TOWARDS THE DEVELOPMENT OF AN ENVIRONMENTAL CURRICULUM FOR MEMBERS OF THE PLANNING PROFESSIONS

THESIS

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DEDICATION

In memory of my father, Cameron Long.

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ABSTRACT

In exercising their professional duties professional planners inevitably impact on the environment. In the past, more often than not, this impact has been allowed to occur without sufficient forethought, and usually to the detriment of the environment. In this research it is proposed that this undesirable state of affairs arises from inadequacies within the professional education of the planners, and that greater emphasis on the **environmental** education of planners is called for.

From the perspective of a participative approach to curriculum development, the opinions of professional planners in the Port Elizabeth area were canvassed to establish baseline data in respect of their environmental education needs. To provide further information and a background against which the perceptions of the professional planners could be assessed, the opinions of the learned societies of the planning professions and of key environmentalists were also sought. In all these opinion surveys postal questionnaires formed the basis of the methodology employed. The extent of environmental education presently available to professional planners at tertiary institutions in South Africa and overseas, with particular emphasis on that available in the civil engineering discipline, was also investigated.

The surveys revealed a strongly felt need for environmental education within the planning professions. The natural environment, the social environment, environmental ethics and interdisciplinary action all emerged as acceptable themes of the said education. A number of environmental topics to be covered were also identified. Block-release and part-time courses emerged as the most popular format for such environmental education offerings. The limited environmental education practice within the civil engineering discipline at South African tertiary institutions was noted, and the overseas practice in this regard provided useful insights.

The data gathered as outlined above, formed the basis from which proposals towards an environmental curriculum for professional planners were made. Although these proposals focused primarily on the civil engineering discipline within the ambit of technikon-based educational programmes, wider multi-disciplinary applications remained an important concern. In the first instance, proposals aimed at expanding the environmental component of the existing first-qualification course were suggested. Secondly, proposals in respect of a post-first qualification, interdisciplinary, environmental study programme leading to a technikon degree were formulated.

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Notes on the use of different typefaces and inverted commas

In this report different typefaces and inverted commas have been used to indicate:

Bold - headings
- the writer's emphasis
- names of publications in reference list

Italics - foreign words
- names of publications in text
- words borrowed from other writers or passages

'Single inverted commas' - words or phrases used in a colloquial manner

"Double inverted commas" - short quotations.

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CHAPTER 1

INTRODUCTION

> And God saw everything that he had made, and, behold, it was very good (Genesis 1:31).
>
> The truth is, many things on which our future health and prosperity depend are in dire jeopardy: climate stability, the resilience and productivity of natural systems, the beauty of the natural world, and biological diversity (Orr 1990: 351).
>
> Whenever society faces large problems there is a tendency to think that either their roots or their solutions lie, at least partly, in the educational system (Brennan 1991: 279).
>
> What was wrong with their education? ... it emphasizes theories, not values, abstraction rather than consciousness, neat answers instead of questions, and technical efficiency over conscience. ... education is no guarantee of decency ... It is not education that will save us, but education of a certain kind (Orr 1990: 351).
>
> As our understanding of the interrelationships between human activities and environmental problems progresses, the core of environmental education, when properly developed, may well become the pivot around which future strategies of general education will turn; it should provide citizens of the world with a new outlook and a new attitude, better suited to the needs of man and nature (Buzatti-Traverso 1977: 13).

1.1 The context of this research

In the course of their practice, members of the planning professions have a very direct impact on the physical and social environment. It therefore seems imperative that they should be made aware of the environmental impact resulting from their professional activities and that their education should enable them to make informed decisions in this regard. The planning professions are defined as those "which initiate, plan or act as the

principal agent in the planning and the execution of developments which have an environmental impact" (Chutter 1991: 1). They include the professions of town planning, architecture and civil, electrical and mechanical engineering. (A listing of the professional organisations that are members of the Environmental Planning Professions Interdisciplinary Committee, EPPIC, is given in Appendix A.)

In an opinion survey conducted by the Centre for Evaluation and Policy of the Foundation for Research Development (FRD) amongst a group of top South African decision makers, more than 50% of the respondents identified *environmental technologies* as being of extreme importance in contributing to the country's competitive position in the international arena (FRD 1992). The comparative position of environmental technologies in relation to other critical technologies is reflected in Figure 1.1. This would seem to suggest that it may be of national significance for members of the planning professions to become involved in the fields of the environmental technologies.

