INDUSTRY SPONSORED STUDENT PROJECTS: IN SEARCH OF CONDITIONS OF RESPONSIVENESS BETWEEN TECHNOLOGICAL EDUCATION AND INDUSTRY TO ADDRESS THE INCREASE IN THE RATE OF TECHNOLOGICAL CHANGE

by

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AUTHORIZATION

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ABSTRACT

The increasing rate of technological change is forcing educational institutions to adapt in its ways and means of curriculum development to remain in a viable position to prepare job ready graduates. In order to accomplish this task, the literature points out that a closer association with business and industry is required for educational institutions to respond to the technological changes as they occur in rapid succession.

This problem was addressed in the School of Engineering Technology at the British Columbia Institute of Technology by introducing cash awards for students producing exemplary industry sponsored student projects in their graduating term. These projects were based on requests from industry with the intent to solve real-world problems. Students in more than 30 specialized fields of technology carried out these applied research projects to produce a tangible product of value to industry.

This innovation was examined over three years (1990-93) to study the results of a closer association with the continuous advancement of technology in industry. The conditions for the required response to the needs of industry as a result were found in an increase in industry sponsored student projects, direct involvement of faculty in technological change, and the opportunity of direct input from industry to curriculum change. As such, a functional relationship was established to allow for curriculum to respond to technological change on an ongoing basis.

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CHAPTER I

INTRODUCTION

As the rate of technological change in society increases, educational institutions are faced with the problems of keeping abreast of a volatile environment. They must endeavour to remain current in their offerings to their clients and responsive to their needs. Thus, the needs of students for preparation to enter the workforce in a technological environment and the needs of industry for a competent workforce to assist in their technological production methods must be taken into consideration and satisfied. Such a client-centred approach in a market-oriented manner means that decisions on what to teach are no longer the sole purview of educators, but must be a response to changing conditions of the workforce in industry.

In addition to students needing preparation, there are those currently employed who require upgrading in relation to technological changes in their industry. Educational institutions must thus respond by keeping current in the preparation of students and by responding to industry's needs for continuing training. John Dennison and Paul Gallagher (1986) thus propose that:

> Rather than operate on the factory model, in which a variety of approaches to teaching and learning is viewed as cumbersome and administratively awkward, it (the college) would subsidize instructors and groups of instructors to develop their own facilitation activities in response to learners, with the college becoming the corporate marketing agency for programs and activities ... . (p.176)

They further emphasize that:

> As Canada's colleges have clearly witnessed in recent years, some important changes have been forced upon them by external forces, others have been inevitable consequences of being parts of networks rather than simply self-standing institutions, and still others have been prompted by internal conditions. In any event, change is likely to be the single most important phenomenon facing Canada's colleges in years ahead, and they need an operating mode that is compatible with responding to, and provoking, institutional change. (p.201)

In the case of institutes of technology, the rapid increase in the rate of technological change is forcing a search for conditions to facilitate the required responses in this changing environment. Educational institutions must discover how they can become more client-centred in their operation. What are the conditions that would support a response to changing educational requirements of students in relation to technological change? If curriculum adaptation is market driven by changes in client needs, under what conditions can this process be most responsive?

Problem Statement and Purpose

To educate and train students to apply the latest technology in industry has become a major challenge, especially because constant updating is required to keep abreast with the increasing rate of technological change. As Robert W. DeSio (1987), Director of University Relations, IBM, points out:

> The engineering and scientific community is one of our most precious resources and assets. In a sense they are the creators of change and innovation which drives the world today. On the one hand they create and innovate and on the other they apply and implement their creations. The need for continuing education and training of this community is a top priority because of its relevancy to the goodness and success of the industrial and business sectors. The root factor is change, and that is what drives everything. (p. 631)

From this urgent theme of responsiveness in education, the purpose of this study is to examine the direction of technological education at the post-secondary level.

> The problem of the study is to identify the conditions that enable educational institutions to be responsive to industrial demands in relation to the process of technological change.

Outline

This problem will be studied in the context of curriculum change in the School of Engineering Technology (SET) at the British Columbia Institute of Technology (BCIT). Specifically, it will study the introduction of cash awards presented to students producing an exemplary Industry Sponsored Student Project (ISSP) in their final term before graduation. This particular innovation was introduced in January 1990, as a joint initiative of the School of Engineering Technology and the Technology Centre. The British Columbia Ministry of Advanced Education, Training and Technology provided a start up grant for the introduction of this innovation, with a provision for continuation pending the success of the program.

Before this time, student projects of a technical nature were a standard aspect of the curriculum in all technology programs in the School of Engineering Technology varying in terms of intensity of direct industry input from program to program. The objectives of introducing cash awards for students producing exemplary "industry sponsored" student projects were as follows:

1. Increase industry involvement in student projects in terms of having industry propose a problem, directly related to their technology.
2. Encourage change in the project course outlines to include the requirement for direct industry involvement in student project courses.
3. Extend professional development opportunities for faculty involved in the supervision of students working in projects with industry representatives solving problems jointly in their current technology.

4. Validate the job readiness of graduates successfully completing projects requested by industry.

The findings of the introduction, implementation and changes of this innovation will be studied in descriptive terms as outlined in the methodology section. It is hoped that the results of this case study will allow for the identification of conditions of responsiveness for a closer relationship between education and industry to remain current in technological education for the benefit of all concerned.

Scope and Limitations

The study will be limited to the introduction of cash awards for students producing exemplary projects in the School of Engineering Technology at BCIT. The changes to be observed will be over a period of three years (1990-1993), in view of the objectives set out above, within the context of conditions of responsiveness to technological change.

Summary of Industry Sponsored Student Project Awards Program

In this program, BCIT Engineering Technology students in more than 30 specialized fields (Table 1) are encouraged to carry out applied research projects "sponsored by industry" in their graduating term. The objective of the program is to apply the students' technical training and problem-solving skills to real-world problems identified by industry sponsors. Students are expected to be innovative and to apply the technological education they have learned at BCIT. The projects should result in a tangible "product", e.g. a report, a technical drawing, a computer program, or a prototype device. Industry sponsors are able to apply fresh, innovative talent to their companies' technical problems at minimal cost, with the hope that they will become

aware of a new approach or new technology that will ultimately benefit their company.

Table 1: School of Engineering Technology 2 Year Diploma Programs

- Civil Technologies
  - Building
    - Architectural
    - Economics
  - Civil and Structural
    - Geotechnical/Highways
    - Water Resources
    - Construction
    - Structures
  - Surveying and Mapping
    - Surveying
    - Photogrammetry
    - Technician's Program
  - Transportation Systems (Highways)
- Computer Systems Technology
  - Decision Systems
  - Data Communications Systems
  - Expert Systems
  - Information Systems
  - Microcomputer Systems
- Electrical and Electronics Technology
  - Automation & Instrumentation
  - Computer Control
  - Electrical Power
  - Telecommunications
- Mechanical Design Technologies
  - CAD/CAM
  - Mechanical
    - Design
    - Manufacturing
    - Mechanical Systems
    - Plastics
    - Robotics and Automation
    - Industrial Education Teacher Education
- Process Technologies
  - Biological Sciences
    - Biotechnology
    - Food Technology
  - Chemical Science
    - Environmental Science & Industrial Chemistry
    - Metallurgy
    - Pulp and Paper
  - Mining
  - Petroleum
  - Wood Products Manufacturing
  - Renewable Resources
    - Forestry
    - Fish, Wildlife and Recreation

The projects are subject to both academic and industry evaluation, and may receive awards depending largely on the impact of the project on industry. Students judged to produce exemplary projects win $500.00 cash awards.

During the course of the project students learn, through experience, a variety of skills that they would not learn in the classroom. Working with companies facing pressures of time and competition, they are exposed to the importance of project

management, problem definition, time management, teamwork, leadership and communication. The program provides opportunities for students to exhibit the necessary management skills of positive attitudes, responsibility and adaptability.

For the students, the benefits are straightforward. Solving a real-world problem may involve a lot of work, but it is exciting and challenging. They have an opportunity to win a valuable award. Above all, they can use the experience to demonstrate to prospective employers that they are competent and job ready.

CHAPTER II

METHODOLOGY

The phenomenon of responsiveness will be studied using the case study approach. In this case study, the focus will be on curriculum development of technological education in response to the increasing rate of technological change in industry. In order to systematically approach the problem and subsequent research questions of this study, the following logical sequence of investigation of BCIT and its relationship(s) with industry is proposed:

1. Antecedents:
   What are the existing conditions that pertain to this study?

2. Transactions:
   The innovation of cash awards for students to increase industry participation in student projects.

3. Outcomes:
   How functional is the process of curriculum change in addressing technological change through industry sponsored student projects?

The above three categories will be viewed from a theoretical point of view in terms of intent, as well as a practical point of view in terms of what is actually observed. As a result of these two viewpoints, the congruency and discrepancy between theory and practice may be observed.

Sources of Conditions of Responsiveness at BCIT

At BCIT, possible conditions of responsiveness are associated with the following institutional structures:

1. The Educational Council, which is made up of elected members from faculty, staff and management, deals with educational matters and reports to the President.

2. Advisory Committees for each technology program at BCIT, which consist of industry representatives advising faculty dealing with the direction of curriculum relevant to the specific technology in their industry.

3. The Learning Resources Unit, which is a department charged with giving professional leadership and advice in curriculum revision at BCIT and reports to the Vice President, Education.

4. Exempt staff including the Vice President, Education, Deans and Associate Deans.

5. Program heads and faculty associated with each technology that deal with their respective curricula and instruction, including the new thrust to increase industry sponsored student projects.

The above sources of conditions of responsiveness are supplemented by sources from outside BCIT as found in industry and associated organizations interested in, and concerned with, the preparation of graduates ready to meet the challenges of technological change, including industry sponsored student projects.

To place the sources of conditions of responsiveness identified above into the perspective for this study, the following illustration exemplifies its theoretical context. At the same time, the situation shows the time frame in which conditions of responsiveness are considered. Thus, the ever increasing rate of change today demands an almost immediate response; transcending the cumbersome aspects of established processes.

One of the bigger races in the high tech industry today is the search for the ideal microchip. Research in this area revolves around the discovery of conditions to provide maximum speed of response in the microchip, which will give the greatest possible effectiveness and efficiency in computer capacity. These conditions of responsiveness are presently being researched in two interdependent areas:

1. The structure of the chip in terms of the atomic combination of elements and the adherent architecture.

2. The environmental conditions of this chip in terms of voltage and temperature.

Scientists anticipate that a certain combination of possible conditions of the areas above will produce the chip with maximum responsiveness. As this race progresses toward faster response time in computers, applications of this research creates improved technology. The new technology is then transferred into industry to improve the efficiency and effectiveness of production, which in turn provides a better competitive position in the market place. However, associated with this technology transfer process is the need to upgrade the skills of the human resources in industry that has to work with this new technology. Educational institutions are required to provide curricula to enable individuals employed in industry to stay up to date with technological innovations to remain productively employed.

This situation concerns the implementation and management of change regarding innovative delivery strategies of educational technology. In order for institutions to be able to respond, the conditions of responsiveness associated with this process must be searched out. Similar to the conditions of responsiveness concerning the ideal microchip, these conditions can also be categorized in two areas.

1. The organizational structure of the institution responsible for delivering education in response to technological change.

2. The environmental conditions within the institution as composed of human resources.

The hypothesis is that a certain combination of conditions will provide the curricula to address technological change and the associated upgrading of the manpower involved.

Instrumentation

As put forth by Robert Yin (1986) : "Evidence for case studies may come from six sources: documents, archival records, interviews, direct observation, participant-observation, and physical attributes."(p.78) Documentation can take many forms such as:

letters, memoranda, electronic mail, and others.
agendas, announcements and minutes of meetings.
administrative reports such as, proposals, strategic plans, and progress reports.
news clippings and articles from the news media.

Archival records can consist of:

service records showing the number of clients served over a given period of time.
organizational records such as organizational charts and budgets.
lists of names and other relevant commodities.
personal records such as diaries and calendars.

Interviews are one of the most important sources of case study information. They can be open-ended in nature or focused to address specific questions. Direct observation can consist of a general field visit to get an indication of a situation or can follow a protocol to gather specific evidence. Physical evidence will be recorded by photographs of the results in this regard.

For the purpose of this case study a variety of methods will be applied to gather relevant evidence to present and illustrate the problem and research questions.

Documentation and archival records will bring to life the conditions pertaining to the various sources of curriculum development at BCIT, namely:

- Vice President, Education
- Education Council
- Learning Resource Unit
- Advisory Committees
- Dean (SET)
- Associate Deans
- Faculty
- Industry Sponsored Student Project Courses.

This evidence will be augmented by a questionnaire administered to the Dean, Associate Deans, and Faculty involved in industry sponsored projects. Structured interviews will be conducted with faculty involved in ISSP, the past chair of the Education Council and the Dean of the School of Engineering Technology. Furthermore, a questionnaire was developed for industry sponsors to measure their evaluation of student performance in ISSP and the worth of the outcome to their business.

In addition to the above methods of gathering evidence, Yin(1986) goes on to discuss the three principles of data collection to establish the construct validity and reliability of a case study. Principle 1: "Using multiple sources of evidence"(p.81). The above sources of data allow for an opportunity to check and confirm the evidence through the process of triangulation. Principle 2: "Creating a case study data base" (p.92). This principle covers the organization of data collected, as well as the notes and interpretations of the investigator. Principle 3: "Maintaining a chain of evidence"(p.96). A step by step log of the collection of evidence is required so that the outside observer can easily trace these steps. The collection of data in a case

study can become an immense logistical problem. However, with the use of the above principles, it becomes more manageable and provides construct validity and reliability.

Data Analysis

With the data collected and organized systematically as previously discussed, Yin (1986) suggests two strategies for analysis. The first strategy is to rely on theoretical propositions. In this case that would bring back the initial problem statement and the research questions, supported by the literature review, based on the theoretical proposition that curriculum development responsive to technological change can be developed better in harmony with industry. The second strategy is to develop a case description to emphasize validity and reliability. These two strategies will be employed concurrently to give the study a level of credibility to accept the conclusions, and use the results with confidence.

Discussion of Results

The results will be discussed using Fullan's (1982, p. 40) simplified overview of the change process in terms of:

initiation <-> implementation <-> continuation <-> outcome

Furthermore, the changes will be discussed in view of the "Factors affecting adoption" as identified by Fullan (p. 41-50), summarized as follows:

1. Existence and quality of innovation
2. Access to information
3. Advocacy from central administration
4. Teacher pressure/support
5. Consultants and change agents
6. Community pressure/support/apathy/opposition
7. Availability of federal funds or other funds

8. New central legislation or policy
9. Problem-solving incentives for adoption
10. Bureaucratic incentives for adoption.

The results discussed in accordance with these factors will lead to the key measure of eventual adoption of the proposed innovation.

CHAPTER III

REVIEW OF THE LITERATURE

The literature on the nature and scope of the conditions of responsiveness to technological changes is vast and diverse. Tom Whiston (1980) in researching this occurrence observes that:

> Vocational planning is closely related to technological change, and concern with technological change is intimately related to concern with education in several ways. If society is to be changed radically by technology, then people will need to be educated in different ways in order to help devise and implement such changes and to help ensure that such changes are beneficial, so far as possible. Thus, changed education is required in order to facilitate the changing of society by technology. (p.9)

It is diverse in the sense that it springs from technology specific situations in either educational institutions or industry. Gordon Thom (1985), by examining cases in "Making Canada Productive" where close relationships between education and industry are detailed, concludes that:

> Education is entering a new market oriented area. Partnerships responses to that market include new curriculum for Canadians, who as life-long learners, must adapt to contribute in a changing technological society. Industry is demanding shorter response times and flexibility from institutions and this is providing an impetus for change within colleges and institutes. (p.5)

The literature is found mostly presented in a case study approach detailing the specific technologies, educational institutions, and its environment in term of the relationship(s) between education and industry. This study is similar in that regard.

For the purpose of this study, the literature can be classified from an industry, educational and government perspective as it deals with the conditions of

responsiveness to address technological change. Industry in terms of a particular technology, education in terms of a pedagogical approach, and government in terms of overall identification of trends and strategies for direction. The overriding factor of the increasing rate of technological change demands conditions of responsiveness to facilitate the provision of technological education required in this dynamic environment. The context of these conditions will be reviewed.

