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DEVELOPMENT OF A NEW, APPLIED ENVIRONMENTAL ENGINEERING DEGREE PROGRAM

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ABSTRACT

Funds to develop new training initiatives are scarce, if not non-existent. This degree program reflects the commitment made by the staff of its originating department and the vision of Dr. A.R. Barren, P. Eng., who made it happen. This particular degree is one of a new breed, significantly incorporating industry in both its development and its presentation. Its success to date indicates that there was a need for this approach to providing an alternative educational program for current and future professionals. Developing a new degree completion program at the same time as the introduction of a new government approval procedure, presented some challenges. On reflection, both the internal and external approval processes were appropriate. It minimised duplication and verified justification to proceed. This paper outlines the process from identifying the target audience, through the development and approval process and concluding with its implementation. This Bachelor of Technology degree was a new credential in the Province of British Columbia, Canada. Its broad range of major elective studies allows individuals to gain knowledge in any four of nine topic areas. The balance of the program provides a general knowledge of engineering and science principles, integrates management topics and requires completion of an industry sponsored project. The applied nature of the course content, combined with the industry professionals that present it, ensures that the material is relevant and appropriate for the individuals from this sector who are participating. The ease of registration into the program, the frequency and modular format of courses that are offered provides a very high degree of flexibility to the participants. Accreditation of environmental degree programs for professional registration is still evolving.

KEYWORDS

Working professional; Letter of Intent; needs analyses; Working Committee; Degree Program Review Committee; external validation; highly flexible schedule

HUMAN RESOURCE TRAINING NEEDS

The projected need for the current workforce to require additional training during their careers is staggering. The changes in industrial processes, the implementation of new technologies in the workplace, etc., will demand that individuals upgrade their skills more frequently than we have ever experienced in the past. The expression life-long learning will be a fact of life as we proceed into the next millennium. The continued growth and evolution of the environmental sector will require training institutions not only to keep pace with the changing technology, but also to deliver it in alternate modes as well as responding to the needs of the learners that we are serving. Maintaining currency in this competitive industry sector, with its constantly changing technology, will require existing and future professionals to continue to upgrade or demonstrate

that they have the skills necessary to perform the tasks presented to them. Having the right balance of skill sets will be critical for professionals working in this sector. The diversity of employment opportunities and responsibilities will require flexibility from the professional.

Traditionally, individuals would look to the university or college system for opportunities to obtain these skills. It is in this context that the British Columbia Institute of Technology (BCIT) has developed a baccalaureate degree completion program that would allow graduates of their Diploma of Technology programs to continue their studies and obtain a Bachelor of Technology degree. The concept of a Bachelor of Technology degree is new to British Columbia (BC) and yet it is most fitting for the only provincial Institute of Technology to be able to award an applied technology degree. Several of these degree completion programs have now been developed, with other degrees currently in the development or approval stage.

A DEGREE FOR THE WORKING PROFESSIONAL

The development of this new degree program presented the opportunity to introduce a more flexible mode of delivery, modification of typical entrance requirements, establishment of a critical review process as well as meeting the needs of industry. This particular degree program was also the first degree to be approved under the new British Columbia provincial government degree approval process. Any baccalaureate (or higher) degree to be offered by any college or university in B.C. must be approved by the provincial Degree Program Review Committee (DPRC). This is to avoid any unnecessary duplication of programs at this academic level.

At a time when operating funds for the post-secondary system were being reduced, requesting funds to develop new initiatives did not meet with any success. The vision for this advanced program in environmental technology lies with Dr. A. R. Barren P. Eng., the Progam Head at that time. The ability to initiate the development of the program lies with the staff of the Civil & Structural Technology. Their commitment to the development of this program was to share in the re-distribution of the department workload to make portions of time available for individuals to proceed with the necessary development activities. Additional funding of approximately $200,000 (CDN) over several years was necessary to develop the inidvidual course materials. This was obtained primarily from revenue generated through program delivery with some support from internal sources.

In developing the overall degree program profile, consideration was given to the minimum entrance requirements, requirements to graduate and mode of delivery. It was realized that graduates of other institutions, as well as our own graduates, would be very interested in pursuing such a program. This degree program was designed for the working professional who would have already achieved acceptable post-secondary training, have established employment and had probably made personal commitments that would likely preclude the opportunity to return to full-time studies. Furthermore, this provided a successful laddering process for individuals to obtain a baccalaureate degree when a university education was not the first consideration when entering a post-secondary training program. These new degrees are a proactive response to meeting industry s needs in higher technological training. The flexible format of night school, seminar, industry training and workshops allows the individuals to gain the applied knowledge that built upon our Institute s reputation of graduates with job ready skills. Continuing professional development (CPD) for Professional Engineers is still voluntary. However, the outlook may be towards a mandatory program, with which this format would be most compatible.