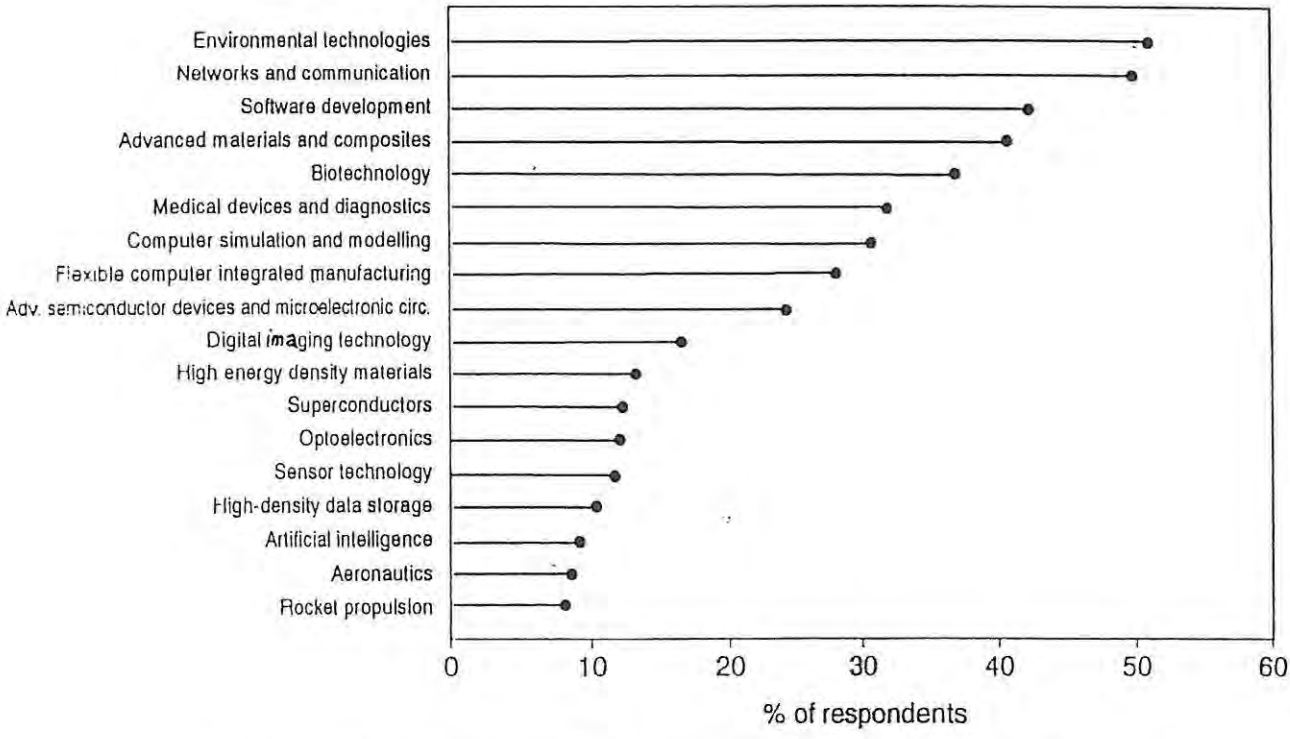

FIGURE 1.1 Distribution of critical technologies rated as extremely important by top decision makers (from FRD 1992)

However, there appears to be a fairly general perception that the planning professions are not as concerned about the environment as they should be. This was reflected for example by Clarke (1984: 412), who suggested that engineers "believed that their projects were unconnected with people and the environment in which they lived". Koehn and Bourque (1990: 968) put it as follows:

> Engineers in general, and civil engineers in particular, because of their association with construction and/or the public sector, have long been the target of angry citizens expressing their frustration regarding changes in the environment.

Planners are also accused of viewing natural resources purely in economic terms and "beyond that there is a rapid loss of interest" (O'Keefe 1986: iii). Gunn and Vesilind (1987) suggested that the practice of engineering has had adverse effects on the physical and social environment due to the limited significance that has been attached to an environmental ethic in their training and practice. Issues such as the recent controversy surrounding the proposed dune mining at St Lucia in Natal may reinforce the perception that industry generally, and their agents the professional planners, are not particularly concerned about the environment.

