim as our set of outcomes. A portion of the faculty felt this was desirable, as this would provide a “safe” route. Others felt that the ABET/AIChE outcomes were too generic and lacked emphasis on what this particular department sought to achieve with its students. In the end we drafted our own set of program outcomes, but then provided a table that mapped the equivalencies between our outcomes and those set forth by both ABET and AIChE.

The second major obstacle to overcome was the manner in which data on the achievement of our outcomes were to be collected. Some of the faculty wanted to see quantitative data concerning our objectives. Others felt that we lacked the database to make any such a quantitation. We finally opted for a data collection/assessment procedure based on qualitative data. This, like all other aspects of our program, may change in the future as we develop the database needed to make the assessments more quantitative.

## B. The Current System

We have now completed five complete cycles (six by the time this paper is presented at the ASEE meeting) in our system. As we expected at the start, some things were done very well at the start and have changed little. Others, however, have required substantial and continuing changes. Since the system is cyclic (collect data, analyze and assess, make changes, collect data, etc.) we'll start by describing the collection of data.

### 1. Data Collection

We currently use eight different tools to collect data for the assessment of our program. These are: course evaluations, the WSU Writing Portfolio, the FE exam results, an exit interview, a focus group interview, a survey of alumni and their employers, a review of grades in selected classes and input from our Advisory Board. Each of these will be described in more detail below.

#### a. Course Evaluations

There are 12 chemical engineering courses required of all students majoring in chemical engineering. A list of expected student outcomes, that support the outcomes set for the program, have been developed for these as well as all other classes in the department. Instructors teaching these classes thus can evaluate how well the students in

their classes have demonstrated these expected course outcomes. A standard format for these reviews is now prescribed. This, along with the fact that our teaching assignments tend to remain constant over a three to five year period, provides an opportunity to both compare student performance with expectations as well as make meaningful year-to-year comparisons.

It was obvious that a detailed discussion of all 12 courses was not possible each year. Thus only selected courses are reviewed each year, although all courses are reviewed on a set cycle. Because of their importance in the curriculum both semesters of the unit operations laboratory and both semesters of the design class are reviewed each year. In addition, one other required course is reviewed. To date four of the eight remaining required ChE courses have been reviewed. The four remaining classes will be reviewed in the next four years. The following year we will start the cycle again.

#### b. WSU Writing Portfolio

Washington State University has placed an emphasis on writing skills for its students. As part of this program the students must complete a Writing Portfolio before they can graduate. The Writing Portfolio consists of two examples of the student's writing from their first two years and a timed written examination where students must write two compositions. The entire portfolio then is evaluated by panels of faculty from throughout the university. Students may receive one of three evaluations on their portfolio – needs work, pass, and pass with distinction.

#### c. FE Exam Results

Since the first FE examination under the new format we have been tracking the results in each section for students graduating from this department. We have not made the FE examination a requirement in the department so we typically do not have a large number of students taking the examination, usually only 10 – 15% of the class. While data on who exactly is taking the exam are not provided, an informal survey of the seniors indicates that students taking the FE exam are a representative sample of the class. By tracking the average results over a number of years, as well as the individual year results, we can see strong and weak areas for our students vis-à-vis national norms.

#### d. Exit Interview

At the end of their senior year the entire senior class has a group meeting with the department chair. The ground rules at this meeting are clear; their comments about anything associated with the program are going to be made available to the faculty as part of our assessment program; however, all comments going to the faculty will be anonymous. This meeting has been a part of departmental activities for over 20 years now. Because of this long standing history the students are well aware of this opportunity to comment on all aspects of the program and take the opportunity to make sound, well-thought out comments. At the conclusion of the meeting the department

chair writes up the comments that have been received (insuring anonymity) and distributes these to the faculty.

e. Focus Group

In addition to the exit interview, student input is also sought through a focus group discussion held early in the Spring Semester. This activity was developed by a college level assessment committee that contracted with a faculty member from the Marketing Department at Washington State University, whose specialty is polling, to conduct the group discussions. This meeting has now been conducted three years in a row and so, like the exit interview, has become an anticipated event in the student's senior year. Offering free pizza also helps encourage attendance with usually 80% or more of the people invited actually attending these sessions.