SEEKING INITIAL APPROVAL

Before seeking any government approval for a new degree program, preliminary approval to proceed with the development of any degree program was required from the Institute s newly formed Technology Degree Committee. This committee consisted of senior faculty members and representatives of the senior executive and reported to the President.

At the time that this degree program was being proposed, our provincial government had established preliminary guidelines regarding the approval process. Typically, this would require the granting institution to submit a formal Letter of Intent outlining initial details of the proposed program of study with the appropriate justification. This document would then be distributed to the other universities and relevant colleges for comment and feedback.

In accordance with the requirements of the Letter of Intent, the Technology Degree Committee required successful demonstration that there was a need for this particular program profile in industry. Intensive needs analyses were performed based on industry surveys, reference to published reports on training needs and the involvement of industry representatives in providing guidance and advice on the initial profile of the program. Estimates of potential enrollment and a preliminary development schedule were prepared. An industry based Working Committee provided the industry perspective on training needs that was balanced by program faculty to establish the academic rigour of a degree program. Assistance in developing this document was given from our Learning Resource Unit. It was their responsibility to develop the templates for all degree program approval documents, to provide the staff to prepare related documents and to assist program area staff in developing the text of the document. On reflection, the success of that proposal was quite clearly linked to the strength of the needs analysis. Some frustrations at the program level were experienced as the government guidelines for preliminary approval were frequently revised during those early stages. The Technology Degree Committee required the internal approval of the proposed Letter of Intent prior to its submission to the provincial government for their approval. With the government approval of the Letter of Intent, we then proceeded with the detailed development of the program.

THE DEGREE MODEL

The environmental sector is diverse and during the preliminary development stage, the scope of the program was identified. It was anticipated that candidates most likely to be interested in this program would be those with either a civil engineering or chemistry background. Within BCIT, other technology program area graduates from environmental health, renewable resources and occupational health & safety had shown interest in pursuing this degree program. Graduates of other degree programs with related backgrounds in bio-chemistry, biology, bio-resource, mining, geology, mechanical engineering, etc. have since participated.

Entrance requirements

In order to differentiate this degree program from those offered by other local universities, the typical entrance requirements listed below were set for all of our degree programs.

- minimum academic entrance requirement of a Diploma of Technology (or bachelors degree) in a related engineering or science discipline
- 2 years of related work experience (prior to entry)

The work experience requirement certainly generated considerable discussion. The benefits of this are: i) that the graduates of this program will have clearly demonstrated a total of 2 years of full time employment with responsibilities related to their prior academic training; ii) their ability to be functional in the workplace is rapid; and iii) that their prior exposure in an industry setting places greater significance on the relevance of the course content. Recent graduates of other degree programs who were unsuccessful, or dissatisfied, at employment opportunities and were considering further education in this degree program are usually ineligible to apply because of their lack of related work experience. While not deterring individuals from pursuing further education, candidates who do not meet the work experience requirement are permitted to take up to 6 lower level credits while they accumulate the required work experience.

The program profile

In preparation for granting baccalaureate degrees, BCIT had examined various degree models from around the world and had determined that these new degrees completion programs would consist of a minimum of

60 credits of advanced study in addition to at least 100 credits of prior study from a typical diploma or degree program. This would satisfy the needs of diploma graduates wishing to attain their first degree, or for existing university graduates wanting to obtain another degree. It was also a requirement that our mode of delivery not duplicate the conventional day school format and that a time limit be established for graduation. Hence,

- a flexible delivery mode, and
- completion of the program within 6 years

The model identified below shows the 5 distinct components with a program chart of all the available courses shown on the following page.

1. Common Core (8 credits typically required in addition to transfer credits)
   This allows for the rationalization of the necessary engineering or science skills appropriate to the balance of the program. All courses have to be completed with credits being granted where participants have completed similar courses during their prior academic training.
2. Management (9 credits)
   Environmental management and business topics to provide the context for compliance driven requirements of this sector.
3. Major Elective Studies (19 credits)
   Within this section there are 9 areas of study from which participants are to concentrate their studies in any 4 topic areas, to match their career direction and prior academic training.
4. Industry Sponsored Graduating Project (12 credits)
   Each participant is required to solve/research a suitable problem presented by an industry sponsor of their choice. Formal approval of a proposal to proceed with the activity is required. Participants are also required to receive training and practice at technical presentations.
5. Liberal Education (12 credits)
   Broadening of one s knowledge in the area of the Arts and Humanities is also a requirement. Participants may select topics from a wide array of subject areas.

