# Engineering and Engineering Technology Program Assessments – DACUM Style

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A DACUM (Develop-a-Curriculum) analysis is a three-phase process, which can be a key part of a program assessment effort. DACUM is a tool that provides course-related duties and tasks, which can be converted into outcomes. Phase I features a panel of off-campus personnel with expertise in the program being assessed. Phase II consists of the interaction between those experts and college's or university's faculty. The third phase is designed to assist program faculty in the preparation of institutional documents needed for approval of any DACUM-related changes.

Since 1998, Harrisburg Area Community College has used the DACUM analysis for more than 30 programs, both career and transfer, in a variety of disciplines. The process lends itself to the development of new programs with input from local experts as well as from national societies and agencies. The DACUM phases have also been used effectively for existing programs, where periodic assessments are required by state, association, and college mandates. The college completed DACUM analyses of Engineering, Mechanical Engineering Technology, and Electrical Engineering Technology two-year programs. There were similarities and differences between the DACUM process and results for a transfer program, Engineering, and for career programs, Engineering Technology.

## DACUM

DACUM was developed by the Association of Canadian Community Colleges (ACCC). In 1970 ACCC selected Holland College of Charlottetown, Prince Edward Island to deliver the first DACUM training[1]. Eventually, DACUM was used for developing all of the college's academic programs.

DACUM is a curriculum development process that includes a detailed analysis by a panel of experts. The panel analyzes the duties, tasks, knowledge, skills, traits, and attitudes of workers in a specific occupation. The experts are largely those performing job functions within that occupation. Whereas supervisory and administrative personnel can provide meaningful input, most panel members should be those doing the job. It is the expert worker who knows her/his job and its requirements best, so it is the worker who can most accurately define the job function best. The occupation being analyzed can be described fully by a matrix of tasks that are performed by successful workers. The tasks are directly related to the knowledge and skills needed to be successful in the occupation.

The DACUM process is typically performed in three distinct, but not independent, phases. Phase I involves a participatory analysis of the specific occupation in question by a panel of experts, who as previously identified, are workers in that job. The panel is assembled by a faculty member responsible for the related academic program. DACUM facilitators lead the panel in identifying the main duties and associated tasks necessary in performing the job. For the DACUM process, duties are the major components of a particular occupation. Each Phase I panel identifies duties that are specific to their occupation, and most panels identify common duties, such as oral/written communication, record keeping, computer skills, etc. Associated tasks are subsets of the duties that describe detailed actions needed to perform the job functions. The product of the first phase is a DACUM Chart, which is a matrix of duties and associated tasks. A focus statement, which is needed to develop the direction of the analysis, and lists of "Knowledge and Skills," "Traits and Attitudes," and "Tools and Equipment," which are all part of the job are included. Each chart lists the names of the Phase I panel in order to signify the involvement of the members and indicate a responsibility for the completed analysis.

Phase II uses a second panel of experts, who include select members from the Phase I panel and the faculty associated with the academic program. The faculty panel members include those full-time and adjunct members with responsibility for the given program. Also, faculty and administrators, who represent other programs and departments which support the program being analyzed, are invited to Phase II. For example, as written and oral communication courses are included in most academic programs, faculty members who represent those interests should be part of all Phase II panels. The purpose of Phase II is to take the tasks from Phase I and assemble them into a curriculum. The tasks are gathered by topic and are separated into subject areas that can then be placed into a logical sequence of study. All tasks identified in Phase I need to be included in the curriculum somewhere. If the program being analyzed is in existence, then existing courses are often used for the placement of specific tasks. Phase II panels often add topics to current courses as well as identify the need for new courses. The items identified as "Knowledge and Skills" from Phase I are also placed into the course structure. As the items are grouped into courses, their association in those courses is purely topical. How the course is taught, in other words whether a particular task is handled as a two-week classroom analysis or as a 50-minute lecture, will be decided by the faculty member who is asked to teach the course. The panel merely assigns tasks to courses. The final product of Phase II is a Curriculum Map, which is the planned sequence of courses and a list of each course with its associated tasks.

Phase III is an academic preparation step that includes the faculty and administrative experts without the job-related participants. The Phase III process is based on the course creation/revision process at the specific institution with the intent of identifying what paperwork needs to be completed to secure approval for the changes made by the previous DACUM panels. The final products of Phase III are the completed forms necessary to send changes to institutional committees for approval. A formal Phase III session is optional in that many academic departments have faculty members and administrators who can produce the approval documentation without the DACUM facilitators. The change approval paperwork identified during Phase III is not an option, however.

As the DACUM phases are designed primarily for occupational analysis and lend themselves well

to career programs, a modified DACUM process is used for transfer programs. The majority of the process is the same as the regular DACUM phases; however, the differences occur in the identification of panel participants and the focus of the process. Instead of occupational experts as panel members, faculty and administrative representatives from potential transfer institutions comprise modified DACUM panels. Instead of a focus statement which delineates the primary responsibilities of a worker in an occupation, the modified DACUM focus statement deals with the primary responsibilities of a student in a transfer program.