The focus group is meant to differ from the exit interview in two important ways. First it is conducted by an impartial third-party thus insuring the anonymity of student comments. Students who might not comment in the exit interview, because it is being conducted by one of the department faculty, may now feel freer to comment. Second, the first portion of the focus group discussion is scripted with specific questions aimed at probing some of the program outcomes that are harder to evaluate (knowledge of contemporary issues, global/societal impact of engineering, professional and ethical responsibilities, and life-long learning). Some examples of questions asked in prior years are:

- 1) List some (if you believe there are any) of the special ethical responsibilities that apply to your profession.
- 2) Can you recall a discussion regarding ethics you had in the classroom or with a professor while at WSU? What was the issue?
- 3) What are some of your professional goals and aspirations?
- 4) What discussion of long-term career goals for people in your profession has occurred in or out of class with your professors?

These questions are followed up by additional probes such as:

- 1) Are you actually talking about these things in classes at WSU?
- 2) Have you ever talked in courses about ethics?
- 3) Have classes or discussions with faculty made you more aware of societal or global issues (e. g., economic competition, etc.)?
- 4) Can you describe any specific experiences in the College of Engineering and Architecture where you interacted with people from backgrounds different than yours?
- 5) How do you think alumni of WSU pursue continuing education? Why would they want to?
- 6) How do you think your perspective will change as you develop in a career and competition for your time becomes more intense?

#### f. Alumni and Employer Survey

A survey, to be completed by alumni and their employers, has been developed by the College of Engineering and Architecture at Washington State University for use in all of its engineering departments. As with the focus group discussions, the survey was developed by a college assessment committee in conjunction with a faculty member in the Marketing Department. An anticipated difficulty with this activity is getting a large enough return of the surveys to give a representative sample. After using a written form the first year, we now make the survey available on-line in an electronic version. The alumni receive a letter from the chair of the department from which they received their degree asking them to complete the survey and indicating the importance of the survey to the department. This letter also asks that they contact their supervisors to complete a corresponding employer survey. In the results received by the college and departments no association is made between the alumni and their employer thus insuring the confidentiality of the employer's response.

Because of the relatively small number of graduates in the Chemical Engineering Department we make this mailing to all graduates within five years of their graduation date. Although this activity is now only in its second year the personal appeal from the department chair seems to be working with about a 20% response. The survey asks the alumni and their employers to rate both the quality of their education in various areas as well as the importance of those areas in their job. The results then are plotted as importance versus preparation for each of the 39 areas targeted by the survey. An example is shown in Figure 1. The goal is to have all of the responses in the upper right hand corner (an important aspect of their job for which they have been well-prepared).

#### g. Grade Reviews

There are a few classes our students take outside of the department, where there are both a significant number of chemical engineering students as well as a significant number of students from other non-engineering disciplines. These occur primarily in mathematics and the biological sciences. Since one of our desired student outcomes is to insure that our graduates can use the fundamentals of the life and physical sciences these courses provide an opportunity to assess the level of mastery of our students vis-à-vis the general university student population. In these situations we conduct a grade comparison. The grades of all students in these classes are separated by major (ChE versus other) and the mean grade and standard deviation computed for each group.

#### h. Advisory Board

All of the data collected via the mechanisms described above are sent to the Advisory Board members well in advance of the annual meeting of the board that is held in the fall. A specific agenda item at the Advisory Board meeting is their assessment of these results, as well as any other input they can provide as employers of graduates of this department.

## 2. The Assessment Meeting

As mentioned above the department assessment program is a cyclic process, as shown in Figure 2. The cornerstone of our assessment process is the assessment meeting that is held annually after the conclusion of classes in May. All of the data from the tools described above are collected by the department chair and distributed to the entire faculty prior to the assessment meeting. The focus of this meeting is an evaluation of student outcomes using all of the tools described above. Other issues may also arise (evaluation of objectives, mission) which will be referred to the next meeting of the department Advisory Board.

The meeting itself starts at 9:00 am with a review of proposed actions from the prior year's meeting. This is followed by a review of the current year's data, ending with the course evaluations. With time for a group lunch this meeting often goes until after 6:00 pm. All of the activities and data collected for the meeting are summarized in a written document. This document is distributed to all faculty and members of the Advisory Board. It also serves as the primary documentation for the assessment/review/revision activities in the department.

## 3. The Advisory Board Meeting

The second major event in our program is the Advisory Board meeting held annually in the fall of the year. The Advisory Board consists of twelve members with a mix of industry and academic representatives as well as alumni from the department and people who received degrees from other institutions. The board members serve on a four-year rotating membership to insure fresh perspectives. At the time of the Advisory Board meeting the board is supplemented by the addition of several current graduate and undergraduate students. During each Advisory Board meeting the members are split into three working groups with each group assigned to discuss a particular task. The topics to be discussed are set by suggestions from the faculty and the Advisory Board members.