Context of Conditions of Responsiveness in Technological Change

The context of technological change for this study is found in the ways and means employed to achieve the production of material ends in the most effective and efficient manner in industry. Richard Cyert and David Mowery (1987) point out:

> Technological change has two major effects: (1) it transforms the processes by which inputs (including labour and materials) are converted into goods and services, and (2) it enables the production of entirely new goods and services. Process innovation is technological change that improves the efficiency with which inputs are transformed into outputs; product innovation results in the production of new goods.(p. 24)

These means of production are continually changing. In the case of industry, the end is increased productivity which translates into increased profits, and adds to the economy and the standard of living (Cyert, 1987, p. 80-85). These means of production that are referred to as technology in industry become ends from an educational point of view. It becomes the responsibility of the educational institutions to adapt their means of providing curriculum that addresses this continuously changing technology. Edwin Mansfield (1982) notes:

> One of the fundamental processes that influences the economic performance of nations and firms is technology transfer. Economists have long recognized that the transfer of technology is at the heart of the process of economic growth, and that the progress of both developed and developing countries depends on the extent and efficiency of such transfer. (p. 15)

Hutchinson Stewart and David Gibson (1990) point out that technology transfer between industry and educational institutions involves the movement and application of knowledge. However, they go on to caution that "before the actual transfer of knowledge can take place, linkages must be formed." (p. 109). As a result, this responsive "means-end scenario" between education and industry in terms of linkages becomes an important and complex situation, in a continuous state of flux.

Industry's system of technological means becomes the source of technological education in terms of a required response. However, with the increase of technological change in industry as a given, the educational ends derived therefrom are not ends in a fixed sense, but remain ever fluid, immersed in industry as part of the ongoing process of technological change. This fluid situation can no longer be compared to a meandering river, slowly altering its course in relation to changing conditions. With today's increasing rate of change, it has become more like flash floods demanding immediate attention to prevent disaster. For example, when engineers decide to computerize production in a saw mill, immediate training is required or the operation will cease. Stewart and Gibson (1990) describe the stark reality in the electronics industry by observing that "advances in technology are occurring so rapidly that individuals graduating with the most up-to-date technical educations will find that the amount of knowledge in their fields literally turns over within a few years." (p. 114)

Within this context of technological change it becomes increasingly difficult for a traditional educational institution to respond to the technological education requirements of industry. John Naisbitt (1984) observes that material taught in

institutes of technology will be obsolete in approximately four years. Hence, the major function of "preparation" carried on by institutes of technology in this regard has been eroded to short term viability due to the rapid increase in technological change. This current situation has serious implications for educational institutions designed to meet the educational requirements of industry. Peter Drucker (1985) foresees the role of public educational institutions as follows:

> But still the great bulk of the activities that are being discharged in and by the public-service institutions will remain public service activities, and will neither disappear nor be transformed. Consequently, they have to be made producing and productive. Public-service institutions will have to learn to be innovators, to manage themselves entrepreneurially. To achieve this, public-service institutions will have to look upon social, technological, economic, and demographic shifts as opportunities in a period of rapid change in all these areas. Otherwise, they will become obstacles. (p. 185)

A Changing Perspective of Technological Education

From the above context of technological change, a new perspective of technological education in response to industry starts to emerge. No longer is the traditional model of education sufficient to act as a means to satisfy the ends, i.e. the ever changing means of industry. The increased rate of change in technology demands a parallel increased capability to respond with appropriate innovations by educational institutions.

The name of "Institute of Technology" to denote the educational institution that provides the educational requirements of industry has become a paradox. An institute, or institution, is characterized by an established set of fundamental rules, customs and practices giving meaning to its members and the surrounding community. As such, it has a tendency to become permanently ingrained in society

demanding adherence, and resisting outside pressures for change. In his address to the 1989 Canadian Vocational Association conference, entitled, "Canada's Skills Training Challenge", Bernard Ostry identifies the changing conditions due to global markets, organization in working relationships, skill shortages, and recommends that "in the end we need to make changes in our educational culture. Instead of talking endlessly about learning as a life-long enterprise, we should make some structural changes that will help bring this about." (p.16).

Technology, on the other hand, is a phenomenon of continuously changing means of production in industry. The paradox in this case has resulted from the increased rate of technological change. An educational delivery system, established as an institute, is losing its congruence within the education-industry relationship due to the ever increasing rate of technological change. As a cumbersome bureaucracy, it has difficulty in remaining responsive to the volatile environment in industry created by technological change. Tom Burns and George Stalker (1961) observe in their study of technological innovation in the electronics and fibre industry that an organic model of organizational structure was more highly associated with frequent adoption of innovations than was a mechanistic structure. In contrast to the mechanistic structure, the organic organization was characterized by frequent lateral communication between individuals and subunits, decentralization of control and an overall high degree of networking between people and units. "The transformation of a mechanistic organization in education to adapt and deal with an organic situation in technological change may thus be the foremost political task of this generation." (Drucker, 1985, p. 187)

The internal structure of an educational institution is governed by Max Weber's (1947) principles of bureaucracy. He presents a hierarchical structure of management with a set of impersonal rules dominating its operation. Bureaucracy, as a mechanistic approach to management, is designed to operate in a steady environment, resisting change. Internal change is difficult to accomplish due to impersonal rules established to protect equal treatment for its members. As such, a steady state emerges that is at times more concerned with the protection of the institution's members than with the environment it is supposed to serve. These present conditions do not bode well for the responsiveness required to facilitate today's technological education requirements for industry.

The above perspective of the relationship between education and industry, based on the context of technological change, leads to a search for conditions of responsiveness that facilitate the transfer of the required technological education into industry. Stanley Spanbauer (1992) reflects on this new perspective as:

> Besides improving internal relationships, instructors in quality based schools establish unique relationships with the community. They present a positive image of their school and actively participate in events with business and industry, other schools and agencies. They constantly update themselves and their programs through meaningful experiences with employers and advisory committee members.

He qualifies those conditions of responsiveness by pointing out:

> Nothing significant will happen in schools without the full support of the faculty and staff. Instructors, because of their "front-line" relationships with both students and the community, have special roles to play which are most significant. (p. 78)

It would appear that a move from mechanistic to organic organization is essential to arrive at a more suitable set of conditions to respond to industry, as illustrated by Dan Dimancecu and James Botkin (1986) when they report:

> As part of the graduation requirement, all undergraduates have to write a thesis on the social impact of technology, as well as have significant experience in industry. As a result, "Worcester Polytechnic Institute students are great," says Gary Newall at General Motors. "You can hire them and they go to work without any retraining or extensive on-the-job apprenticeship." (p.95)

Context of Conditions of Responsiveness in Technological Education

Conditions of responsiveness are defined as the requirements for an effective response to a given situation. In this case, the situation is technological change in the production methods in industry. The required response is a curriculum from an institution that will satisfy the educational requirements of industry. The conditions of responsiveness are thus the conditions that allow an educational institution to react readily to transfer the appropriate education into industry as required by the ongoing process of technological change.

Conditions of Responsiveness in the Context of Institutional Change

Michael Fullan (1982) examines the meaning of educational change through factors associated with adoption, affecting implementation, and continuation of change. These are addressed in the K-12 system and are, to a large extent, determined by the traditional structure associated with K-12 schooling scenario. According to John Goodlad (1983), this model has not changed very much over the last fifty years. Thus, Fullan is considering curriculum change within a steady organizational structure. His heavy dependence on organizational structure leaves his

theory very much oriented to the internal dynamics of the organization. In the education-industry relationship, on the other hand, conditions of responsiveness cut across organizational boundaries of education and industry. Fullan's description of "meaning" makes this situation more complex because educators and members of industry speak different languages that have different meanings related to their own organizations, stemming in part from the fact that one group operates in the public sector and the other in the private. But, from this starting point, there is much more. If Fullan's description of a theory of "changing" were to be used in dealing with education and industry, the factors relating to implementation of innovation in industry would also have to be identified. The combination of these two sets of factors would then lead to conditions of responsiveness across organizational boundaries.

In addition to organizational structures, the human conditions for responsiveness become paramount. In view of the anxieties associated with change, subjective meaning in terms of human conditions has to be achieved in association with objective meaning expressed in structure. As Fullan (1982) points out:

> The anxieties of uncertainty and the joys of mastery are central to the subjective meaning of educational change, and to success or failure - facts which have not been recognized or appreciated in most attempts at reform. (p.26)

Dianne Common (1981) in her article, "Two Decades of Curriculum Innovation and So Little Change," also refers to the underlying conditions of change:

> The major function of implementation, or implementation planning, is to provide or construct a set of conditions within a school so that the instructional practices implied or prescribed by the curriculum can then occur. (p.43)

But she goes on to deal with the attached human condition:

> Through implementation processes a curriculum is interpreted and translated by the users of the curriculum. In other words, the curriculum is adapted to meet the needs or to accommodate the skills, expectations, and values of the users. (p.44)

Even though her writing also springs from the K-12 situation, both sources of conditions of responsiveness are identified and linked.

The search for conditions of responsiveness in the relationship between education and industry is not easy. The objective, structural conditions and the subjective, personal conditions have to be considered as two interdependent sources. Because organizational structure has to be very flexible in an organic as opposed to a mechanistic sense, the consideration of human conditions becomes even more important. The lessening of structure in an organic organization will force individuals to find their meaning in task orientation rather than in organizational maintenance. This shift may be a contradiction in view of Abraham Maslow's (1965) hierarchy of needs theory. Can security needs be met "through" achievement, rather than "prior to" upper levels of need fulfilment? Seeing that Maslow's motivation theory in terms of a hierarchy of need fulfilment can not be proven empirically, the answer may be yes. However, this situation could also be viewed as a "disease" brought on by the rapid advancement of technological change described by Alvin Toffler (1976). In order to place conditions of responsiveness in their appropriate perspective for this study, the model below is proposed.

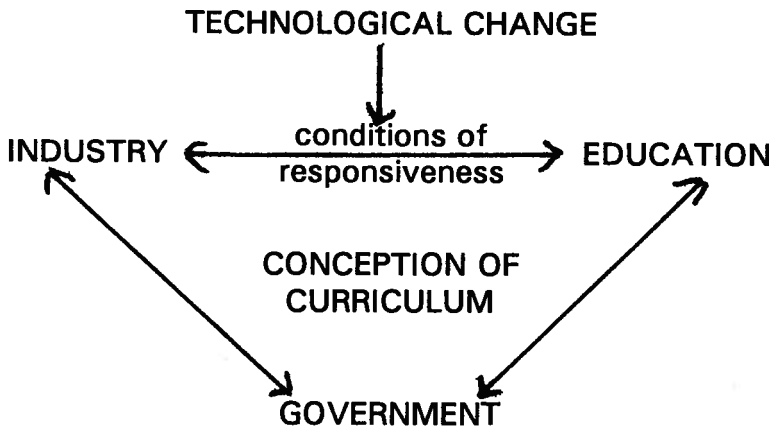

Figure 1: Conception of Curriculum Response to Technological Change

Noting Toffler's statement that "the only thing constant in the world is change itself", technological change is viewed in this model as a constant affecting the relationship between education and industry. The involvement of government will also be considered. In the final analysis, the resultant education required by industry will emerge through a conception of curriculum. Industry responds to technological change by using the benefits to remain competitive in world markets. In turn, educational institutions respond to these changes in industry through innovations in their own technology (curriculum). Both education and industry are subject to government policies.

The conditions of responsiveness to be searched out in this study are located along the line of interaction between industry and education. As discussed previously, the conditions of responsiveness are part of the organizational structures of industry and education. In addition, they are part of the individuals associated with these structures.

If technological change is accepted as a constant affecting the relationship between industry and education, then the conditions of responsiveness become the grease that lubricates the interaction between the two. It should also be noted that, in the above model, curriculum does not find itself in its traditional position as part of education. Instead, it is placed in the centre of the model as the crucial issue, drawing from, and affecting all three partners in the total enterprise. The placement of curriculum in this regard may be a significant shift in paradigm reflected by Thomas Kuhn (1970). Education, through its curriculum, may no longer provide the answers to a lot of questions as technological change is creating a new order. Curriculum can no longer be formulated in isolation from those it is to serve. The rapidity of change creates continuous obsolescence in curriculum so formulated. This curriculum formulation has to become part of the interactive process between industry and education. Advisory bodies associated with educational institutions to formulate current curriculum may no longer be as viable due to the rapid increase in the rate of technological change.

As one searches for the conditions of responsiveness along the arrows of interaction between industry and education in the above model, the paradigm associated with the science of management as presented by Frederick Taylor (1911) would appear to be an appropriate solution. The answers may be drawn from the theories of management based on organizational structure along the continuum from mechanistic to organic approaches; from the "bureaucratic" to the "matrix" model. However, this approach is still too mechanistic from an organizational point of view to suit the requirements of rapid technological change.

The study of organizational behaviour as outlined by Fred Luthans (1985) in terms of leadership, motivation and communication should provide the conditions of responsiveness. However, as Kuhn points out, there may come a time in science when the existing paradigm no longer answers all questions. Anomalies may need to be accommodated. According to Kuhn, a paradigm transcends theory to the extent that those who have constructed it and hold to its explanatory value are the reason for its existence. Paradigms do not change because those that have created them do not wish to change. Instead, paradigms are replaced by individuals who create new ones that are able to accommodate anomalies to the previous paradigm. Hence, the use of the word revolution in his essay, "The Scientific Revolution."

This management approach is well documented by Fullan (1982). However, the intangible quality of the human condition identified by Kuhn that remains the underlying construct of the phenomenon of innovation and its implementation and that quality of the human condition is a given, driving the management process to its intended outcome. Harry Wolcott's (1977) case study, "Teachers vs Technocrats", further illustrates the underlying human condition in terms of moieties. It appears to be the comfort zone of those directly involved and affected that has a large bearing on the acceptance of change. In addition to the existing paradigms that provide a basis of identifying conditions of responsiveness, the associated human condition warrants further investigation. The conditions of responsiveness may be a function of personality within the various structures associated with the relationship of industry, education, and government (Theodossin, 1986). This leaves us with two sources of conditions of responsiveness. Those as manifested in the organizational

structures associated with the model and those inherent in the human condition dependent on the comfort zone within those structures.

Context of Curriculum

When the desired relationship between education and industry is viewed within the context of curriculum the literature is immense in terms of volume and orientations. Within the context of conditions of responsiveness between education and industry, needs assessment becomes the critical component as a source of curriculum development oriented toward technological change. Curriculum as a whole however cannot be neglected to satisfy the need for specific curriculum in relation to specific technologies emerging from specific situations, as pointed out by Vic Kelly (1982):

> The first need is to achieve some clarity over what we are to understand by the term 'curriculum'. It is a term which is used with several meanings and a number of different definitions ... . To begin with, it will be helpful if we distinguish the use of the word to denote the content of a particular subject or area of study from the use of it to refer to the total programme of an educational institution. (p.7)

Kelly maintains however, that the whole has to be formulated first to give guidance to individual curriculum aspects related to specific areas of study. To proceed in a rather piecemeal way within subjects, rather than according to an overall rationale, will show curriculum as "the amorphous product of generations of tinkering" (Taba 1962, p. 8)

Notwithstanding the traditional top-down approach in comprehensive curriculum planning in today's context of the rapid increase in the rate of technological change,

a changing orientation is required to keep abreast. As such, Daniel Tanner and Laurel Tanner (1975) summarize curriculum decisions as follows:

> As education begets new knowledge at a seemingly accelerated pace, the response had been to parcel out such knowledge into increasingly separate and specialized domains. However, the specialization and segmentation of knowledge have made the curriculum more remote from life at a time of rising demand to make curriculum more responsive to emerging societal needs and problems. (p. 47)

Nevertheless, they recognize the emergence of differing conceptions of curriculum during the twentieth century to accommodate the changing times, including the implied reference to technological change:

> Since that time, curriculum writers have defined curriculum variously as (1) the cumulative tradition of organized knowledge, (2) modes of thought, (3) race experience, (4) guided experience, (5) a plan for learning, (6) educational ends and outcomes, (7) a production system. (p. 47)

These differing conceptions of curriculum allow for an appropriate approach to curriculum development in response to technological change by placing more emphasis on one or other in relation to the situation under consideration.

The terminology of "means" and "ends" in curriculum planning is often criticised (Hirst, 1974) on the basis that means can bring about achievement that can also be considered ends in themselves. As discussed previously in the relationship of technological means in industry, considered ends from a curriculum planning point of view, this criticism can also apply. Nevertheless, Hirst concludes that:

> If, therefore, curriculum planning is to be understood as a means-ends-matter, it must be interpreted to cover both logical and empirical relationships. If this is done, I see no reason to doubt its suitability. What it does is assert unmistakable the need for a clarification of what we want achieved and that alone makes it a useful framework in terms of which to examine the contemporary flood of curriculum development. (p. 14)

In this sense, conditions of responsiveness as they arise in close relationships between education and industry can be utilized to clarify the means and ends for mutual satisfaction and progress toward updating curriculum. For the purpose of this study, John Dewey (1915), supplies the link between theory and practice when he writes about industry and educational readjustment:

> The chief effort of all educational reforms is to bring about a readjustment of existing scholastic institutions and methods so that they shall respond to changes in general social and intellectual conditions. The school, like any other human institutions, acquires inertia and tends to go on doing things that have once got started, irrespective of present demands. (p. 167)

This still applies today, but the rapid increase in the rate of change has brought a new urgency to the situation.

Needs Assessment in the Context of Responsiveness

Needs assessment as part of curriculum development is well represented in adult education literature. Thomas Sork (1983), in his critical analysis in this regard, presents his findings in various categories of interest. For the purposes of this study, a limited number of contributions will be examined to provide an orientation required to allow for continuous responsiveness as a result of openness in needs assessment.