HACC's Assessment Effort

HACC programs are reviewed on a five-year cycle with the purposes of enhancing the quality and efficiency of program offerings, identifying program weaknesses, and suggesting improvements to correct such weaknesses. The academic program reviews are mandated by state statute and accreditation requirements. Program review goes well beyond the scope of the DACUM process, as the DACUM phases are responsive, valid tools to aid in completion of the entire assessment. Assessments include the Phase I DACUM Chart, Phase II DACUM Curriculum Map and program sequence, a proposed-versus-existing program comparison, which should accompany the approval paperwork generated in Phase III, 6-month graduate survey results, 24-month graduate survey results, enrollment and graduation data for the five-year period since the last assessment.

By the end of academic year 2001-02, over 30 DACUM sets of phases had been completed. The large majority, over 80%, were of career programs that included Administrative Office Specialist, Building Construction Technology, Mechanical Engineering Technology, Electronic Engineering Technology, Fire Science Technology, Pharmacy Technician, Small Engine Repair, Medical Assisting, and Architectural Technology. Modified DACUM sessions were held for Liberal Arts – Psychology, Theatre Arts/Performing Arts, Engineering, International Studies, Liberal Arts – Mass Communications, and Liberal Arts – Mathematics/Mathematics Education.

Engineering and Engineering Technology DACUM Sessions

In Fall 1999 HACC conducted a modified DACUM Phase I session with seven panel members. Of the seven members, four were current faculty members representing three different transfer institutions. One member was a former full-time faculty member and was now in private practice while being an adjunct instructor at the college. The other two members were graduates of the HACC Engineering program, one currently working in industry and the other in state government. The panel derived the focus statement, "An Engineering Transfer Student will have the background, motivation, and ability to pursue further study in any Engineering Discipline." The result of the Phase I session was a DACUM Chart with 7 duties and 47 tasks[2].

In Fall 2001 HACC conducted a combined DACUM Phase I session for both the Mechanical Engineering Technology and the Electronic Engineering Technology associate degree programs. Eleven panel members included three current faculty members from two different institutions, two graduates of the programs each working in industry, and five industrial members who had at one time been adjunct members of the college faculty. The more detailed focus statement from this session was, "A Mechanical or Electronic Engineering Technician, working independently or

cooperatively, identifies specific problems related to her/his field, collects information, determines solutions, applies appropriate tools and technology to the problem, and communicates the results in commercial, industrial, or governmental organizations." The resulting DACUM Chart featured 11 duties and 69 tasks[2].

Table 1 shows the facets of the jobs being analyzed and whether they were included as duties or tasks or not at all. The duties are broader and typically include between three and nine tasks. Similar duties for the two DACUM sessions included communications, computers, problem solving, and life skills. Data collection and report writing were identified as duties for engineering technologists but were seen as tasks for engineering students. Mathematics, on the contrary, was detailed as a duty for the engineers, while only a task for applied mathematics for the technologists was suggested. Whereas learning was an appropriate duty for engineering transfer students who will pursue the bachelor degree, it was not included in the technology session. Technician-level jobs, such as design/drafting, equipment repair, and project management were included in the technology session as duties and were excluded by the engineering panel.

| Item | Engineering | Engineering technology |
|---|---|---|
| Communication | Duty | Duty |
| Computer | Duty | Duty |
| Problem solving/analysis | Duty | Duty |
| Life skills (ethics, professionalism) | Duty | Duty |
| Data collection | Task | Duty |
| Technical report writing | Task | Duty |
| Mathematics | Duty | Task |
| Learning | Duty | ----- |
| Design/drafting | ----- | Duty |
| Equipment repair | ----- | Duty |
| Project management | ----- | Duty |

Table 1: Comparison of Duties and Tasks for Engineering and Engineering Technology DACUM Sessions

In the history of conducting DACUM analyses at HACC, both communications and computer-related duties are included in the Phase I of all DACUM sessions, so their inclusion in Engineering and Engineering Technology reviews was expected. Another common duty, which centers on professionalism, is included in many program analyses even if the specific tasks that comprise the duty vary with the program. Mathematics and further learning were deemed major duties for the engineering students, where job-related functions, such as data collection, equipment repair, and drafting were important to the technology majors. An interesting comparison was for the technical report writing item, where the engineering session identified it as a task and the technology session as a duty. Report writing is critical to both professions, but with the engineering DACUM analysis handling the two-year engineering program, the panel saw writing as a single task. The expectation is that if the panel considered a bachelor-degreed engineer, report writing would have had greater importance.