Information obtained during the industry surveys for the needs analysis also indicated that this industry sector would likely respond to shorter, more responsive periods of instruction. Prospective candidates would likely be able to commit themselves to shorter training periods as the nature of employment often required individuals to be out of town, often at short notice. Furthermore, virtually all of the teaching faculty were also to be drawn from industry and similarly, their availability could not be committed for 10 or 12 week periods. This resulted in the adoption of a 6 week modular format. Many of the courses would be 1 credit, representing 18 contact hours, which would include the necessary time for student evaluation. A few courses were better suited to a 2 credit format; 36 contact hours over 12 weeks. Early discussion and debate arose over the number of hours per credit. There were suggestions that varied from 12 to 18 hours per credit, with the Institute finally adopting a minimum of 15 hours per credit, similar to the university system. This particular program retained the 18 hour per credit format. In combination with a Diploma of Technology, the total hours of instruction easily met or exceeded the total hours of instruction for a typical university degree.

The inter-disciplinary nature of an environmental program also presented some challenges as to which program areas on campus had jurisdiction over which topics within the program. Agreement was established fairly early in the development stage and inter-departmental co-operation has been quite good.

As an Institute of Technology, BCIT does not offer university transferable, credit courses in the arts and humanities to meet the liberal education component. Participants would obtain these university transfer credits through registration at other universities, community colleges or through the BC Open Learning Agency and seek transfer credit into this degree program. Post-secondary education in Canada is governed on a provincial basis. Therefore, participants with academic training from other provinces, or other countries, will require that their liberal education credits be verified through the Open Learning Agency for

transferability into the BC system. It is anticipated that in the near future, BCIT will develop some courses that will be approved as part of the liberal education component.

Determining the curriculum

Based on the initial recommendations of the Working Committee for the overall content of the program, additional expertise was solicited to help define the objectives and outcomes of each course within the program. Development contracts with industry experts were secured that required these individuals to prepare a curriculum outline for departmental and committee review. A detailed Student Study Guide was then developed which was the basis of the instructional material for each course. The selection of the industry expert for the course development also included a commitment that this individual also teach the course. This approach to the development of course materials allowed for current, practising experts to incorporate current, applied technology directly into the course. Some courses require students to purchase text books in addition to the course materials that are supplied. In other topic areas, the Student Study Guide was sufficient.

In addition to seeking industry support in developing the program, copies of the degree proposal were sent to several of the accrediting agencies for their review. Their comments and Letters of Support were of significant value in recommending approval of the final degree proposal. Copies of the industry survey questionnaire responses, which also included support for the development of the program, were included as part of the final degree proposal. The initial needs analysis combined with the strong industry support provided a very convincing argument to approve this new program.

OBTAINING FINAL APPROVAL

To enhance the probability of a successful outcome to the approval process, our Institute Technology Degree Committee required both an internal and external validation of the full proposal prior to its submission to the DPRC. An internal School Committee was formed consisting of senior faculty to provide a critical review of the proposed degree. Their comments and recommendations were incorporated into the proposal. An External Validation Panel was convened to further review the proposal. This Panel consisted of 2 industry experts (not associated with any aspect of the program development), 2 senior academics from other universities and 2 senior faculty (independent of previous reviews) from BCIT. Again, comments and recommendations were incorporated prior to this Panel s approval.

With the approval of the President of BCIT, this degree proposal was submitted to the DPRC. This committee consisted of academics, Ministry staff and representatives appointed by the government. The schedule of their meetings required that our own internal approval process occur within certain time frames if the process was to proceed expeditiously.

As noted earlier, this degree approval process had only just been implemented. As many as 50 other degree proposals had been submitted at the time that this degree was submitted. Two things were in our favour at that time. The first was that BCIT had implemented a rigorous internal approval process. The second was that this particular program had previously received internal approval as an Advanced Diploma Program. At that point in time, BCIT had not been given baccalaureate degree granting status and a logical progression for a credential beyond the Diploma of Technology was an Advanced Diploma of Technology. The basis of this degree proposal had already been established.