First, it must be noted that Ralph Tyler (1949) sets the stage for much of what is to follow in needs assessment literature. Tyler's four basic questions can be gleaned from many program models presented. His approach is linear and yet allows for the inclusion of whatever has bearing on program development. As such, his model is logistic and yet fluid. It is the fluidity of a program model that is important in today's environment of continuous change. Flexibility is required to incorporate the many changing variables to be considered for needs assessment in the area of

technological education. Tyler's questions not only allow for that to take place, they demand it.

Tyler's first question, "What educational purposes should the school seek to attain?", allows the concept of needs assessment to be utilized in a wide variety of situations. This question can also be utilized within the technological education context. It goes beyond the strict parameters of what is actually needed. It digs into the context and environment surrounding the needs to be addressed. As pointed out at the beginning, it is the intent of this study to provide a connection between needs assessment and program development in terms of conditions of responsiveness between education and industry. Tyler provides a good start in terms of opening up the concept of needs assessment to include conditions that have bearing on that process.

Then there are those who have gained much experience in the field of program planning in education. Edward Blank (1982) views needs assessment as a strict and very detailed observation of what is required in terms of performance to get the job done. It is straightforward within the context of the union or management that controls the workforce. The subsequent design of the program is lengthy and detailed and needs to be repeated should any changes occur. Blank's procedure of needs assessment and program development takes place based on the performance required, apart from the actual job site.

Allison Rossett (1987), on the other hand, bridges that gap between the professional program designer and the environment that the design is intended for. Her definition of needs assessment demonstrates that:

> Needs assessment is the systematic effort that we make to gather opinions and ideas from a variety of sources on performance problems or new systems and technologies. (p. 62)

Her approach still addresses the logistics through "systematic effort", but also starts to dig into the conditions of responsiveness involved in the process through gathering "opinions and ideas from a variety of sources". Although this data could be gathered at a distance through questionnaires and surveys, it also allows for dialogue as part of interviews, which is a two way vehicle for responsiveness. At this stage, the needs assessment process starts to take on a life of its own. Rossett presents the future approach as follows: "Training will have to be very efficient, increasingly more individualized, and on demand, embedded in the system that employees use to perform their work." Education must be in a position to respond as change occurs in the environment. Needs assessment becomes a condition of immediate response.

Thomas Sork in his paper, "Needs Assessment in Adult Education", also explores the thought surrounding needs assessment from its initial concept to wider possibilities of meaning. Nevertheless, after discussing the many interpretations that can and have been associated with the term need, Sork develops a technical definition proposed as "the present and proposed quality of human capability." Or, in more general terms from which he derives this technical definition, "a gap between a present state of affairs and a desired state of affairs." Viewed from a technological education perspective this definition appears to be performance based, separate from the environment where the need exists. Sork recognizes this distinction between theory and practice when he explains:

> Theoretically, identifying needs is a very straightforward process. First, the present state of affairs is described, then the desired state of affairs is described. In practice, however, the process can become rather complex because of the amount and types of information necessary to construct needs and the frequent problems of reaching agreement on how the desired state of affairs should be described.

He then goes on to illuminate the steps involved in coming to grips with these complexities in a responsive mode(s). It is interesting to note that Sork's first two steps in his basic planning model are "analyze planning context & client system" followed by "justify and focus planning". The words needs assessment are not used, but implied in the second step. The use of different language in the model, away from needs assessment, leads to a fuller immersion into the contextual factors associated with program design, as in conditions of responsiveness.

From Blank to Rossett and Sork, the common thread of approach to needs assessment is "performance". However, a shift was noted in the move to a greater awareness of the "contextual factors", as Sork refers to them, that have to be taken into consideration. It is no longer adequate, as in the case of Blank, to provide programs for training drawn from, but not connected to, the worksite. Responsiveness must be part of the needs assessment process in terms of symbiotic relationship in order to stay in tune with the accelerating rate of change in technology.

Responsiveness in the Context of Industry

The results of a recent survey by the Corporate Council of Education of the Conference Board of Canada (1992), produced the following "Employability Skills Profile" required of the Canadian workforce:

1. Academic Skills
   Those skills which provide the basic foundation to get, to keep and progress on a job and achieve the best results.

2. Personal Management Skills
   The combination of skills, attitudes and behaviours required to get, keep and progress on a job to achieve the best results.

3. Teamwork Skills
   Those skills needed to work with others on a job and to achieve the best results.

The above employability skills profile suggests the curriculum that provides access to the type of education required in this regard must come from a model that can address change as a result of technological change in industry. The curriculum model to suit these needs must be open to input from a host of sources associated with the dynamics of change.

Responsiveness in the Context of Government Policy

Government publications regarding the economy and the effect of technological change have been prolific at the federal and provincial levels. The increase in the rate of change has forced governments to continuously re-examine their policies to provide leadership and direction. Starting in 1987 with a discussion paper by Gordon Thom, entitled "Employer Interaction with Public Colleges and Institutes in Canada", it becomes evident that similar topics as in the literature receive detailed attention for future strategies. The increased rate of technological change supports the creation of partnerships between education and industry to become more responsive to overall labour market needs in view of the economy. "The post-secondary system needs to be more pro-active and responsive to the needs of employers and therefore colleges should solicit partnerships more aggressively." (p. 32) The benefits derived therefrom

lie in the area of student involvement in industrial processes for educational purposes and faculty for exposure to new technology for professional development.

The many reports issued by the federal government touching on the responsiveness issue between education and industry in view of change and the economy as overriding factors receive a critical response from David Lewis in his speech to the Canadian Vocational Association in Ottawa on October 29, 1992. He started with the "Prosperity Report: An Action Plan for Canada's Prosperity" by pointing out that is costs only 20 million dollars over the period of one year, 1991-1992. Of the 54 recommendations in this report he pointed out: "The report asks for revamping of the educational system without, of course, any detail." He went on to illustrate the frustrations and lack of subsequent action derived from government reports by summarizing the collective efforts in this regard:

> You will forgive me, of course, if I remind you that this new report which everyone says is going to be the basis for public policy is an add-on to The Prosperity Through Competitiveness document which came from the federal treasurer not so very long ago. As it was an add-on to Michael Porter's report, Canada at the Crossroads, The Reality of a New Competitive Environment. As it was an add-on to the Labour Force Development Strategy which Barbara McDougal provided in 1989. As it has been an add-on to the De Granpre report on what you do around training and labour market adjustment in the face of consequences of free trade. As it was an add-on to the Canadian Job Strategy fashioned in 1985 with many, many interpolations and alterations and amendments over the last number of years. (p.8)

These reports are filled with background research by Statistics Canada detailing the needs in terms of skill development required through responsive technological education. Lewis went on to conclude: "We keep repeating these nostrums as though they were discovered biblical truths and never deal with the reality in the areas which

are described, ..., the need for training which becomes a cause celebre for the society." (p. 8)

Reports from the provincial governments seem to fall in the same category of glorious vision but no subsequent action. The "British Columbia Human Resources Development Project: Report of the Steering Committee" (November, 1992) also emphasizes the need for greater collaboration between education and industry to provide the required education responsive to technological change:

> As the context for learning changes, it is also timely to reassess the roles that our education and training institutions should play in ensuring a well educated, skilled workforce. At different times in our history, the expectations society has held out for its institutions has differed. If we are to use all our resources in support of learning to greatest effect now, it is important to determine carefully where the responsibilities of education and training institutions should end and where the responsibilities of business and labour should take over. They should not be operating in isolation or at cross purposes. (p. 50)

Further admonition to get on with the job of providing technological education in response to technological change in industry, but no details for direction.

Summary

It becomes evident from the literature that a closer relationship between education and industry is essential to address the needs brought about by the increasing rate of technological change. Jerry Murphy (1992) in "A Policy Paper on Applied Education" as a joint effort between the Society of Vocational Instructors of British Columbia and the British Columbia Association of Vocational Administrators, identifies the two main points that require immediate review:

1. With the increasing rate of change occurring throughout society and the economy, we need to examine the issues facing many areas including apprenticeship, technical, career and developmental education.

2. A stronger partnership that bridges business/industry, high school, and college/institutes is required to improve the quality and productivity of the work force. (p. 17)

These areas of concern are refined by Janet Patterson (1993) of Algonquin College in "Key Issues in Higher Education", where she observes:

> Community and regional partnerships will be critical for any institution of higher education. Field experience, co-operative programs and higher employer/faculty exchanges is the only hope of keeping our institutions current with technology and process. Institutions will not be able to afford applications technology and employers want skills-ready graduates. (p. 19)

The relationship envisioned is almost of a symbiotic nature with one feeding the other on a continuous basis. In order to work towards this end the structural relationships discovered thus far must be complemented by a functional relationship that can provide the instant feedback required in the process of change. The conditions of responsiveness must become alive in terms of functional and personal interplay between faculty, students and representatives of industry to realize their common aim in this regard.

Research Questions

In order to investigate the problem stated earlier in view of the orientation of the literature, the following research questions have been formulated:

1. What structural conditions support an educational institution to respond to technological change?
2. In what ways do human conditions facilitate the responsiveness of technological education?
3. What conception of curriculum enables educational institutions to address curriculum change?

It is within the conditions of the structural and functional relationship between education and industry that responsiveness is inhibited and/or encouraged toward an

evolving curriculum responsive to the rapid increase in the rate of technological change. Hopefully the case study of industry sponsored student projects in the School of Engineering Technology at BCIT will provide the arena to shed some light on this increasingly urgent problem.

CHAPTER IV

PRESENTATION AND DISCUSSION OF RESULTS

Existing Conditions of Responsiveness Reviewed

The existing conditions of responsiveness to get input from industry into the required technological education to be offered by BCIT were found in the components within the organizational structure. As such, they were found in the hierarchy of the organization from top to bottom starting with the BCIT act flowing through the Board of Governors, Education Council, Advisory Committees and the Staff Society Contract. The specifics dealing with responsiveness to industry at each level were searched out and can be found summarized in Table 2.

Table 2: Excerpts From the Official Hierarchy of Operating and Managing Component Structures at BCIT Pertaining to Curriculum

SOURCE DOCUMENTS	EXCERPTS PERTAINING TO CURRICULUM
INSTITUTE OF TECHNOLOGY ACT	Purpose of Institute The purpose of the institute is to provide, maintain and operate buildings, equipment, facilities and services for offering and providing courses of instruction in technological and vocational matters and subjects, and, for that purpose, to continue and carry on the Institution that, on July 4, 1974, was maintained and operated by the Department of Education under the name "British Columbia Institute of Technology". Powers and Duties of Board Provide for the management and carrying our of the curriculum, training, instruction and education offered and provided by the institute and programs approved by the minister. Establish i) an academic advisory committee; ii) a program advisory committee in respect of technology programs;
BOARD OF GOVERNORS HANDBOOK	Powers and Duties of the President and Chief Executive Officer Plan, direct and supervise the delivery of educational programs, institutional services, professional and support staff relations, student relations, management of physical plant, properties, information systems and external relations. Recommend the appointment of such instruction, administrative, support and service staff as the Board considers necessary to carry on the business and operations of the Institute and generally provide an organizational structure to carry out the purposes of the Institute; Education Committee - Major Responsibilities Strategy issues • Identify and foster the evolution and implementation of programs that fit the BCIT mandate. • Achieve a finely-tuned sensitivity to, and anticipation of the needs of business and industry for a highly-trained, job ready work force and, in doing so, fully utilize an effective advisory committee system.

Table 2: con't

EDUCATION COUNCIL HANDBOOK	Terms of Reference of the Educational Council To maintain a continuing review of the educational policies, programs and priorities of the Institute and, notwithstanding the generality of the foregoing, shall make recommendations to the President with respect to the educational goals and objectives of the Institute. To recommend to the President the curricula and standards for all programs and courses of study. • to review continually the performance and evaluate the effectiveness of the advisory committee system. • to make recommendations to the President with a view to ensuring the effectiveness of such committees. Educational Planning and Policy Committee • Assess the impact of future socio-economic and technological forces on the institute and develop recommendations for responding to change. • Review proposed modifications to educational programs with respect to: o program objectives and content o course objectives Committee to Review Education Programs and Priorities • Review and make recommendations regarding educational priorities for new and existing programs consistent with the long range plan; • Review and make recommendations regarding proposals for educational innovations. Educational Standards Committee • Review and make recommendations regarding the effectiveness of advisory committees;
ADVISORY COMMITTEES ORIENTATION MANUAL	Goals To assist the Institute, the School, and the Program in achieving or maintaining a high quality training program to provide the industry concerned with job-ready graduates who have appropriate knowledge, skills and attitudes. Objectives To review and comment on program quality in several significant aspects including curriculum, facilities and equipment, instruction and delivery methods. Planning Issues Review curriculum, instruction, and delivery method with respect to a five-year forecast. Policy • To advise the Institute on issues relating to program-specific needs assessments, program planning, development, implementation, and evaluation; • To review the curriculum and delivery methods and recommend changes if desired.
TEACHING FACULTY STAFF SOCIETY CONTRACT	Professional Responsibilities of Employees • Each Employee has a professional responsibility to remain a contributing, up-to-date and effective member of the technological community at B.C.I.T. as it maintains its leadership role in technological education. • Duties for teaching Faculty may include reasonable assignments in the activities listed below, as appropriate to the specific position and individual: laboratories, lectures, clinical experience, tutorials, seminars, student course advising, student screening, selection advising, collegial evaluation, course evaluation, student evaluation, performance evaluation, interviewing, course preparation, course upgrading, curriculum development, program planning, coordination and evaluation, meetings and Departmental committee work, field trips, library liaison, contact with Employers, professional development, invigilation of exams, equipment control and design, and other administrative duties necessary for normal operation of the Department.

As shown, these conditions of responsiveness pertain to the respective levels associated with the hierarchy in the organizational structure. From a management

point of view, these conditions of responsiveness become subject to the arrangement of many meetings and subsequent flow of paperwork to get the desired results of industry through the increasing rate of technological change.

From a structural point of view, this approach is sound as far as providing accountability in the organization. However, from a functional point of view, it appears to have become too cumbersome to react quickly to the ever increasing rate of technological change that the curriculum eventually has to deal with.

From the structural components dealing with curriculum input, it is the Advisory Committee that is considered the cornerstone of BCIT's reputation for job-ready graduates. The President's message in the "Orientation Manual for Advisory Committee Members", outlining their responsibilities, points out:

> As an Advisory Committee member, you are joining a group of people who are very important to BCIT. Maintaining close ties with business and industry is the guiding principle for quality control and curriculum development. This link is established on a program by program basis to ensure that each program has the benefit of individuals who have the expertise to advise faculty and administration about the knowledge and skills required by graduates for employment in specific careers. (p.4)

That is a tall order in view of the constant changes in technology in industry. Especially in view of the fact that these advisory committees meet twice a year at most. Their effectiveness in this regard depends on the collective industry background of its members and the direction and leadership they receive from faculty and administration.

This system of input through advisory committees dates back 25 years to the founding of the Institute. The president alludes to the changing responsibilities in

view of the current situation in industry as a result of increasing technological change by noting:

> The expanded mandate for BCIT announced by the Government in the Spring of 1988, requires BCIT to focus on initiatives that increase the level of entrepreneurial activity within the Province. This mandate (full text included later), expands the responsibilities of the Institute into applied research and technology transfer; two activities that require an even closer relationship with business and industry than has been maintained in the past. We hope that the members of the Advisory Committees will be prepared to assist us in moving into these new areas. (p.4)

These expectations do not appear very realistic based on two meetings a year. Continuous contact with the technology program is required to remain in a position to make the contributions asked for.

From an operational point of view, the annual reports of the Advisory Committees of the Engineering Technologies from 1991/92 were examined to discover to what extent they were involved in curriculum development. Excerpts relating their involvement in the process of curriculum change are noted in Table 3. The actual role of the advisory committees, as gleaned from this examination, appears to be concerned with the direct relationship of curriculum to the needs of industry. They act in accordance with their role outlined in the president's expectations as noted above, but indicate that this role is becoming more difficult in relation to the constant review of curriculum required to stay up-to-date with the needs of industry.

Table 3: Excerpts From Advisory Committee Annual Reports, 1991-92 Reflecting Involvement in Curriculum Issues in Response to Technological Change.