Because the Advisory Board meeting includes representatives from a broad range of constituencies (faculty, alumni, industry, academia, and the citizens of the state through the student participation) it is used to address the broadest scope of assessment activities. These would include changes to the program's mission, objectives, and outcomes, planning the future direction of the department, and curricular changes. While all of the assessment tools may provide information on these topics those proving to be of particular value are: the Advisory Board meeting itself, the alumni and employer survey, and the focus group discussions. The minutes from the Advisory Board meeting, as well as all data presented at the meeting, are also summarized in a written document. This serves as further documentation of the EC2000 process in the department.

### C. What Has Been the Impact of the EC2000 Process?

The impact of the EC2000 assessment procedures described above can be broken down into two areas – how well have our procedures satisfied ABET and how has the program benefited from these new procedures. In terms of meeting the expectations of ABET our program seems to have been successful. During the 2001 accreditation visit our visitor had many favorable comments about our process. Among these were; an acknowledgement of the length of time that the process had been in place and its documentation, the use of the focus group to assess non-technical issues, and the inclusion of students in the process, in particular, in the Advisory Board meetings. The annual assessment activities, even though started in a rather rudimentary form, have now established a precedent amongst our faculty, students and alumni. Each group now sees, from prior experience, that these reviews do indeed play an important role in the department. Thus, while there may be changes in the format used, or the data collected, each group actively participates because of the obvious benefit to the department.

We are fortunate that the College of Engineering and Architecture at Washington State University has also embraced the EC2000 principles. As a result of their actions the focus group meetings and alumni/employer surveys have become an integral part of the assessment activities in all programs within the college. In particular the focus group approach appears to have been particularly successful in assessing items such as professional ethics, global/societal contexts, contemporary issues and life-long learning. We have also been able to elicit some comments from students that may never have come to light in any discussion with a faculty member in the department.

Not everything has worked as we planned. Over the four years for which we have data 97% of the chemical engineering students have received ratings of either “Pass” or “Pass with Distinction” on the Writing Portfolio. Only 3% have received a rating of “Needs Work”. The assessment of student writing skills from our course reviews, particularly in the unit operations laboratory and the design courses, is not nearly as positive. Thus, while the Writing Portfolio results are easily collected, their worth is now in question.

There are a number of other benefits to the program in this department that have arisen as a result of the EC2000 procedures. A major change has resulted from the fact that our primary assessment activity, the assessment meeting, involves the entire faculty. Our feeling was that there had to be one annual assessment activity involving the entire faculty in order to make the EC2000 activities work. In years past only a small portion of the faculty were involved every sixth year in accreditation activities. Thus it was possible for the majority of the faculty to never think about broader issues, such as program objectives or student outcomes. As a result of the involvement of the entire faculty in the assessment meeting we have observed not only an increase in interest in the department’s program but also a much wider involvement of the faculty in all departmental matters. This is evident by the generally higher morale in the department as well as more active involvement in department meetings, social activities, recruiting, and fund raising. Indeed, if one of the intents of EC2000 was to foster greater participation by

the faculty in the totality of the programs offered by a department (as we suspect it was) it has been hugely successful in this department.

A second major change in this department, brought on by EC2000, was the establishment of an Advisory Board. We were rather late in establishing an Advisory Board for this department as most other departments in this college did so well before EC2000 came into existence. Our first thoughts were that the Advisory Board would provide us the input from industry necessary for assessing the program in the department. Our board has been much more than this providing active leadership in recruiting, program development, fund raising, and strategic planning. The inclusion of current students with the industrial and academic board members at the Advisory Board meetings has also provided valuable contacts for all parties.

The biggest impact of EC2000 in this department, however, has been that felt by our students. In the past student involvement in our program was largely restricted to standardized course/teacher evaluations and occasional assistance with recruiting activities. While we had always had a relatively close relationship with our students, as a result of our low student to faculty ratio, the students viewed the program in the department as something over which they had no input. The inclusion of students in the assessment process has energized the entire student body. As they now feel that they do have a voice in shaping the program they have become a much more active partner in the department. For example, at the last Advisory Board one of the students suggested that having students return to their high schools might be a more effective recruiting tool than the phonathons and letters we had been using. This student was able to get a number of students to do this over the Christmas break. The students have pointed out areas that receive duplicate coverage in the various classes that they take. As a result we were able to reduce the number of credits needed to get a Bachelor's degree by 5% without sacrificing content. They have also informed us of gaps in the course coverage allowing us to add topics such as teamwork and public speaking in our seminar class. They see their inclusion as a positive aspect of the department activities (as do we) and take their roles very seriously. In the long run the energy and insights of the students into the content and operation of this program may be the biggest benefit of EC2000.