With a significant head start in preparing a degree program, this particular proposal was far more complete than any other degree proposal submitted at that time. Subject to some points of clarification, the DPRC recommended that this degree proposal be approved as a Bachelor of Technology degree. The was first in the province to be approved under this new process and the first for BCIT. As with all other programs at BCIT, a permanent industry based Advisory Committee was established and meet twice a year to continue to provide guidance and feedback for this program.

IMPLEMENTATION OF THIS NEW DEGREE

As was previously alluded to, this program of studies was partially developed at the time that baccalaureate degree granting status was being extended to BCIT. Students had already enrolled in several of the courses that had been offered through our night school, part-time studies program. There was no difference in the course objectives or outcomes between the former Advanced Diploma Program (ADP) and the new degree program. Applicants into the ADP were also required to be interviewed by the Program Head and meet the same entrance requirements as the new degree program, with the exception that the 2 years work experience was not an entrance requirement for the ADP. It was agreed that if the degree program was approved, the ADP would be discontinued. The degree approval process acknowledged that students were already taking some of these courses and would likely transfer into the new degree program. While most of these individuals did have the required work experience, those that did not were required to meet this prior to graduation from the program. For students studying in the night school format, it will likely take them 3 to 4 years to complete their studies and they should, therefore, have the necessary work experience in time for graduation.

This degree program received formal approval in the Spring of 1996. At that time, base funding for the program was granted so as to retain a small, full-time staff and a program assistant. All courses are presented on a cost recovery basis with an Institute fee structure of $172 per course credit. Several hundred individuals have participated in this program, with annual participation now levelling at an equivalent of approximately 50 full-time students.

Many have just taken select courses to complement their existing knowledge, others are working towards this new degree. In general, about 60% of the participants have already obtained a bachelor s degree, some with Masters degrees. The split between civil engineering and chemistry applicants appears to be about even and represents approximately 80% of the participants in the program.

The high level of interest shown in this program can likely be attributed to several factors.

1. The scope of the curriculum and the applied nature of the course content. The intent of this program was not to make an engineer out of a scientist or vice-versa. The breadth of fundamental knowledge in conjunction with management topics and the opportunity to select advanced topics to suit individual careers is attractive. In combination with their prior academic knowledge, these individuals are being well prepared for a successful future. For the right person with the personality and ambition to want to act in a supervisory capacity, this program provided them with a better range of knowledge necessary in this multi-disciplinary sector.
2. The highly flexible schedule of courses. The primary mode of operation is in the night school format and the Institute is located in the centre of a large metropolitan area serving some 1.8 million people. Each of the participants having already experienced at least 2 years of full-time, advanced, post secondary education are looking for an alternate to full-time studies. There are two cycles offered during one academic year permitting individuals to be able to take some courses starting at almost any time they choose. Between 40 and 50 courses continue to be scheduled every 3 months. Careful management was required to ensure that the schedule of programs was advertised correctly, the industry based faculty were available, that rooms were booked and printed materials ready. As the Student Study Guide is frequently updated and revised by the faculty, mass production in advance was not appropriate. There also appears to be increased interest in courses being held during the summer months. This is now leading towards year-round offerings of this program.
3. The extensive use of industry based faculty/specialists. The program faculty consists of 35 to 40 industry based practitioners that provide the students with what is happening now and an outlook for the future. Most of the faculty have Masters degrees with about 20% having Ph.D s. Their desire to participate in this program is closely linked to their wish to contribute to the next generation of professionals.

4. The registration process. The service oriented approach by both the program area and the Registrar's Office allows participants to be interviewed and registered into the program at any time. All applicants for the degree program are required to be interviewed by the Program Head as well as submitting a formal application through the Admissions Department. The personal interview takes about an hour and concludes with the suggestion of the initial schedule of courses that best fits the applicants availability. The Registrar's Office issues a formal letter of acceptance upon meeting the entrance requirements. Individuals who are taking courses for professional development receive a letter of acknowledgement from the department.

Advanced education and training is becoming more competitive with less funding being made available from traditional government sources. Promotion of these new initiatives has been successful through the advertising and presentation of Information Sessions that are open to the general public. In addition, some direct marketing continues through the mailing of a newsletter. Becoming established as a new degree program, from a new degree granting Institution has also required promotional materials be developed and marketed across the industry sectors in conjunction with a major advertising campaign to increase the awareness of BCIT as a new degree granting Institution