The curriculum review and Strategic Planning studies have injected a fresh focus for this technology program, providing a good platform for further extensive assessment and implementation to ensure that this technology maintains the high standard for graduates.
Set up a "tracking system" of graduates to evaluate program objectives and directions to ensure training is directed to industry and graduate needs.
With such a comprehensive review of the program being considered, an active participation of the advisory committee or committee of the advisory , should work alongside staff and administration.
Active Participation cannot result with one or two meetings per year.
The computer technology has revolutionized the industry procedures. Graduates must have the basic computer skills and application knowledge.
A curriculum review was started with committee members and industry representatives checking course content for industrial reliance.
The committee is working toward the completion of the curriculum review in conjunction with proposed program changes.
Other major activities in which the Advisory Committee has been involved include ongoing consultation regarding course and curriculum renewal.
A renewed emphasis should be placed on co-operative work terms. Both students and employers benefit from co-operative work terms or "practicums". The emphasis in the curriculum and in student projects should be on systems engineering or how various equipment is interfaced to control a process.
There is a need to restructure the committee and reconfirm the member's willingness in assuming an active role in the program's curriculum review process.
In so far as the program is relatively new and given that the current industry members were involved from the planning stage onward, this program has remained very sensitive to industry requirements as evidenced by dropping the preventative maintenance portion of the program to allow more emphasis on projects.
The successful work experience program will be repeated in January, 1992. Extending the length of the work experience program to tie in with student projects will be considered.
A program of industry based special projects has been initiated, where groups of students are working on studies in industry. The department will continue to solicit ideas from industry for future projects.
Need to upgrade instructors to keep current with the needs of industry, to maintain job readiness level in graduates, and for some curriculum changes.
Curriculum changes recommended by the Curriculum Review will be implemented subject to availability of resources.
The faculty have also embarked on a form of education partnership with two organizations to increase the work experience component of the program.

These difficulties are reflected by comments such as, "an active participation of the advisory committee or committee of the advisory, should work alongside staff and administration. Active participation cannot result with one or two meetings per

year." And yet another advisory committee recommends, "There is a need to restructure the committee and reconfirm the members' willingness in assuming an active role in the program's curriculum review process." Further evidence of the acceptance by advisory committees that they have difficulty in becoming directly involved in curriculum change is noted by, "Other activities the advisory committee has been involved in include: ongoing consultation regarding course and curriculum renewal." This sample of evidence supports the assumption that advisory committees act in a validating role regarding curriculum change relative to technological change in industry. Because of their structure which determines their degree of involvement, they recognize their position as removed from the process of curriculum responding directly to industry needs.

Nevertheless, they recognize the need "to upgrade instructors, to maintain job readiness in graduates, and curriculum change." The opportunity to do so by having students involved with industry as part of the curriculum is evidenced by observations such as "extending the length of the work experience program to tie in with student projects will be considered." This approach is further validated by "a program of industry based special projects has been initiated, where groups of students are working on studies for, and in, industry. The department will continue to solicit ideas from industry for future projects." Another advisory committee goes as far as to recognize the utility and value of industry sponsored student projects by advising specifically "the emphasis in the curriculum and in student projects should be on systems engineering or how various equipment is interfaced to control a process."

These observations support the need to have students stay in close touch with changing industry operations through the curriculum.

The need to have industry directly involved in the curriculum through student project work is recognized as valuable addition to the advisory role of the committees. This functional relationship with industry through projects supplements the structural relationship established through the advisory committees. Curriculum renewal is found to be an urgent problem that requires attention beyond the procedures in place at the moment. Even the curriculum review process that guides this is structured to the extent that it takes place periodically, as opposed to constantly relative to the increased rate of technological change.

The program review referred to be some Advisory Committees is also part of the "Strategies for the Nineties - Educational Group Plan:"

> BCIT has developed a program review-redesign process that involves instructors and industry. The result will an industry validated curriculum that is clearly articulated for the benefit of students and instructors. Each program will be reviewed using this program redesign process every five years with the assistance of the Learning Resources Unit. One result will be industry relevant curriculum complete with student learning outcomes focused through strong curriculum threads.

This process shown in Appendix A is heavily dependent on structure and takes place only every five years. Some Associate Deans have noted that curriculum change carries on the day after the process is complete, relative to continuing changes in industry.

The Mechanical Technology curriculum review process with the Learning Resources Unit (LRU) as adapted to suit its needs is shown in Appendix B. It can be noted that the major input for change is more in keeping with the demands from

industry that are difficult to work through a structured committee approach especially in view of the real time issue that drives the demand for change relative to the rapid change in industry. This necessitates a more direct involvement of industry representatives into the curriculum change process. A functional relationship in this regard would complement the structural approach already in place though the existing structures noted previously. This additional condition of responsiveness is found in industry sponsored student projects where faculty, students and industry representatives work together in the application of the latest technology required in industry. This environment is viewed as a source of direct input from industry to affect curriculum change.

Strategy for the Nineties

The increased emphasis on industry participation directly into the curriculum as sponsors of student projects grew out of the discussions leading up to BCIT's "Strategy for the Nineties: Education Group Plan" (September 1991). As a result of an increased rate of technological change in industry it was felt valuable for students to have more direct contact with industry as part of their studies.

BCIT's mandate at that time changed "to become an innovative and flexible advanced technology enterprise which will focus on those initiatives that increase the level of entrepreneurial activity within the province. BCIT will specifically:

> establish expertise in specific technological areas and develop applications for British Columbia business and industry:
>
> facilitate technology transfer by providing innovation, industrial assistance and contracted applied research; and,

> provide a highly trained work force vital to the establishment and continuance of advanced technology in British Columbia."

The entrepreneurial activity beyond the original delivery of technological education became the responsibility of the Technology Centre established in 1989. As summarized in the strategic plan for the nineties, "for more than 25 years, BCIT has delivered job-ready graduates. Now there is a new emphasis on a two-way flow, knowledge IN to expand our expertise, and knowledge OUT through direct assistance to industry and applied research. The Technology Centre provides the focal point for this expansion of our mandate." (p. 14)

This increased emphasis on responsiveness to industry in a two-way channel of technology transfer is further reflected when the "demands for learning" are reviewed in the School of Engineering Technology by observing:

> One of the ways that existing diploma programs will be enhanced will be the inclusion of major student Research and Development projects as part of the curriculum in cooperation with the Technology Centre. These projects, which will be sponsored and evaluated by industry and supervised by faculty, will represent an ongoing technology transfer activity between BCIT and industry, and will provide valuable, direct industry contact for students. (p. 5)

Initiation

The initiation of the change process (Fullan, 1982), combining the resources and responsibilities of the School of Engineering Technology and the Technology Centre to increase the technology transfer activities between BCIT and industry, began in the fall of 1989. In order to increase the participation of industry as sponsors in student projects, additional resources and an action plan was required.

Before commencing the increase in industry sponsored student projects (ISSP) as a vehicle to be more responsive to industry, the increase in cooperative education in SET was seriously considered. Cooperative education was successfully introduced in the electronic engineering technology program in 1985. This was possible mainly due to the size of the program allowing for a double intake (September and January) of over a hundred students per intake. This allowed students to either be out in industry employed in work terms or at the Institute enroled in academic courses.

Unfortunately the other technology programs in SET did not have large enough intakes of students to proceed economically in this manner. Most programs take in between 20 and 40 students in a single intake in September. In addition, the difficulty of finding placements in industry during economic down-turns (Ellis, 1987, pp. 18-19) was another disadvantage. The inefficiency and inflexibility combined with swings in the economy were discouraging factors in expanding cooperative education programs in SET.

Seeing that project courses were already in place in the curriculum, a method ensuring greater participation of industry as a driving force in these student projects could accomplish the same objectives as cooperative education. As a matter of fact some faculty viewed cooperative education work terms of students as cheap labour for industry with the student involved in peripheral work rather than in the technology that was the subject of study. Industry sponsored student projects would be more focused from a technological education perspective. It would also have greater involvement of faculty to ensure that educational objectives for the students were met. In addition, these projects for the benefit of industry and students were at no

cost to industry, as part of the student's work to complete the graduation requirements. ISSP could be increased at a very slight increase in cost to the Institute as compared to cooperative education.

Implementation

The action plan devised to accomplish the task of increasing the involvement of industry was to introduce the innovation of an Awards Program. Students would be awarded cash prizes for producing exemplary projects, sponsored by industry. Funds would be made available to purchase new equipment and supplies above and beyond the existing allocations in capital and operational budgets. This would be an indirect reward and incentive for faculty to become involved in ISSP requiring new up to date equipment. Industry would benefit by having the latest technology available for students to work on their problems.

The overall action plan to proceed consisted of the following components:

1. The Technology Centre provides the funds for the secondment of a faculty member for six months to coordinate the implementation of the ISSP awards program ($30,000.00)

2. The Technology Centre provides $50,000.00 to enhance industry sponsored projects with supplies and equipment, where needed.

3. The Ministry of Advanced Education, Training and Technology is approached for a grant to award the students involved in award winning industry sponsored projects. ($15,000.00)

4. The School of Engineering Technology, through the Dean and Associate Deans, would provide the leadership and direction required for implementation and continuation; from innovation to institutionalization.

These components were in place by January, 1990 and the award program was under way encouraging additional industry participation in student projects as sponsors.

Students eagerly sought out industry sponsors for their projects in order to be eligible for cash awards ($500.00 per student). Faculty cooperated enthusiastically to benefit from the project enhancement grants to purchase new equipment required for new industry projects.

It should be noted at the outset that industry involvement in student projects was already prevalent before to the introduction of the award program. In January, 1990, it was noted that 80 student projects already had industry sponsors prior to the announcement of the awards program. However, after the awards program became known, the number of industry sponsored projects increased from 80 to 145 during the 1990 graduating term from January to May.

The range of industry involvement in student projects at that time could be noted from the project course descriptions in the BCIT Calendar. Notable examples to illustrate the range of orientation of projects from the "in-house" laboratory variety to that of a full fledged "industry sponsored student project" are as follows:

> ELEX 439 Technical Project (Telecom) - In the final term, students are required to research, design, prototype and evaluate a technical project within their fields of interest. Formal documentation in the form of a written report is required.
>
> BISC 438 Directed Studies - Students will select projects and prepare a formal report on some aspect of biotechnology. Projects may have a laboratory component in which students perform experiments toward their projects under the supervision of an industry or faculty sponsor.
>
> CIVL 499 Projects - The objective of this course is that the student makes a contact with the civil engineering/construction industry, and in conjunction with a company, develops a project. This project should involve the investigation of a current and relevant problem for the company. Interim progress reports should provide full details of the investigation, conclusions and recommendations.

The major goal of the awards program innovation was to increase the industry participation in student projects and have that eventually reflected in all project course outlines and course descriptions of the respective technology programs in the calendar. In addition it was felt that the School of Engineering Technology would become more responsive to industry from a functional point of few to complement the structural relationships already in place to allow for industry input into curriculum. This functional relationship between student, faculty and industry revolving around problems in their respective engineering technologies could also present the opportunity for faculty to experience professional development relative to advances in industry due to technological change. As such, industry sponsored student projects were viewed as an additional source of conditions of responsiveness for BCIT to keep abreast with industry.

The initial guidelines for the awards program were formulated in conjunction with the Associate Deans as presented in Table 4.

Table 4: Original Guidelines and Evaluation Procedure for Industry Sponsored Students Project Awards Program (BCIT Policy Document, 1990)

GUIDELINES:
Must be sponsored in terms of a formal request by industry, received on company letterhead, outlining their needs in terms of technical aspects involved, how the project is to be managed and an objective description of the end product. (Normally something which adds value to the company's technical operation.) The establishment of a project of this nature should be carried out jointly with industry and faculty to meet academic content requirements.

Project sponsors must be external to BCIT, School of Engineering Technology.

Must be performed in the student's graduating year and completed by the end of the term prior to convocation.

A project can be undertaken by up to five students. (Should there be more than 3 students involved in the project, the maximum prize money allocated per project will be $1500.00).

On completion, the project must be presented both orally and in written form, including an executive summary, and supplemented by audio visual material if desired.

Periodic records must be kept indicating sound project management techniques, as per industry standards.

Students shall have adequate time to work on their project.

EVALUATION:
The industry sponsor completes a confidential evaluation form for the project. (with emphasis to be on the student workmanship and the impact on the client's business).

The faculty involved will grade the project in terms of degree of difficulty involved and quality of work, (plus written and oral presentation), in relation to S.E.T. standards.

The Associate Deans will rank the projects in their respective technologies in consultation with the faculty involved, and make recommendations for projects to be considered for awards.

The Dean (in consultation) will make the final decision on award winners. A formal student presentation may be required at this stage.

EVALUATION SUMMARY:

% OF MARK	CATEGORY	EVALUATION PROCESS
20%	Written Report	Marked by faculty in charge of project with industry input.*
30%	Project Demonstration and/or oral presentation	Evaluated by Faculty.
30%	Technical Content	Determined by Faculty.
20%	Project Management	Determined by Faculty and industry.*

* The evaluation by the industry sponsor will be as per "Confidential Student Project Evaluation Form".

It should be noted that the guidelines were intended for centralized control from the Dean's office through the coordinator as evidenced by the evaluation procedure: "The Dean (in consultation) will make the final decision on award winners." This aspect will be further examined as the innovation progresses toward institutionalization, in discussion of results.

Table 5: Increase in Industry Sponsored Student Projects (ISSP) and Relative Participation by Students and Faculty.

Academic Year	Number of ISSP	Number of Students Involved in ISSP	Number of Students Enroled in SET	Number of Faculty Involved in ISSP
1989-90	145	262	487	55
1990-91	182	321	493	61
1991-92	182	327	523	45
1992-93	290	479	516	72

As anticipated and noted in Table 5, the participation of industry in student projects increased over the following three academic years. At the same time, participation of students and faculty increased accordingly. The number of industry sponsored student projects in the School of Engineering Technology doubled from 145 to 290. The participation rate of eligible graduating students enroled in SET increased from 53.7% to 92.8%. Faculty participation increased by 30.9%.

The lack of growth during the 1991-92 academic year was due to the fact that the Institute was closed because of a strike by support staff, with faculty honouring their picket line. This closure lasted three weeks and came during the crucial time in the beginning of industry projects, (January 20 - February 10), with students and faculty having to make alternative arrangements in terms of salvaging the project work internally at BCIT without industry sponsorship. Hence, the significant drop in faculty participation in industry projects during this year occurred, because they had to work with students that had lost their industry participation, to complete the project internally as best as possible under these circumstances.

Table 6: Summary of Industry Sponsored Student Project Awards.

Academic Year	Number of ISSP Recommended for Awards	Number of Winning ISSP	Number of Students Awarded
1989-90	50	16	24
1990-91	49	23	51
1991-92	66	32	72
1992-93	72	31	71

The number of ISSP recommended for awards also grew over the three year period as did the number of winning projects and students involved, noted in Table 6. However, it is interesting to note that the number of winning projects and students stabilized from 1991-92 to 1992-93.

The initial guidelines established for student awards in industry sponsored student projects were changed after the 1991-92 academic year. The initial grant from the Ministry of Advanced Education, Training and Technology to cover student awards for a period of two years was renewed for another year to expire at the end of the 1992 academic year. Continuation of the student awards had to be supported by BCIT. It was agreed to carry on this successful program with minor modifications to move from innovation to institutionalization.

The student prizes were decreased from $500.00 to $200.00 each. They would be funded with half the prize money coming from the participating technology programs and the other half matched by the Technology Centre. At the same time, the winning projects were to be decided at the Associate Dean level for each technology program, away from the centralized approach of the Dean's committee

previously in effect. The secondment of a faculty member by the Technology Centre to coordinate the awards program remained in effect throughout. The project enhancement funds of $50,000.00 per year also continued throughout. The newly instituted guidelines for awards reflect the decentralization and institutionalization of the awards program, as presented in Table 7.

Table 7: Revised Guidelines and Evaluation Procedures for Industry Sponsored Student Project Awards, (BCIT Policy Document, 1992).

GUIDELINES:
Must be sponsored in terms of a formal request by business/industry, or associated organization external to the technology program in question, outlining their needs in terms of technical aspects involved, how the project is to be managed and an objective description of the end product. (Normally something which adds value to the company's technical operation.) The establishment of a project of this nature should be carried out jointly with industry and faculty to meet academic content requirements and act as a vehicle for technology transfer.

Must be performed in the student's graduating year and completed by the end of the term prior to convocation.

On completion, the project must be presented both orally and in written form, including an executive summary, and supplemented by audio visual material if desired.

Periodic records must be kept indicating sound project management techniques, as per industry standards.

Students shall have adequate time to work on their project.
Exemplary projects will be displayed at the Projects Fair by the students, to receive their awards.

EVALUATION PROCEDURE:
The project sponsor completes a confidential evaluation form for the project, (with emphasis to be on the student workmanship and the impact on the client's business).

The faculty involved will grade the project in terms of degree of difficulty involved and quality of work, (plus written and oral presentation).

The Associate Deans will rank the projects in their respective technologies in consultation with the faculty involved, and decide which projects are exemplary to be recommended for awards.

The awards are decided and confirmed in collaboration with the results from the confidential evaluation of the industry sponsor.

Outcome

In addition to documenting the increase in industry sponsored student projects as a result of the implementation of the student awards program, further data was gathered to investigate the research questions of this study stemming from the problem statement and literature review. The questionnaire developed to rank the sources of curriculum development in terms of conditions of responsiveness to technological change (Appendix C) was administered to the Dean, Associate Deans, and faculty. Industry sponsored student projects were included as a condition of responsiveness relative to the existing conditions already evident in the organizational structure at BCIT. The results are noted in Tables 8 and 9.