#### D. Summary

The Chemical Engineering Department at Washington State University implemented its EC2000 assessment program in 1996 and has now completed five complete cycles in the process. Our approach has been to start with a rudimentary procedure and let the procedure and tools develop as experience was gained. This has resulted in an assessment procedure that drew praise during our recent accreditation visit. Other, more important, benefits have arisen as a result of our instituting the EC2000 procedures. By involving the entire faculty in the EC2000 process we have observed a fuller faculty participation in all other departmental activities. The establishment of an Advisory Board in response to our EC2000 assessment process has also yielded significant benefit to the department. More importantly, however, has been the increased participation by the students in the department. Their inclusion in an active role in the



EC2000 process has resulted in many new and creative ideas for improvements in the program as well as building stronger faculty/student relationships.

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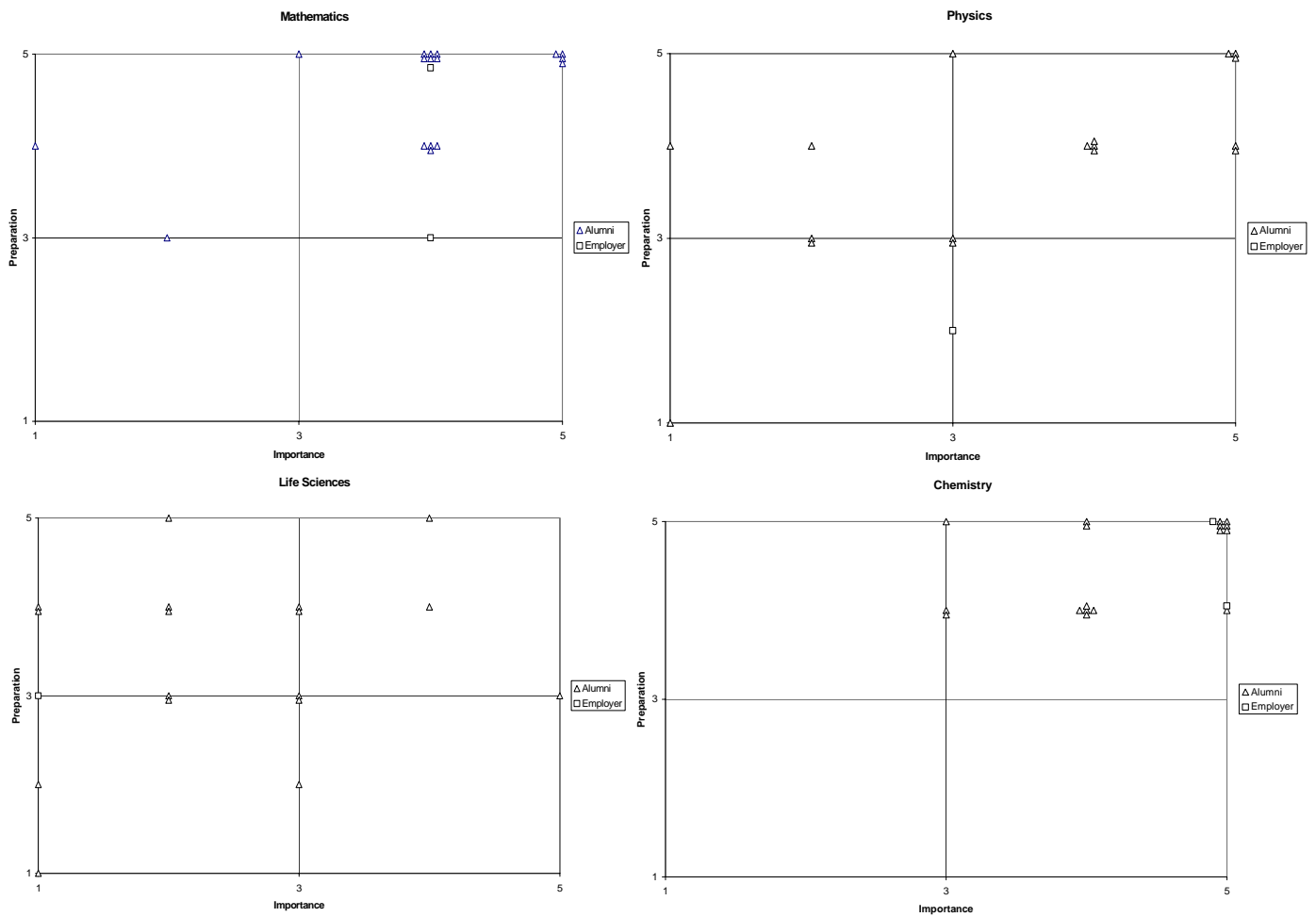