In addition to duties and tasks, the DACUM panels identify "Knowledge & Skills," "Traits &

Attitudes," and "Tools & Equipment" for each program. Table 2 includes those items that were common for both the engineering and engineering technology sessions. There was no surprise as the panels identified more detailed equipment and skill lists for the more lab-oriented technology programs.

| Groups | Items | Engr | ET |
|---|---|---|---|
| Knowledge & Skills | Computers/software skills | X | X |
| | Science/math skills | X | X |
| | Communication skills | X | X |
| | CAD | X | X |
| | Standards & regulations | X | X |
| Traits & Attitudes | Ethical | X | X |
| | Creative | X | X |
| | Self-confident | X | X |
| | Team player | X | X |
| | Dependable | X | X |
| Tools & Equipment | Computers/CAD software | X | X |
| | Calculus | X | |
| | Differential equations | X | |
| | Probability & statistics | X | |
| | Mathematics | | X |
| | Lab equipment | X | |
| | Motors & generators | | X |
| | Programmable logic controllers | | X |
| | Machining tools | | X |
| | Circuit modeling software | | X |

Table 2: List of Results for Engineering and Engineering Technology DACUM Sessions

One specific area which each DACUM panel identified as a duty band was lifelong-learning based. The Engineering panel called it "Life Skills," while the Technology panel named it "Career Development." Included in the Engineering band were tasks, "formulate long-term professional plan," "encourage interaction with professionals," and "develop healthy lifestyles." Similar tasks in the Technology band were "participate in continuing education," "read professional journals," and "join professional organizations." In theory, the DACUM analysis considers what workers need when they are on the job two years after graduation, but lifelong learning is a common theme of almost all DACUM analyses.

Assessment Results

At the time of this writing, the engineering technology programs at Harrisburg Area Community College are still reacting to the DACUM analysis in terms of program assessment. Combined with the student surveys and external reviews, program changes have been identified but are still

being made to ensure program improvement is achieved.

The Engineering program has been changed based on the recommendations of the DACUM analysis. In March 2000, a final "Program Review Report" was written and submitted as the overall assessment of the Engineering program. The following program changes were incorporated.

- The graphics requirement was changed from a two-credit board drafting course to a three-credit CAD course that includes two and three-dimensional drawing and solids modeling.
- Macro economics was added as a required course. The three credits count as part of the college's general social science transfer electives.
- Technical writing was added as a second English course as an alternative to expository writing.
- Interpersonal communications was added as an alternative to the college's effective speaking requirement.
- A cooperative work experience was added as a three-credit technical elective. None had existed previously, and through the DACUM discussions, the experience was identified as a significant improvement in the program.
- A second one-credit orientation course was added. The existing course has long been career-development and transfer oriented, while the addition deals with technology and software issues.
- Technical electives were decreased from three three-credit courses to two courses in order to accommodate the other revisions.

In all, the program was made stronger by improving required courses and adding pertinent electives, while the overall credit count was reduced from 66 credits to 64 for the two-year associates program.

Summary

Specific to engineering and engineering technology programs, the DACUM results show the similarities of the two types of programs. Students with similar traits and attitudes can find success in either program. Communication and computer skills transcend the divide between the programs and are necessary for any graduates working in the engineering field. Differences between the two DACUM analyses are not surprising while understanding the focus of each program. The lab-oriented engineering technology programs and courses lend themselves to detailed identification of tasks and equipment that must be included in the programs. The engineering program at the two-year level is more general with the detail being left to the upper division programs at the bachelor-degree institutions.

The DACUM process is an integral part of the program assessment procedure at Harrisburg Area Community College. While still relatively new to the college, many of the programs and a larger number of faculty members have used the process to date. There are a few items of note that can help ensure a more positive DACUM experience. Those items are as follows.

- The selection of DACUM panel members from outside the academic institution is critical. Phase I and Phase II typically each require a working day to complete. Participants need to dedicate the full day for Phase I and a select number of those participants need to be

available for Phase II. Participants who know the occupation or the transfer requirements well are the most beneficial. Panel diversity in terms of traditional factors, such as gender, race, and age is helpful, but diversity in terms of a wide variety of industries and organizations may be more important.

- Once trained, a DACUM facilitator knows the basic process rules in order to lead successful sessions. Facilitators should be well-trained and should follow the rules closely. Some flexibility is necessary and inevitable, but the more structured the sessions, the more productive they are.
- Facilitators should come from a variety of academic and non-academic departments on campus, so that no facilitator works on a DACUM session for a program in her/his area of expertise. The facilitators should be neutral to the process outcome.
- Administration, in addition to the faculty, must support DACUM as an assessment tool. The time involved is a demand on everyone's schedule, but the commitment must be there for both faculty members and administrators to be available for the DACUM sessions.

The DACUM process is worthwhile for any program review as it is triggered by the thoughts of a panel of experts in the field and involves the program faculty interacting with that panel. DACUM can be used as a precursor to an ABET review with the focus being the self-study of the program under review.

References

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2 "DACUM Overview." Available [Online] http://www.hacc.edu/DACUM/dacum.html. February 15, 2002.

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