Table 8: Ranking of Sources of Curriculum Change Taking into Consideration the Increasing Rate of Technological Change as Ranked by Faculty Supervising Industry Sponsored Student Projects.

Sources of Curriculum Development:	Ranking by Faculty Respondents (n=10):										Mean:	Rank:
Vice President, Education	8	6	-	5	7	7	5	5	-	6	5.1	6
Education Council	7	7	-	7	6	8	6	7	-	8	6.2	8
Learning Resources Unit	6	8	-	8	8	5	8	5	-	7	6.1	7
Advisory Committee(s)	5	2	2	2	4	3	3	1	3	3	2.8	2
Dean	4	5	-	6	5	6	1	6	-	5	4.7	6
Associate Dean	2	3	4	4	2	4	2	4	4	4	3.3	5
Faculty	1	1	3	1	1	1	4	2	1	1	1.6	1
Industry Sponsored Projects	3	4	1	2	2	2	7	3	2	2	3.0	3

Table 9: Ranking of Sources of Curriculum Change Taking into Consideration the Increasing Rate of Technological Change as Ranked by the Dean and 5 Associate Deans.

Sources of Curriculum Change:	Ranking by Dean and AD's Respondents (n=6):						Mean:	Rank:
Vice President, Education	4	-	6	8	7	6	6.1	7
Education Council	8	-	8	7	8	8	7.8	8
Learning Resources Unit	7	6	3	4	6	7	5.5	6
Advisory Committee(s)	1	4	4	1	4	2	2.66	2
Dean	2	3	5	6	3	5	4.0	4
Associate Dean	6	2	2	3	2	4	3.13	3
Faculty	5	1	1	2	1	1	2.0	1
Industry Sponsored Projects	3	5	7	5	5	3	4.66	5

The similarities and differences in ranking between the Dean, Associate Deans and faculty directly involved in ISSP shows that their common agreement in ranking "faculty" first as a source of curriculum change, followed by advisory committees. They also agreed that the Education Council ranked last. This was confirmed from an interview with the past chair of the Education Council in that she discovered that curriculum was a faculty matter as evidenced in the Staff Society Contract noted

previously in Table 2. Industry sponsored student projects are ranked third by faculty and fifth by the Dean and Associate Deans. The remaining rankings are fairly similar between the two groups with the slight differences indicating that the Dean and Associate Deans depend more on the administrative structures as sources of curriculum change with the faculty leaning more toward the functional aspects, such as members of the advisory committees as "representatives from industry" and industry sponsored student projects.

These rankings support the assumption that the administrative staff is more committed to a top down approach due to their position in the hierarchy, whereas the faculty operate more in a bottom up approach tied to the happenings in industry. However, the two differing approaches in this regard can lead to conflict but at the same time can be complementary as evidenced in the previous discussion of the changing role of advisory committees. This becomes evident from the interviews with the ten representative faculty members directly involved in industry sponsored student projects. They leave no doubt that curriculum is their main responsibility and that the administration can work to the detriment of change in this area because they are tied to administrative policies dictated from above. The faculty see industry sponsored student projects as sources of curriculum change, whereas the Associate Deans see them more as opportunities of integrate curriculum. However, a synergy of the two approaches was evident to work to advantage.

Results from Interviews with Faculty Supervising ISSP

The results of the interviews with ten faculty members directly involved in the coordination and supervision of industry sponsored student projects lends support to

the combination of top down, bottom up approach to managing the curriculum. Faculty place a heavy emphasis on industry contact, and at times work around the barriers associated with top down management style. The questions and summary of their responses during the interviews can be found in Appendix D.

The innovation of cash awards for students in exemplary industry sponsored student projects was welcomed by faculty. Especially the associated opportunity to receive immediate assistance in equipment supplies to enhance these projects. For example, the chance to get $5,000.00 to acquire a Global Positioning Unit to do projects for the Coast Guard, forestry and mining companies was eagerly accepted. The operative word "immediate" made the project enhancement grants so attractive. The awards program coordinator had worked out a special arrangement with the vice president of finance, the director of purchasing, and the purchasing agent to have requests for project equipment acted upon immediately. There were no meetings or special paper work involved to establish this process. It was a matter of attracting good will from all those involved in the purchasing bureaucracy to share in the pride of the new student awards program and look good to industry. With their assistance they became part of a success story and, enjoyed it.

The availability of funds for student projects outside the regular budgeting process became a major attraction for faculty and students to increase their involvement in industry sponsored student projects. For example, if faculty needed a piece of new equipment that was somewhere down the line in the capital acquisition plan of the Institute, a student project for industry requiring that piece of equipment could bring it immediately. The first 486 computers arrived at the Institute as a result

of their need for industry sponsored student projects. The level of interest, excitement and enthusiasm related to industry sponsored student projects definitely increases in response to the introduction of cash awards for students and funds for equipment to assist faculty.

The interview responses with reference to cash awards for students ranged from "I like it, great incentive.", to "Cash is useful but students work hard anyway." One faculty member observed, "People get rewarded in reality, so you may as well do it here." In the final analysis, the introduction of cash awards from a faculty point of view was mixed, "Cash does not make all the difference. Students who do a good job will do it regardless. An award is good, like a plaque or ribbon. Competition is good." Nevertheless, students did not hesitate to express their pleasure at the awards ceremony when they received their cash awards.

Faculty also expressed their observation that industry sponsored student projects allowed for a closer association with industry to get access to new material that should be incorporated in their courses. This became evident to the extent that some project work in industry actually led to the creation of new courses to respond to new technology adopted by industry. They expressed that industry sponsored student projects led to "some indirect effect to introduce new topics as industry progresses. The technology that clients want to solve their problems is new. The work in ISSP gives feedback to improved supporting courses. This will lead a new course to support that new development in technology. You get into projects that lead to new courses. You get new equipment for projects that can lead to new courses, eg: machine vision. It forces our program to communicate more closely with

industry. It forces us to remain current." Industry sponsored student projects were definitely considered a condition of responsiveness initiating curriculum change as a result of changes in industry.

The question of professional development from involvement in ISSP brought similar positive responses. Faculty reported, "In many ways it keeps me current. I see what is happening in industry on a daily basis. Tremendous involvement broadens my background and improves my knowledge. You are dealing with emerging technology and pulls you into a learning mode. Makes you more aware. In supervising ISSP the instructor absorbs new technology. He learns along with the students. Instructor considers projects from industry and gets to know the range of problems. It forces you to try new things. Students come up with problems that you are not familiar with. That sparks interest to follow up. Industry driven, helps us keep current and with trends. We make a lot of contacts and are aware of future developments. Every project is different and unique and gives you a wide perspective of jobs required by industry. Therefore, it enhances you professional development." This string of faculty responses adds to the evidence that industry sponsored student projects act as a condition of responsiveness supplementing the structural conditions already established at BCIT.

The advantages and disadvantages of cooperative education versus industry sponsored student projects evoked similar responses to those already gleaned from the literature. Cooperative education was found to be desirable but not practical in view of the additional cost and the small number of students in the respective technology programs. In addition, faculty felt that they had more control over

educational objectives in ISSP because students stayed in continuous contact. "We get more experience out of projects. In coop, faculty is more removed. In projects faculty spends more time than just a site visit in coop. Projects fit nicely with concurrent courses. Coop students may get trivial work not related to curriculum issues. In projects, because work is done on campus, faculty are closer and can react quicker. Advantage of projects is integrated team approach with faculty and employers." As can be noted, these comments further re-enforce the project approach as a condition of responsiveness.

It was also discovered that the emphasis on ISSP had definitely increased over the past three years since the introduction of the student awards program. "Increased the software component of the program, a background course was introduced. Increased the hours allocated to the project course. A special lab dedicated to students doing industry sponsored student projects has been introduced. Next year the project course will be doubled in hours allocated to it. The emphasis has increased in terms of awareness. Added more time to blossom projects. Refined the process of student projects. Do a better job at it now. Very appreciative of the involvement of a coordinator. Also moved other courses around as a result of greater emphasis on projects. They were introduced two years ago and are now in the curriculum." A definite move to adoption and expansion of industry sponsored student projects was observed.

The benefits derived from greater emphasis on ISSP were many, serving students, faculty and industry. Comments to that effect during the faculty interviews were as follows: "Students get exposed to real life, a lot of effort. They learn a lot.

Students are more focused on what they do. Rounds out their thinking, organizing, planning and intellectual development. Know how to apply things they learned, but also skill development; integrate knowledge. The possibility for real success or failure, not just a mark. Allows students to pull course material together to apply it. More industry contact. Insight into future career possibilities. Their report is good for a job interview and leads to a good many jobs. Use project sponsor as a reference. The build up of projects allows us to satisfy clients. Enhances image with industry. Fosters good relationship between industry and BCIT." Responsiveness was the key to this dynamic relationship between students, faculty and industry to accomplish the projects undertaken.

Results of Industry Evaluation of ISSP

The results of the questionnaires submitted to those industry sponsors whose projects were recommended for awards indicate a high degree of satisfaction with the work of students, as represented by the average scores presented in Table 10. This expression of strong agreement is evidence that BCIT students respond well to the needs of industry in these student project courses in the curriculum of SET. This validates the job-readiness of graduates and will be further examined in discussion of results.

Table 10: Averaged Industry Responses in Evaluating Student Performance in their Respective Projects (1992).

Please rate your sense of agreement or disagreement with each of the following statements by placing an "X" in the box that represents your feeling. If you believe that any item is inappropriate for this particular project mark it as "N/A."

1. The original concept for the project was in line with expectations of our organization.

strongly disagree					X	strongly agree

2. The student(s) focused on achieving the objectives of the project.

strongly disagree					X	strongly agree

3. The results of this project have made a valuable technical contribution to our organization.

strongly disagree				X		strongly agree

4. The student(s) managed their time and resources effectively.

strongly disagree				X		strongly agree

5. The student(s) maintained contact with us throughout the project.

strongly disagree				X		strongly agree

6. The technical quality of the work done on this particular project.

Failed to meet our expectations				X		Exceeded our expectations

7. The work done by the student(s) met accepted technical standards.

strongly disagree				X		strongly agree

8. The initiative shown by the student(s) on this project.

Failed to meet our expectations					X	Exceeded our expectations

9. Based on our experience with this project, we would undertake another with BCIT.

strongly disagree					X	strongly agree

10. If we had developed this project ourselves, without student assistance, we estimate the costs would be in the range of:

		X		
less than $1,000	$1,000 - 5,000	$ 5,000 - 10,000	$10,000 - 20,000	more than $20,000

11. Over and above the cost if we had done this project ourselves, we estimate the dollar benefit to our organization from this project as:

			X	
less than $1,000	$1,000 - 5,000	$ 5,000 - 10,000	$10,000 - 20,000	more than $20,000

In addition to the satisfaction of student performance, the value of these projects in terms of dollars is significant. From industry's point of view, this is a definite indication of success.

From Innovation to Institutionalization

Within the context of Fullan's (1982) model of change with its stages of initiation, implementation, continuation, and outcome, the most important idea that arises is that "change is a process, not an event" (p. 41). As he observes, the number of variables associated with this process are immense. This view is supported by the fact the model is not linear but implies feedback among the four phases identified. Nevertheless, Fullan identifies factors affecting the adoption of change. This discussion of results of the innovation of awards for exemplary industry sponsored student projects will use these factors, appropriately modified at times to suit the context of this particular study. This approach will serve as basic framework for clarity and cohesion.

Existence and Quality of the Innovation

As Fullan observes: "Innovations are usually developed in response to the incentive system of society. Market conditions (federal tenders, government-sponsored development, saleability in terms of values, costs, etc.) serve to delimit the educational changes likely to be generated" (p. 42). In this particular case the innovation introduced was directly in accordance with those observations. Industry needs job-ready graduates and requires institutions capable of maintaining this delivery under conditions of increasing technological change. Government concurs and assists

in making funds available to assist in introducing awards to encourage students to pursue educational activities to meet this objective.

However, the existence of awards for above average students has been in existence for many years. These awards take the form of scholarships based on academic performance as rated by faculty and funded by a host of individuals and organizations, including industry. The awards introduced through this particular innovation differ to a certain extent in that they are determined jointly by faculty and industry as part of the evaluation process. It is no longer the sole responsibility of faculty and the institution to determine the award winners. What faculty perceives to be an excellent project may not be the case, judged from an industry point of view. This shift in evaluation responsibility did not go unnoticed by faculty. After the announcement of the first set of awards in 1990, there were distinct grumblings as to how and why some student projects were exemplary as opposed to others faculty felt were more deserving. The results of the confidential industry evaluation had a profound affect on the outcome of winning projects. This change in process to determine awards from an educational point of view was unsettling and a cause of debate. As one Associate Dean pointed out, the introduction of awards in this manner may have an adverse effect on the pedagogy of the projects course. How true, because it was the intent to have greater industry participation in the content of project courses suited to their particular technology and industry needs in a changing environment.

Some projects were completed in superb fashion from an academic point of view. The reports were cosmetically pleasing in presentation with flashy covers,

extensive tables and graphs illustrating their outcome(s), and yet had very little impact from the industry's perspective. On the other hand, there were projects that were very brief in report documentation and yet were judged to be of significant value by the industry sponsor. In the final analysis the industry evaluation became the overriding factor in determining the winning projects. This outcome was in keeping with the objective of the competition for awards as made clear in the guidelines, "something which adds to the company's technical operation", to satisfy the objective of producing job-ready graduates.

This change in the evaluation process for course outcomes was met with resistance, and yet recognized to be of value in keeping with the objective to remain current with the changing needs of industry. In time, this resistance decreased and was accepted and incorporated in the overall thrust of industry sponsored student project courses. Industry evaluation became an integral part of project courses and eagerly looked forward to in validating the efforts of students and supervising faculty. It became the new reality in keeping with changing times. By incorporating industry as the driving force in student projects it became accepted to also incorporate industry evaluation in addition to faculty evaluation to judge the overall results. The project course moved to become a truly joint responsibility between faculty and industry both from a theoretical and from a practical point of view.

As a result of the introduction of student awards, student projects moved across the boundary from the institution into the domain of industry where need for technological education was expressed as part of their daily operation relative to changing technological conditions. This shared responsibility created a functional

relationship in determining the educational needs of the day supplementary to the structural conditions already in place toward the advisory committees established for each technology program.

The awards for students' performance in exemplary industry sponsored student projects were distinct from those gained through academic achievement in place for many years. This distinction was made clear in discussions to combine the awards ceremonies for both type of awards. The result of these discussions was a resounding no. It was felt that students who excelled in producing viable product for industry as part of their projects should be recognized distinct from academic performance. Academic performance is of value, but so is practical work, especially from a technological perspective. The academically gifted should not overshadow the practical know how in this regard. This conclusion by faculty was an encouraging decision to support the intent and objectives of the project course to encourage greater participation by industry directly in the curriculum.

This realization became the foundation for future efforts of faculty to increase the quality of industry sponsored student projects in the following years. More attention was paid to get industry directly involved to offer the opportunity for quality projects for students to enhance and exploit their experiences as part of their studies at BCIT. Faculty and students became more attuned to the progress of technological change in industry and the opportunity to get involved as part of their course work during their project courses. The experience became more challenging and rewarding. The contribution through projects for industry led to increased exposure for students to continue that work as full time employees upon graduation. This result was similar

to that of a cooperative education student in work terms with a company. However, project work was a less costly and quicker route to the same result.

Access to Information

The initial information consisted of the guidelines formulated for industry sponsored student project award eligibility. The prospect of cash awards for exemplary industry projects motivated students and stimulated faculty. The availability of funds to acquire new equipment to support industry projects motivated faculty to become actively involved in seeking out industry to participate in order to qualify for project enhancement grants from funds allocated by the Technology Centre for this purpose.

The introduction of this information became the responsibility of the coordinator of the awards program, but the follow up and pursuit of these benefits were eagerly accepted by faculty interested in this program. This changed the direction of project courses from internally oriented problem solving exercises based on situations drawn form industry based on observations by faculty to direct participation from industry as project sponsors, as demanded by the guidelines covering eligibility for student awards and project enhancement funds. Students gained access to cash awards and faculty the opportunity to get the latest equipment in their labs to pursue new technology developments for their students to satisfy the changing needs in industry.

The crucial aspect of the access to information by faculty regarding the introduction of student awards was through the personal contact between the awards program coordinator and the faculty involved in student project courses. The written information in the guidelines was supplemented by oral interpretation in this regard.

The day to day contact in the implementation of the program ensured a positive attitude and prevent any negative interpretations that could arise.

The information regarding the objectives of the awards program was presented within the general context of what was required to remain responsive to industry in view of the increasing rate of technological change. This was not strange to anyone because technological change was the topic of discussion in the literature, in the daily newspaper, on television and during faculty coffee breaks. The introduction of awards to increase industry participation in student projects was one way to meet the challenge of responding to industry's needs.