Figure 1: Example of Results from Alumni/Employer Survey

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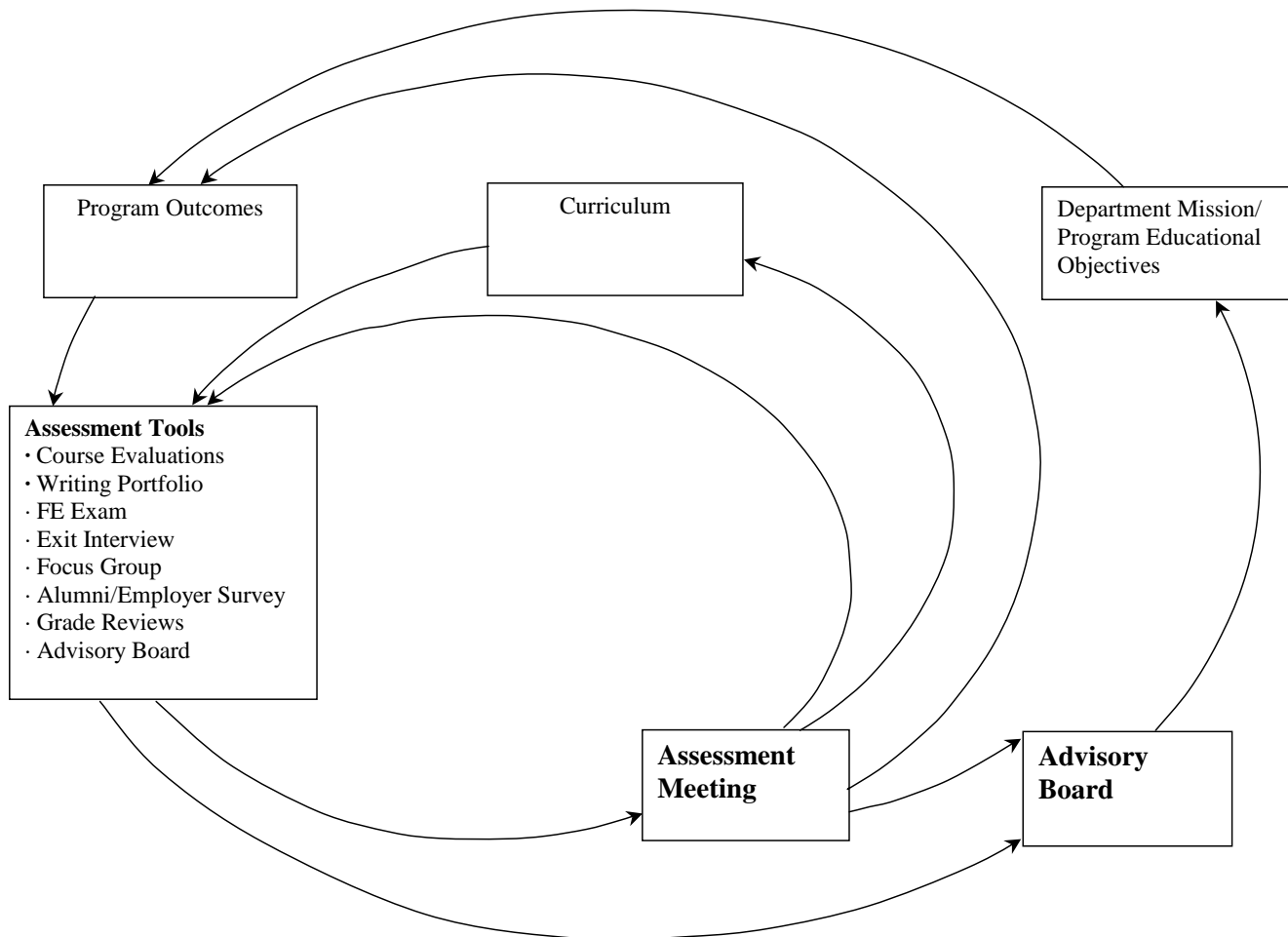


Figure 2: EC2000 Process for the Department of Chemical Engineering at Washington State University

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