Advocacy from Central Administrators

The Dean of the School of Engineering Technology became the champion of the awards program for students in industry projects. He had the full support of the director of the Technology Centre in making the resources available to implement the program. The additional central administrators supported the program completely. Even though the support of central administrators was essential, it was perceived by faculty as a "catch" leading to mistrust of their motives. It became the responsibility of the awards program coordinator to defuse this mistrust. It was quickly overcome by the prompt arrival of equipment requested to enhance industry projects. The ability to deliver on promises quickly was extraordinary in relation to experience in acquiring new equipment due to bureaucratic inefficiencies. Internal responsiveness to support the program with actual deliverables in relation to need changed the perception of faculty.

Faculty Advocacy

In order to gain faculty advocacy, it was necessary for the coordinator of the awards program to act as a cheerleader for these awards. The central component of selling the implementation as a benefit to faculty was the ability to provide new equipment quickly: as speedily, for example, as phoning the 1-800 number of the supplier to get immediate delivery via Federal Express Courier delivery, quite a departure from the usual purchase order procedure which would take weeks or even months. Nevertheless, it was the coordinator's responsibility that this paper work was executed in accordance with the requirements of the purchasing department and the Vice President of finance.

Trust and confidence in the good intentions of the awards program had to be built upon, and earned by, the delivery on promises of the central administration through the actions of the coordinator. The delivery of three new 486 computers, the first to arrive in faculty labs at that time (1990), was a certain indicator that the program meant business. This news spread quickly among faculty and led to an immediate arrival of further requests for new equipment to support industry sponsored student projects. These request were accommodated in speedy fashion, resulting in positive advocacy of faculty in favour of integrating additional industry participation in student projects. The real possibility of getting new equipment quickly in this manner was a great inducement to faculty advocacy.

In addition, as the awards program grew over the years, the faculty became immensely proud of industry's glowing evaluations of student projects which reflected their capabilities as supervisors, to deliver value to industry as a result of these

projects. The recognition of students and faculty during the presentation of awards to the students after the successful demonstration of their projects became an intrinsic reward stimulating further advocacy for the program.

Linking Agents

The linking agents in the adoption of the awards program in this situation were the Associate Deans. Even though they are technically part of the central administration, distinct from faculty as part of the Staff Society bargaining unit, their operational allegiance was with faculty. They were respectful of central administration and its objectives but at the same time sympathetic to faculty and their problems in dealing with curriculum in relation to students and industry. Some were in favour of the awards program and some had reservations for very good reasons. Changes lead to difficulties and those usually end up on their desks. The increase in industry sponsored student projects brought industry directly into the curriculum, no longer separated by the bureaucratic boundaries created through the structural relationship with advisory committees. Advisory committees met only twice a year with a pre-established agenda, usually controlled by the chairman and the administration.

By having industry directly involved in the delivery of technological education through projects with students, conditions could, and would arise, that normally would not have to be dealt with in a controlled laboratory situation. This change in response to industry through a functional relationship created an additional set of conditions of responsiveness. This functional relationship, in an algebraic sense, demanded immediate response as part of the equation. The administrative

responsibilities that would result were considered an additional burden that could be prevented by operating student projects in the traditional sense as extended laboratory exercises with a predetermined problem and predictable outcome. The additional resources required to deal with this new situation of responsiveness in an unpredictable sense were perceived as a welcome departure from the norm.

The Associate Deans are the key administrative link in the structured approach to the delivery of technological education. As such, they have to deal administratively with the conditions of responsiveness that arise through the participation of industry in student projects. The formal structured relationship with industry through advisory committees offers a buffer against adverse conditions. The functional relationship through the active participation of industry in the curriculum does not offer that protection. Immediate responsiveness to the benefit of all concerned is required. The student in this situation requires the unwavering support of the administration to be successful in gaining the credits required to graduate.

Concerns regarding the difficulties that these situations could present were raised by the Associate Deans on many occasions to the extent that at times they were not inclined to support the awards program. The advantages in being responsive to industry were recognized, but the difficulties that could arise and have to be dealt with administratively with the bureaucracy of BCIT would rather be avoided.

In the final analysis, the linkage through the Associate Deans became the focal point of the success or failure of the awards program. The advantages of students exposed to the latest technology in industry, the awards they stood to gain, and the new equipment it brought to their programs were subject to the amount of

administrative difficulties that could arise from these new conditions of responsiveness in providing technological education, addressing technological change. After three years of success, taking into consideration the difficulties that had to be overcome, some reservations still remain in this regard.

This situation of trying to deal with an organic functional relationship, as in industry projects, in the context of a mechanistic structural organization will be discussed further under bureaucratic orientation. It is the critical aspect of the successful operation of the awards program and increased responsiveness to industry through student projects.

The linkage between industry and BCIT from an organizational point of view is the key, as brought out in the literature and embedded in one of the research question of this study, "What structural conditions support an educational institution to respond to technological change?" It would appear that a blend of conditions from the mechanistic to the organic mode of organization would have to be found. Responsiveness demands an organic approach, but accountability requires a mechanistic order to verify results.

The solution may come from the answer to the second research question of this study, " In what ways do human conditions facilitate the responsiveness of technological education?" It may be that the individuals involved in the conditions of responsiveness may have to deal jointly with the organic approach to accommodate responsiveness and yet deal with the issue in a mechanistic manner to remain accountable.

Community Pressure/Support/Opposition

In this case, taking industry as the community, no opposition was evident. On the contrary, industry was very satisfied with the results of their participation in student projects. The evaluations confirmed this conclusion. Industry saw tremendous benefit of being directly involved as partners in the delivery of technological education. They became the direct beneficiaries by having their problems solved by teams of students applying their skills and technology. As the industry evaluations indicated, over one half million dollars in direct benefit was realized annually by the industry sponsors involved.

The Ministry of Advanced Education, Training and Technology was pleased with the outcome of the awards program after one year, extending the grant for another year. The technology transfer by students satisfied their interest in the awards program from an educational and economic point of view. This encouraged other community colleges in the province to follow BCIT's example of increasing industry involvement in student projects; namely: the University College of the Cariboo, and Camosun College.

New Central Legislation or Policy

No new policies were created, nor additional funds made available by the ministry to further stimulate this activity either at BCIT or at other community colleges. However, the success achieved at BCIT was widely communicated as a desirable example to follow, but by utilizing existing resources without additional monies from the ministry. The start up grant that BCIT had received became exactly that and no more, other than words of encouragement by the ministry.

At BCIT, the Vice President of Education supported the continuation of awards for exemplary industry projects as a new and regular BCIT program extending it to include other schools under the direction of the Technology Centre. The awards were reduced from $500.00 to $200.00 per student involved in an award winning project. The money to cover these awards were to be split 50/50 by the Technology Centre and the participating technology program .

This led to expansion of the awards program into the School of Business in their marketing and operations management technology programs. The funds to cover the awards came out of revenue producing programs of the Technology Centre and the participating technology programs. This saw a shift from government funding, either directly by the ministry or indirectly from funds received by BCIT from the ministry, to an entrepreneurial activity of providing funds from revenue producing programs operated by BCIT in addition to the regular diploma programs offered. As such, the innovation of the awards program for students involved in exemplary industry projects became institutionalized. This process and its implications will be further discussed under "Bureaucratic Orientation".

Problem-Solving Orientation

As mentioned above, the problem of continuing the awards program in terms of adoption after the ministry grant had expired was solved in an entrepreneurial manner, by utilizing resources acquired from revenue producing programs. This move tested the viability and importance of the awards program relative to other activities desired that required additional funds. Administrators and faculty had to decide collectively that the utilization of these funds generated by their respective revenue

producing programs was warranted to continue the awards program. By reducing the awards to $200.00 they felt that it was still an incentive to encourage students to participate, and continue to provide the benefits derived from increased participation of industry in student projects.

The institutionalization of the awards program at the conclusion to the 1991-92 academic year in this manner was accompanied by a continued increase of industry, student and faculty participation in student projects as shown previously in Table 5. At this time the funds to support the awards program coordinator were continued for another year with the intent to withdraw thereafter and have the program operate internally through existing support staff. This would complete the institutionalization of the innovation to operate as part of the regular programs, incorporating the industry sponsor component into the curriculum, as an integral aspect of the course outlines for student projects.

Bureaucratic Orientation

As pointed out by Fullan and evidenced in the literature review, bureaucracy inhibits change and its adoption. At BCIT the innovation of the awards program was initiated and carried out informally with the silent blessing of the administrative bureaucracy. The initial receipt of the grant from the ministry encouraged the required steps that were needed to take advantage of this opportunity. Even though the innovation arrived in a typical top down fashion associated with bureaucracy, the implementation was engineered in a bottom up approach. The secondment of the coordinator was approved in accordance with the policies of personnel and staff society. The associated paperwork was prepared and channelled through the

necessary steps of approval by the coordinator and filed where needed to leave the required paper trail accordingly.

From that moment on, the coordinator worked directly with faculty to gain their support and enthusiasm to implement the awards program with the objective of eventual adoption and institutionalization. This work was monitored and approved by the Dean and Associate Deans at their regular weekly meetings. The role of the coordinator became that of a cheerleader with the Dean as the champion of the program.

Key Measure of Institutionalization of ISSP

The key measure of the success of implementation came from the introduction of new industry sponsored student project courses in the curriculum. The previously noted increase in participation by students and faculty was one definite measure, but the actual legitimization of this measure in course outlines leading to course descriptions in the calendar was most definite. Course outlines from previous student project courses were amended to include the requirement of an industry sponsor to be involved. New courses were established in technologies that previously did not have these in their program of studies. Two examples from each situation can be noted from the actual resulting course outlines presented in Appendix E. The electronic engineering technology established a new course to augment the previous project courses in their options. And the food technology program, which never even had a project course, established a new industry sponsored student project course under the heading, directed studies. This measure was a sure sign of buying into the concept of industry sponsored student projects for the long haul.

CHAPTER V

SUMMARY AND CONCLUSIONS

This final chapter will summarize the content, findings and conclusions of the case study in terms of the conditions of responsiveness required to address the rapid increase in the rate of technological change to provide the required technological education in this regard. The newly discovered conditions, as part of the emphasis on industry student projects, will be viewed as an outgrowth of existing conditions as well as providing new impetus for curriculum change and a shifting conception of curriculum in this volatile environment of technological change.

Summary

The existing conditions to enable BCIT to respond to the needs of industry over the past 25 years have served the Institute well. It has produced job-ready graduates valued by industry for their competence in technology applied in industry to increase production. With the increase in the rate of technological change, this structured approach, spearheaded by the advisory committees, has lost its edge somewhat, as noted from discussion of their annual reports (1991-92). The remaining components in the organizational structure were found to be in a support role, such as the Learning Resource Unit and the Education Council for example. The Board of Governors and the administration fulfilled the role of enablers and protectors. As such, the conditions of responsiveness associated with this structure were viewed as supportive, and yet restrictive, in view of the fact that the rate of technological change is increasing exponentially.

These structural conditions to respond to the needs of industry were still found to be effective to the extent that the individuals involved in these structures extended their time and effort to work through and beyond the restrictions that the committee structure can impose. It was found that the interest and commitment that transcended organizational policies produced that extra effort to keep up with the demands of change. Some advisory committees are still proactive in meeting the changing needs of industry, whereas others have become reactive and carry on only in a validating capacity.

The introduction of the innovation to increase the involvement of industry in student projects provided an opportunity for more direct industry contact. This association of faculty, students and industry representatives working together in projects involving the latest technology, allowed for additional responsiveness to complement the existing structures that had served so well in the past during a more stable environment. Even though there was structure surrounding the industry sponsored student projects in terms of a course outline, the participants were free to experiment with the application of technology to provide benefit to industry. That was evidenced in the student project evaluations by industry and the large number of different projects undertaken.

The blending of a structured approach within the organizational structure at BCIT with the entrepreneurial activity of individual industry sponsors in student project work, provided an opportunity to extend the conditions of responsiveness. The traditional value of accountability required to be upheld by a public institution through appropriate structure was augmented by the innovative approach in student projects

to allow for experimentation to come to grips with the pressing needs in technological education to respond to technological change. As such, the conditions of responsiveness were extended beyond the boundaries of the Institute into industry. This extension of conditions made responsiveness a two way street. Information flowing out to industry through existing structure at BCIT and information flowing in from industry representatives directly involved in curriculum through student projects.

The conception of curriculum under these circumstances changes from one held in trust by the Institute to serve industry, to one of industry taking more responsibility as a result of its involvement in student project work, leading to shared ownership. In view of today's rapid increase in the rate of technological change, an adaptation of a functional relationship through day to day project work supplements the structural relationship established through advisory committees and allows for the renewal of curriculum as required in "real time."

These observations reflect the current direction of technological education as found in the literature review. The need to respond to technological change in the curriculum that is current and viable is becoming a pressing problem in educational institutions. The traditional approval in terms of organizational structure and curriculum theory must be augmented by direct interaction of the parties involved to force the changes required. A move from the mechanistic to organic approach is required to give industry direct access to curriculum to share the responsibility for continuous change in response to technological change. Industry sponsored student projects can serve as the medium to facilitate the responsiveness required.

Conclusions

The introduction of the innovation of cash awards for students producing exemplary industry sponsored student projects has led to beneficial results in the area of providing additional conditions of responsiveness to address the increasing rate of technological change in industry. This innovation as studied over the past four years as a basis for this case study has met its objectives stated at the outset and is continuing to flourish. Those at BCIT that started this innovation and those who have come on board to give it broader support, have brought about the institutionalization of this awards program. At the same time, the detractors have provided meaningful constructive criticism to advance cautiously with this innovation. The shift from internal formulation of curriculum under the guidance of advisory committees to the introduction of direct industry input through industry sponsored student projects has given the Institute additional conditions of responsiveness to keep abreast of technological change in industry.

Faculty, who are at the centre of curriculum change, have gained additional avenues for professional development to remain current. Their involvement in industry sponsored student projects gives them continuous feedback in areas where changes in curriculum are required to meet the needs of industry. This has increased their knowledge and confidence in making and recommending curriculum change to keep producing job-ready graduates. Their involvement with industry in student projects keeps them in the condition of "real time" response to industry needs demanding curriculum change. As one faculty member reported, "some courses do not even make

it into the calendar because it takes eighteen months notice to have these changes introduced. By that time technology in industry has changed and so has the course."

The additional conditions of responsiveness through industry sponsored student projects have also given the Institute the opportunity to be more effective in fund raising. Industry is more approachable for donations in view of the fact that they can directly observe the benefits produced by the Institute, through their direct participation in projects. The outcome of the project brings economic value to their company and the student can be hired as a valued employee contributing to the bottom line, the first day on the job.

The functional relationship with industry established through student projects gives rise to conditions of responsiveness enabling to keep curriculum abreast with technological change. Amongst the conditions of responsiveness it was found that the human condition in this dynamic interaction, driving industry projects, becomes the source for change in curriculum. The evidence from this case study suggests that the top down management approach through structure has to allow for the bottom up approach of gathering data required for curriculum change in a "real time" condition "on line" with industry. The rapid increase in the rate of technological change requires minimum interference and maximum flexibility to exchange the information required to stay in touch and up to date. Industry sponsored student projects, as witnessed in this study, provide that opportunity.

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APPENDIX A:

Program Design: Curriculum Components
Learning Resources Unit, BCIT

Program Design: Curriculum Components

ASSUMPTIONS

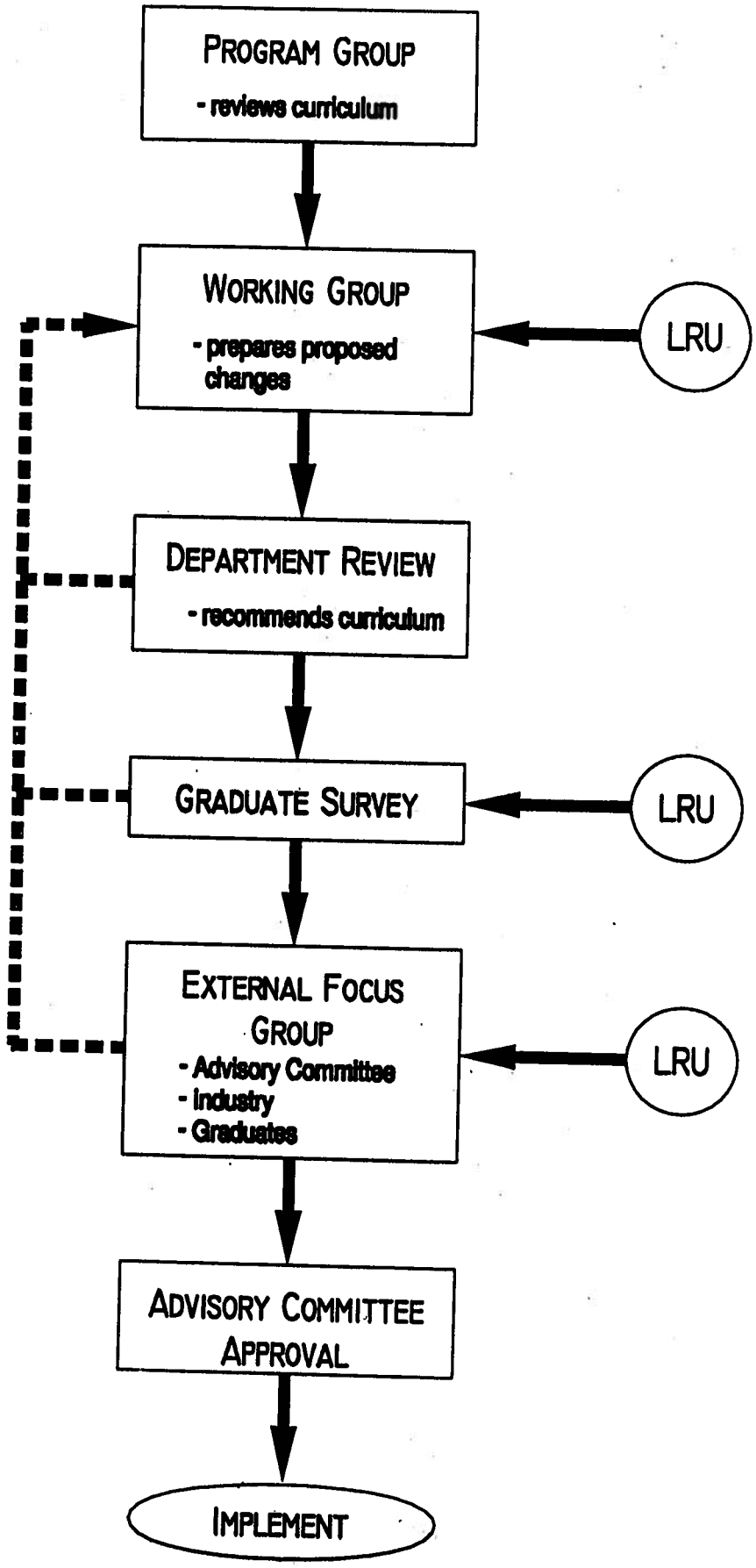
- The following curriculum components are elements of new program design and of the Curriculum Review Process for existing programs.
- All products described in this document are "student centred" in their design; ie they describe program, course or learning expectations in terms of student's cognitive and skill development as opposed to describing instructor behaviour.
- Various curriculum development processes and techniques may be used at each step. Each of them should be systematic, structured, visible, appropriate, comprehensive, efficient and participatory.
- The design and development of the administrative and operational aspects of the program commences early in the process, and influences and is influenced by the curriculum development process.

	Degree of external and internal Input and Feedback	
	EXTERNAL	INTERNAL
PROGRAM NEED A statement which verifies the viability of a proposed or existing program based on a needs assessment. The needs assessment process also results in recommendations for the general operational and curriculum direction of a program based on employment requirements.	*High*	*Low*
PROGRAM AIM A vision of the long-term direction for the program in areas of curriculum and instruction.	*Moderate*	*High*
PROGRAM GOALS General statements which describe two distinct facets of the program curriculum: • major curriculum components (also called clusters or streams) reflecting distinct, logical groupings of the curriculum content • statements of the general or "across-the-curriculum" learning goals	*High*	*High*
PROGRAM MAP A diagrammatic reproduction of the program showing the organization and relationship of all courses.	*N/A*	*High*
COURSE GOALS Precise statement(s) of the major purpose of each course in the program, stated in terms of expected student performance.	*Moderate*	*High*
COURSE LEARNING OUTCOMES Statements of the specific student performances required to attain the course goal(s).	*Moderate*	*High*
STUDENT CENTRED, OUTCOME-BASED COURSE OUTLINES A detailed description of the course goals, outcomes, grading, course operation, schedule etc. for each course. To be used as a planning resource for faculty and a learning resource for students.	*N/A*	*High*

APPENDIX B:

Mechanical Curriculum Review Process

MECHANICAL CURRICULUM REVIEW PROCESS



APPENDIX C:

Questionnaire: Industry Sponsored Student Projects As A Source of Curriculum Development

INDUSTRY SPONSORED STUDENT PROJECTS AS A SOURCE OF CURRICULUM DEVELOPMENT

Taking into consideration the increasing rate of technological change in industry, to what extent do industry sponsored student projects lend themselves to curriculum change to keep abreast, relative to other sources of curriculum development listed below: Please rank from top to bottom (1 to 8):

RANK

__ Vice President, education
__ Education Council
__ Learning Resources Unit
__ Advisory Committee(s)
__ Dean
__ Associate Dean
__ Faculty
__ Industry Sponsored Student Projects

From an organizational (administrative) perspective at BCIT, please identify the forces that impact industry sponsored student projects as a source of curriculum development:

THE TOP 3 HELPING FORCES:

1. _____

2. _____

3. _____

THE TOP 3 RESISTING FORCES:

1. _____

2. _____

3. _____

Additional comments with specific reference to curriculum development relative to technological change are welcome:

_____

_____

_____

_____

continue on reverse side

APPENDIX D:

Questions for the Interview and Summary of Interview Responses

Questions for the interview with instructors that teach and coordinate the Industry Sponsored Student Project(ISSP) courses in the School of Engineering Technology at BCIT.

1. What type of ISSP course is best suited to your technology?
   - length: one term, two terms, (how many hours)
   - inside vs outside the institute, advantages vs disadvantages

2. What aspects of the infra structure at BCIT support/inhibit ISSP?

3. Are ISSP an additional load to what you perceive to be your regular duties as an instructor? What do you perceive to be the extra's?

4. Is your regular teaching load diminished to compensate for time spent on ISSP? Or is it considered the same as all other courses in your technology in terms of a loading factor in accordance with the Staff Society Contract?

5. To what extent does your involvement in ISSP contribute to your professional development? In what way(s)?

6. Do you think ISSP lend themselves to changes in curriculum? In what ways? Be specific and give examples.

7. In the same vein as a textbook for a course, what kind of learning materials are used as a foundation for ISSP?

8. Do you favour the introduction of cooperative education into your technology? (advantages/disadvantages)

9. What are the comparative advantages and disadvantages between cooperation education and ISSP, from a curriculum development point of view?

10. Why has cooperative education not been introduced into your technology program?

11. Has the emphasis on ISSP been increased over the past three years in your technology program?

12. What have been some of the beneficial results and some of problems associated with ISSP? (priorize please).

13. What are the advantages and disadvantages to cash awards to students in exemplary ISSP produced in your technology?

14. Where does overall curriculum development come from in your technology program?

15. Who is responsible for the development for individual courses (Based on the 4 questions in Tyler's rationale?)

16. Are you familiar with Tyler's rationale in relation to curriculum development?

17. Are you familiar with Constructivist theory in relation to curriculum development?

18. Are you familiar with any other curriculum development theory?

19. Is there a departmental, institutional, provincial, federal guideline(s) to curriculum development in your program? (that you are aware of to be taken into consideration with course development)?

Question 1. Summary:

One term is fine. Outside is real, inside is perceived not related to external needs. 4 hrs/week

One term but taylor the project to the time available. Inside: more control over student, better evaluation of project. Outside: industry skews the project management more important to their goals that cannot be controlled.

600 person hrs/student on project. 4 students per team. Outside: the variety of projects is greater. Inside: projects are less realistic, not for people that have to make a profit. Relationship with client is different. Internal, more contact and better communication with students.

One term, 3hrs/student/week, students are expected to double that with time of their own. More time would be better but would interfere with other courses required, and exams. On campus brings better faculty supervision monitoring quality. We have the equipment to provide technology transfer. Outside: problems with scheduling and getting access to the equipment to do the project.

One half term 4hrs/student. Will be changed to a full term next year. Have to do it inside because the student has to do other courses in a full schedule, no time to go in and out of the institute.

Switching from weekly 4 hrs supplemented by students own time including lunch hours , to a 5 week concentrated internship to do the project outside in industry. Inside the instructor can devote a lot more time to supervise the projects. Outside is encouraged to experience the work place to validate what they learn here and interact with other people in the work environment.

One term, it takes a while to get them geared up, nothing gets going till the term starts. To difficult to fit more time in.
Outside does not work out as well, companies have different priorities, it is a course that has to be completed. The time involved going back and forth does not accomplish a lot.
Companies are basically used for evaluation, the student has a tight schedule.

Cannot go longer than one term, 10 weeks. Outside based on real building sites, students can get a better point of view

At least a month of directed studies desired for project in the curriculum. Inside advantages are facilities available to support the project that are not available in industry. In house projects makes students rely on faculty to help out.
Disadvantage is that the student does not get out to experience industry setting.

Question 2. Summary:

No inhibitions, all support.

Student project coordinator helps purchasing equipment.
Awards in terms of recognition and $$ helps.
Also how the staff presents projects is motivating.
Negative: restriction of time, 4 hrs/ week,
First time the students are on their own and have to organize themselves.

CST provides resources added by the student projects coordinator.
Downside: project execution has to be balanced with other things students have to do.
The lack of time for ISSP depending on student interest, especially those that get very interested in their project.

The school term with other courses in it. faculty time is not sufficient. Student Faculty ratio is too high.

The whole program is oriented to industry, they support it.
Good backing from industry and the Associate Dean.
Inhibit: lack of time to complete the projects considering the rest of the course load

One concern is insurance coverage while the student is out there. Project course teams up with Tech. communication to do reports.
Problems with confidentiality, companies working on new discoveries that are patentable. We stay away form those projects. Projects are plentiful enough to choose from so not problem here. In small program administration is no problem, we do our own thing. Advisory Committee is very appreciative of program head recommendations.

money outside of regular operating fund is worthwhile.
Not really anything that cannot be overcome - a lot of inertia. Students like to work on their projects in the lab in the evening, supervision is a problem here, but it can be scheduled with access to certain equipment only to avoid dangerous situations.

Nothing inhibits.
Support comes form other staff and gives it a more direct link with industry through other courses.
Distance between industry is a problem, even distance between other technologies on campus is a problem, will work on that in the future.
The coordinator was helpful in supplying resources for equipment required in the projects.

Nothing inhibits other than the program structure, with students also responsible for other courses. WCB covers it.

Question 3. Summary:

No, part of regular course load.
Additional time is added to spoon feed poor students and the unpredictable things that happen adds additional time.

A lot of load, more than regular load. It is also very satisfying to work with students one on one, quality time, leads to satisfaction.

No, instructor time is allocated. one hr/week extra allocated.
Instructor's responsibility to become more efficient.

No, written into the curriculum, but still a problem to find the time for administrative duties to support projects.

part of regular load.

Yes and no. No in the sense that the instructor is allotted a certain amount of time per week. But when you are acting as the project sponsor to be validated by industry, that creates the need for extra time.

No, it is part of your load but it becomes more than 3 hrs on your time table. Supervision is a problem, but it can be scheduled.

No, part of the course, restructured the curriculum , added 4hrs per week to the project course.

That is part of my load. Many students can make a heavier load so students have to rely on their own.

Question 4. Summary:

Yes, project course is 4 hrs. Sometimes a bit more time but the instructor has to be a broad based thinker.

Same, but put more instructors on it. Limit to 5 projects per instructor.

No, the load is allocated to administering ISSP.

We spend 50% more time than the allocated loading, it adds to the workload.

Somewhat, total time is more. A lot of organization has to be done.

The same.

Considered as another course. The projects have doubled up on office hours to the extra evaluation time involved.

Same as other courses, taking into account staff loading.

The same.

Question 5. Summary:

In many ways it keeps me current. See what is happening in industry on a daily basis.

You are dealing with emerging technology and pulls you into a learning mode. Makes you more aware.

In supervising ISSP the instructor absorbs new technology. He learns along with the students. Instructor considers projects from industry and gets to know the range of problems in industry. However, not very deep.

Industry driven, helps us keep current and watch trends. We make a lot of contacts and are aware of future developments.

Every project is different and unique and gives you a wide perspective of jobs required by industry. Therefor, it enhances you professional development.

Zip. Occasionally, but nothing more than he would pick up in other sources. Bio technology is a small community and we run into each other regularly to keep up to date.

It forces you to try new things. Students come up with problems that you are not familiar with. That sparks interest to follow up.

You get liaison with peers in the profession. You have to search out suitable projects. It gives and maintains contact with the field, which is a positive benefit.

Tremendous. Involvement broadens my background improves my knowledge.

Question 6. Summary:

Some indirect effect to introduce new topics as industry progresses.

Not immediately but eventually. It leads to refinement of courses, especially in the lab. work. Not a major step in new areas, but course material will be changed as a result.

They must. The technology that clients want to solve their problems is new.

That is a hard question. The work in ISSP gives feedback to improve supporting courses. ie. what knowledge is required to do the project plus additional skills such as communicating, problem solving, and data base modelling.

Yes, for example the Xilinks project. This will lead to a new course to support that new development in technology.

Occasionally, not to a large extent because projects are very focused and curriculum is very broad. The flavour of a hot new topic will not become part of a student project because of the confidentiality involved.

Indirectly. You get into projects that lead to new courses. You get new equipment for projects that can lead to new courses,
eg: machine vision.

Marginally so, not directly. Faculty look at it four times per year. But they have, because of accommodating ISSP, shifted other courses for support and accommodation.

It forces our program to communicate more closely with industry. It forces us to remain current. Good luck.

Question 7. Summary:

Hand outs from instructors:
- design process from beginning to end,
- documentation re: technical specifications.
- bidding process to demonstrate ability.

Gets very diverse. Product literature, calling people that work in the area, research labs. Bring back material from industry, stacks of information. It trains people to be able to integrate information from other fields. This is mostly the responsibility of students working on projects. It is part of the learning experience.

They are pretty well on their own to get the information to execute their projects. Get manuals and also expertise from the industry sponsor.

None really. The other courses in the program, some project planning, but mostly background research. The students have to do this themselves.

Get guidance from faculty and sponsor. Students have experience from other courses. They also report on a regular basis, have regular meetings with their sponsor, do an oral presentation and provide a final report.

None. All done using their knowledge working to a course outline in terms of expectations.

All the courses that go before, then this course. All projects are different. For this course students do all their own research related to the project, no formal stuff. Tcom course runs concurrently to help them write their final report.

Research into building codes, sites, and design criteria. Review of other course material and multiple input from other sources, ie. journals. Students put their thinking caps on.

None. Past courses, library, and sponsor provisions.

Question 8. Summary:

Hard to answer. Advantage, paid experience. Disadvantage, adds time onto the program. Should be looked into further.

Yes, if we had the number of students to support it. Great idea.

Yes. Disadvantage is the extension of the length of the program and the impact on scheduling it if you do not have the critical mass of students to support it. Also, are there always enough student placement opportunities in industry?
Advantage is the experience students get, looks well on their resume, employers are looking for this. Instructors benefit from experiences students bring back to classes, spreads knowledge about.

In principle it would be good. Reservations about resources available to do this. The economy may not allow for enough student placements.

We already have coop in our program.

Everyone likes coop, work experience is excellent. The disadvantage is that it adds time to the program. Coop is optional, projects are mandatory, Mandatory coop is a problem. What do you do with the student who cannot get placed?

Formal coop has a lot of restrictions to it that BCIT cannot handle. The advantage is work experience. The disadvantage is the additional cost.

We have it in a mini format in terms of a four week practicum mixed with existing classes when lab time is devoted to going out to external offices in industry. The disadvantage is extending the program. It is not worth it, the work term just gives them exposure, almost counter productive working in a peripheral situation. They get half the money that a graduate would and they have to pay fees.

Not familiar with it.

Question 9. Summary:

You are closer to the student in projects. In coop you are removed.

Don't know enough about coop, but projects have a bigger impact because they do the project right here and faculty is involved.

Projects fit nicely with concurrent courses. Other courses support projects, we equip them. Coop students may get trivial work not related to curriculum issues. No close relation between coop and curriculum development. If advisory committee members hire coop students, may be.

Not much response with coop. In projects, because work is done on campus faculty are closer and can react quicker. Consistency of evaluation is better in projects.

Students coming back from coop have experience to do better projects. Have not experienced any feedback from coop students in this regard with feedback of the latest technology exposed to.

None to either. The blend of Tcom and project is an advantage, would not have that with coop.

From a faculty point of view, get more experience out of projects. In coop faculty is more removed. In projects faculty spend more time than just a site visit in coop.

Advantages of projects is integrated team approach with faculty and employers. Coop is cheap labour. Better exposure in projects. In coop the students would not get near the educational opportunity as in projects. Coop is production work, projects is theoretical design, better insight in design process.

Very difficult to find employers for coop position. Not familiar enough with the food industry.

Question 10. Summary:

Topic never came up. Should be done at the Associate Dean level.

Not enough students.

Not enough students. Don't have the resources to do it.

Lack of faculty resources and money, also expertise.

We have coop.

Projects and practicum work is better suited to our technology.

We had coop once, but have withdrawn when we parted from electronics technology and went back to single intake in september. Not enough students.

Time is the limiting factor. What would be cut to put it in?

No idea. No support from industry.

Question 11. Summary:

Same as before.

Refined the process of student projects. Do a better job at it now. Very appreciative of the involvement of a coordinator. Also moved other courses around as a result of greater emphasis on projects.

Yes there are more projects and students. The Dean has funded a work student to automate administration records of project courses.

Yes. Increased the software component of the program, a background course was introduced. Increased the hours allocated to the project course.

Yes. A special lab dedicated to student doing industry sponsored student projects has been introduced. Next year the project course will be doubled in hours allocated to it.

Change in format from one half to one day a week, to a continuous period of five weeks in the term. Sponsors prefer this.

No, done projects right from the start, but yes, more emphasis on industry sponsorship.

The emphasis has increased in terms of awareness. The nature has not changed. Added more time to blossom projects.

Yes, they were introduced two years ago and are now in the curriculum.

Question 12. Summary:

Benefits, students get exposed to real life, a lot of effort. They learn a lot. Problem is that some poor students attach themselves to bright student so they also get good marks.

Benefits: leads to a job. Students are more focused on what they do. Rounds out their thinking, organizing, planning, and intellectual development. Know how to apply things they learned, but also skill development; integrate knowledge. Same thought process as thesis, practice sense to use knowledge, problem, time, supplies, and resources. They learn to deal with sponsors, time consuming, and stick handle around problems.

The build up of projects allows us to satisfy clients with previous problems. Environment provides a very realistic learning situation. The possibility for real success or failure, not just a mark. Fosters a good relationship between industry and BCIT. Good P.R. Downside: two failures last year. Students did a lousy job and client expectations were too high. This term one project is failing due to inadequate supervision.

Benefits: tremendous learning experience. Allows students to pull course material together to apply it. More industry contact. Insight into future career possibilities. Problems: not enough time in an already crowded curriculum for students that need more time for preparation. Industry also has to respond quickly. Unions, political problems with students not being able to do a project.

Benefits: Enhances image with industry. Students gain experience, time management skills, and discipline. They learn how to prepare an engineering plan.
Problem: Students complain about not having enough time. We could also use more equipment.

Real benefit to students. Their report is good for a job interview and leads to a good many jobs. Use project sponsor as a reference.
Disadvantage: A wide disparity in quality of projects. Hence problem in monitoring projects. A lot is done on faith.

Nicest thing is to see the students create a finished project; satisfaction.
Problems: Time schedule from industry. Expectations from companies may be too high or too low, so you still have to nail it down so that it is doable. This is a faculty responsibility. Faculty has to build up the project with industry. Faculty should find the projects and hand them to the students.

Students get very enthused. Students create a portfolio to get jobs. Students get almost as good as architectural students at UBC.
Problems: Students get so enthused that they take time away from their other courses to work on their project. Not easy to control.

Question 12. Summary continued:

Positives: Students meet industry and actually see what real life is about. They have to take the initiative to succeed. As a result of industry sponsored student projects you get instructor professional development and curriculum renewal.
Difficulties: Poor sponsors, poor students, poor projects. To find enough quality projects for students to do.

Question 13. Summary:

Makes little difference, they work hard. Cash is useful but students work hard anyway. Put the money toward taking the sponsor out to dinner.

Provides motivation as long as it is not trivial. $200.00 is marginal, $500.00 is better. Winning enhances your credentials in terms of status.

They are a positive influence administered properly. If the guidelines are clear, eliminating flashiness. People get rewarded in reality so you may as well do it here.

No disadvantage. Awards are beneficial. Students are pleased with recognition. Students are motivated as result of competition.

Underplay the cash awards. If they win it is icing on the cake. Some students get exited, some not a big thing.

I like it, a great incentive

Cash does not make all the difference. Students who do a good job will do it regardless. An award is good, like a plaque or a ribbon. Competition is good.

Not a primary motivating factor. A bonus or carrot dangling. The cash made available to provide the supplies for students to do their project really helps out. Students still spend more on top of that ($250.00 per team). Credibility and credence are the motivating factors.

No advantage.
Disadvantage: the award is too low to be a major incentive. It recognizes exceptional projects above and beyond others.

Question 14. Summary:

Associate Dean level, look at courses then instructors take three months to revise the course development with the Learning Resources Unit, then to Advisory Committee for comments.

From faculty.

Program heads curriculum committee and the Dean, it gets focused there. Different elements are discussed by individual instructors. The month of June is allocated for updating courses. Those instructors on temporary contracts don't get this month of June so they have to do it on the run. There are some visionary long range ideas about off campus electronic delivery. 18 months in advance the material has to be decided to be included in the calendar. There are courses in the calendar but the content has been changed. Things are changing so quickly. For example the Hong Kong bank gave a new mainframe machine which has now gone down the tube and they have gone to personal work stations.

Faculty evaluation through projects and advisory committee feedback.

Program head meets with industry advisor and initiates, faculty do it. However, are major initiators and talk it over with advisory committee members.

In-house faculty

Primarily from faculty, they initiate it, from various sources, projects being one of them, this keeps us ahead.

In essence from staff in dialogue with the associate dean and industry advisory committee. Nothing is constant but change, when staff sees it they set things in motion to respond to that.

Within industry and faculty. We need more industry involvement.

Question 15. Summary:

Course instructor.

Instructor.

My own experience, the presenter of the course is responsible and it happens in real time. When the contract starts, 2 weeks of real frenzy to get 2 lectures prepared and then keep up on the go. The learning resources unit is a good idea but could be more in touch with instructors. They should contribute more but the pace is too quick.

Individual faculty. Discussions and decisions at faculty meeting looking at the whole.

Instructor in conjunction with program head and other faculty.

Faculty as a group.

Faculty within the program lays out course maps and goals. Then take to department and advisory committee. Bottom up to the top.

Most capable person on staff with industry expertise in relation to topic. Courses come from industry, get staff from industry if expertise is not in-house.

Each instructor in conjunction with curriculum review.

Questions 16, 17, 18. Summary:

The answer was "no" without exception to all three questions. However there were some interesting off the cuff comments to note:

- we go by the seat of our pants, common sense and experience.
- The (individual's surname) theory.
- could not put a name to it but have done it a few times.
- seat of pants
- what comes naturally
- I stay away from mumbo jumbo. I am not a professional educator. They suffer from not seeing the forest for the trees to get hung up with procedural details, teaching experience preferred, emphasis on deliverables rather than delivery.
- Whatever, the learning resources unit refers to learning objectives and enabling objectives.
- Not really. What we are doing probably incorporates that. We do it in a practical way instead of spending countless hours with theory and what we not really want too much of when technology is changing.
- No not a whole lot of time, we are implementing it and students do real well in the real world.
- Not directly but curriculum review by industry will be incorporated, reviewed by the advisory committee.
- Basically we identify the job skills required, courses required to provide those skills.

Question 19. Summary:

Not that I am aware of.

Comes from advisory committee, a broad based impression. They may not know what is going on in industry but they have feelings; helps set direction. It mainly comes from the instructor. To talk to the learning resources unit is like talking a different language, hard to make the connection. Projects are good.

No. Standards are now being developed but I don't know how easy it would be to apply them.

No, not in content. But the influence of the advanced diploma and subsequent degree development will dictate the time allocated to technology vs management portions.

The Association of Science Technologists of B.C.

No.

Advisory Committee, and the University of Victoria with reference to the bridging program.

Not directly, but curriculum review by industry will be incorporated, reviewed by the advisory committee.

No.

APPENDIX E:

Industry Sponsored Student Project Course Outlines

- Electronic Engineering Technology
- Food Technology

BCIT School of Engineering Technology

Electronics Technology Computer Control, Telecom, Power, Automation & Instrumentation

Course Outline: ELEX 469 Industry Sponsored Technical Project

Level	Credits	Hrs: Lecture	Lab	Tutorial	Total Weeks	Total Hrs

Prerequisite(s)

Minimum overall GPA of 65%. Same course prerequisites for regular Projects course

Equivalent Course(s)

None

Course Summary

ELEX 469 is offered to students from all four options as an alternative to the regular Technical Project course (419, 429, 439, 445). Students enrolled in ELEX 469 will fulfill their final term project requirement by working as part of a team to assist industry sponsors in solving technical problems. Each team will consist of at least two members, and will be required to communicate with the industry sponsor on a regular basis through meetings and reports. A formal report and an oral presentation with the industry sponsor in attendance will also be required as part of the evaluation process. ELEX 469 students will have preferred access to the Industry Sponsored Projects Lab for the duration of the term; however, students in other projects courses may also have access with permission from the ELEX 469 instructor.

Required Text(s) and Equipment

No text required

Reference Text(s) and Recommended Equipment

Equipment: Parts and special equipment will be suppled either by BCIT or the industry sponsor. Normal electronics and computer equipment will be available in the I.S.P. lab.

Evaluation

As in regular Projects courses

1991.11 Originator: _____ Program Head: _____

Electronics Technology - Computer Control, Telecom, Power, Automation & Instrumentation

Course Outline: ELEX 469 Industry Sponsored Student Project

Course Goal(s)

This course allows students to apply knowledge gained in the classroom to solving "real world" technical problems as they occur in industry.

Course Outcomes

1. Evaluate a technical problem in conjunction with other team members, and the industry sponsor.
2. Formulate an overall engineering plan, including specific objectives.
3. Assign duties to members of the team.
4. Provide regular progress reports to the industry sponsor.
5. Construct prototype circuitry.
6. Arrange information meetings with the industry sponsor as major objectives are met.
7. Combine prototype circuits into a combined engineering prototype.
8. In consultation with the industry sponsor, develop a printed circuit board if required.
9. Write a final report on the project overall.
10. An oral report will be given by each member of the team, with the industry sponsor in attendance.

ELEX 469 INDUSTRY SPONSORED PROJECT COURSE GUIDELINES

1. Each ISP must have a request from the sponsor on company letterhead, with a brief description of the technical details of the project, and an overview of the expected outcome.

2. Emphasis will be on the "design team" approach with each "team" composed of 2 or more students. Each student will be assigned a specific section of the project.

3. Each team of students will meet with their sponsor at the beginning of their project, and thereafter communicate their progress on a regular (i.e. weekly) basis.

4. The staff advisor will monitor the students to make sure that this communication is taking place, and the ISP coordinator will maintain ongoing contact with the sponsors for the duration of the course.

5. Before work commences, and after the initial meeting with the sponsor, an agreement will be drafted between the sponsor, the students, and BCIT specifying responsibilities and ownership of the final results. This will be signed by all parties involved.

6. At the end of the term each sponsor will be invited to attend the oral presentations by the students involved.

7. Overall evaluation will include a mark for "quality" of communications with the sponsor. (e.g. intermediate reports, regularity of contacts, etc.).

8. The Projects Lab in SW3-2910 will be available for meetings between students, advisors, and sponsors.

9. At the completion of ELEX 469, each participating student may be eligible for a $500 award from the Science Council of B.C. Evaluation for this award is performed separately from the normal BCIT marks process.

FOOD TECHNOLOGY

Course Outline: FOOD 4390 - DIRECTED STUDIES IN FOOD TECH

Level	4	**Hrs:** 3/wk		**Total Weeks**	20
Credits	4.5			**Total Hours**	60

Prerequisite: completion of Term 3 courses in the Food Technology program or by permission of the instructor.

Date prepared: January 1994 **By:** K. Turner and A. McCannel

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Course description:

The student will be assigned to an appropriate industry-proposed project which may involve product formulation, quality assurance, sanitation-related, or other food processing problems. The student will work with an industry-liaison person and Food Technology faculty to research the problem, present detailed methodology for carrying out the project, write progress and final reports to present the findings. The food processing industry will be able to provide input into student education and evaluation. The interaction will enable the Food Technology students at BCIT to establish concrete links with the food processing industry.

Reference texts:

as required

Evaluation:

Project methodology	10%	(designed w/industry)
Progress report (weekly)	10%	
Oral report (15 minutes)	25%	(will be done 2X)
Final report	35%	
(as per communications instructor)		
Evaluation by faculty	10%	
Evaluation by industry	10%	

Course goal(s):

To provide the student with an opportunity to apply skills learned in a variety of courses in the Food Technology program to specific food processing projects or problems so that the student can:

[a] gain an appreciation for the needs of the food industry.
[b] experience at least one facet of the food industry.
[c] to make his/her skills known to prospective employers.

Course schedule:

1. Student resumes shoud be ready by January 12, 1994.

2. Notify companies of possible student assignment and have industry liaison person interview students and select student for the project by January 19, 1994.

3. Familiarize students with library search techniques.

4. Orient student to project assignment by January 26, 1994 and meet with industry liaison person to discuss the project.

5. Student will begin research of literature dealing with the project by January 26. Weekly reports will begin on January 31, 1994 and are due every Monday at 12:00 noon. These reports should include hours spent and work completed. This first report should include "KEY" words to be used in your literature search and any references found. New references should be included each week.

6. Student will draft project methodology proposal by February 9, 1994.

7. Student will complete literature search on project by February 28, 1994 and hand in to instructor as part of weekly progress report.

8. Student will develop detailed methodology by February 28, 1994:
   - equipment required
   - procedures to be employed
   - ingredients or reagents required
   - location of research and proposed dates of activities
   * hand in to Food Technology instructor (Separate from the weekly reports)

9. Student will start laboratory or pilot plant work by March 2, 1994.

10. Laboratory or pilot plant work should be completed by April 29, 1994.

11. A draft of the final report (excluding final results and recommendations) will be made available to the TCOM instructor by April 29, 1994. Final reports with final results and recommendations will be handed in to the Food Technology instructor by May 13, 1994.

12. Student will present oral reports to TCOM instructor and class. A second presentation will be given to Food Technology faculty and industry liaison persons for evaluation in the week of May 9-13, 1994.

13. Projects will be evaluated by Food Technology faculty for presentation to the School of Engineering Technology projects competition.

BISC 439 - DIRECTED STUDIES FOR FOOD TECHNOLOGY

PROJECT GUIDELINES
DRAFT

1. Industry sponsor
   - will not expect the student to spend more than 6-8 hr per week on the project since it comprises only 10% of the student's workload in the winter term.
   - will meet with the student to discuss the intention and scope of the project
   - will be available to the student on a regular or as-required basis to direct activities or to discuss progress or problems related to the project
   - will arrange for access to plant or laboratory facilities where required for the proper implementation of the project
   - will provide or arrange for any ingredients or supplies required by the student for the project. N.B. These will be provided by the industry sponsor or billed by BCIT to the sponsoring industry firm.
   - will discuss the level of confidentiality required by the industry firm with the student and the BCIT faculty member responsible for the directed studies. Any restrictions will be provided in a memo to the BCIT faculty member and the student who will be willing to sign and adhere to a suitable confidentiality agreement.
   - will be provided with a final report on the project results by the student
   - will assess the student's performance in the project by filling out a form provided and received by the BCIT faculty member no later than May 27, 1994. This assessment will constitute a portion of the student's final grade for this course.

B. Student
   - may select two possible projects under the direction of the BCIT faculty member
   - may be interviewed by the industry liaison person who will select the student for the project
   - will meet with the industry liaison person to discuss the project and develop a project methodology proposal
   - will arrange for suitable times to speak to industry liaison person and to do laboratory or pilot plant work at the industry location or at BCIT
   - will provide transportation to industry site within the Greater Vancouver area
   - will be punctual, courteous, and professional in all situations
   - will develop detailed methodology for the project, carry out all phases of the project diligently and provide a progress report as well as a final report to both faculty and industry
   - will have Wed. afternoon (Jan-Feb) and all-day Wed (Mar-Apr) to devote to the industry project
   - will adhere to the schedule as presented in the course

outline unless previously arranged with the instructor
- must keep an UP TO DATE lab book detailing dates, observations, changes to protocol, data, sample preparation, hours spent working on this part of project, and name and amounts of supplies used.

NOTE: Some travel expenses are available if needed. Prior approval is required.

FOOD TECHNOLOGY DIRECTED STUDIES

SAFETY

The subject of safety is of great concern to Anne and myself when you are doing directed studies here at B.C.I.T. Many of the procedures and equipment here can be dangerous and if there is only one person present and someone is injured there is no one to give aid in the event of a mishap.

Please arrange your schedule to use B.C.I.T. equipment on the wednesday that directed studies is scheduled for. It is also important that you notify Anne or myself before hand (a day ahead if possible) of your need to use the following pieces of equipment:

Retort, instron, penetrometer, deep fat fryer, blanching equipment, steam kettles, atomic absorbtion spec, gas mixing valves and air tanks, etc.

Chemical analysis: Soxhlet, Kjeldahl, muffle furnace, use of any hazardous substances

This is also to ensure proper use of the equipment so that it is not damaged.

ORAL PRESENTATIONS

Each student is responsible for her/his overheads and any other materials needed for presentations. It is not up to the instructor to prepare these for you.

If pictures/slides need to be developed these can be done through Kim Cummings. However there must be at least a 3 day lead time for pictures and at least one week for slides. Alternatively you can have your films developed and we will reimburse the cost to you. This must be approved first.