Latterly however, the planning professions have become more sensitive about and interested in environmental issues, as is evidenced for example by the formation in 1974 of the Environmental Planning Professions Interdisciplinary Committee, or EPPIC, "in response to a general criticism of the professions' disregard of environmental matters..." (Chutter 1991: 1). In 1991 a division of environmental engineering was formed within the South African Institution of Civil Engineers (Middleton 1992). In the journals of the planning professions articles and editorials on the environment are also appearing with increasing frequency (cf. *The Civil Engineer in South Africa*, October 1971, May 1973, October 1981, September 1984, June 1987, February 1991). Special issues on the environment also reflect this growing concern (cf. *The Civil Engineer in South Africa*, February 1974, April and May 1980, September 1992).

Despite these developments it is postulated here that the introduction of environmental education into the training curricula of the planning professions has been somewhat

lagging, particularly so in South Africa. Many overseas universities, for example, offer bachelor degrees in environmental engineering, but this is not the case in South Africa. Engineering curricula at South African technikons appear to be almost devoid of environmental topics (NATED 1993b: 201, 208 & 221). Bandler (1989) reports on the lack of environmental education for engineers in Australia, and the writer of this report believes that a similar situation exists in South Africa. An editorial in *The Civil Engineer in South Africa* (April 1991: 115) suggests that environmental management skills are poorly developed in Southern Africa and calls for the establishment of a postgraduate course in this area for persons with "technical backgrounds".

1.2 The aims of this research

In response to the scenario outlined above this research attempts to clarify the scope and the depth of environmental education regarded as desirable for members of the planning professions. It also tries to determine to what extent these requirements are being met at present. On the basis of the information gathered in these investigations proposals are put forward towards the development of an environmental curriculum for members of the planning professions.

It must be stated at the outset that there is a bias in this research towards the civil engineering profession. This is due to the background and training of the writer. Nevertheless it is an implicit objective of this study to investigate the potential for the development of common measures to address the needs of the different planning professions. Thus, where applicable, interdisciplinary proposals are put forward.

1.3 Definition of terms

During the study it has become clear to the writer that some of the terms used in this report may be variously understood by different individuals, and hence their use in the

context of this project needs to be clarified. The explanations given here will however be limited to those concepts that are central to the theme of the research. Other terms to which the writer attaches a specific meaning for the purposes of this research, will be defined where they first arise.

Environment

It may still be the case, more often than not, that planners (and others) conceptualise 'the environment' as being the natural environment. However it needs to be stated that, in the context of this research, and of contemporary environmental education, this concept is understood to have bio-physical, socio-economic as well as ethical dimensions. This is not to deny the central role played by the bio-physical environment in the sphere of the professional activities of the planners. Indeed it is often the impact (or expected impact) of these activities on the natural environment that elicits the first calls of environmental concern - the St Lucia controversy being a case in point.

Environmental education

The definition given here has been formulated by the IUCN[1] in 1971, and has since enjoyed general international acceptance.

> Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness amongst people, their culture and their biophysical surroundings. Environmental education also entails practice in decision making and self-formulation of a code of behaviour about issues concerning environmental quality (quoted by Irwin 1991: 15).

Further clarity can be added to the concept of environmental education by considering the principles ascribed to it at the intergovernmental conference on environmental education held at Tbilisi, USSR in 1977. In the light of these principles and subsequent third world perspectives, environmental education has been described by Blignaut (1991: 2-3) as follows (writer's emphases):

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[1]International Union for the Conservation of Nature

i) It is seen as an **integrated lifelong process** that should occur at all levels of education from pre-school to adulthood, through formal and non-formal education.
ii) It is about the **interactions that occur in the natural, the built and social environment.** It should lead to the understanding of human interactions and political processes, together with the nature of socio-economic issues and the effect of these on environmental degradation or enhancement.
iii) It is for **developing attitudes and value systems** which lead to socio-economic improvement through positive social interactions and the maintenance and improvement of the natural and built environment.
iv) It aims to develop an individual's understanding, skills and the feelings of empowerment that are necessary for both positive behaviour towards the biophysical and social environment in everyday living, and for **active participation in group efforts to find the optimal solutions for environmental problems.**
v) As such it requires a **holistic and preferably interdisciplinary approach** to teaching with opportunities for diverse learning experiences, but with particular emphasis on direct experiential learning in natural, built and social environments.

Environmental management

The definition used in this study and given here is paraphrased from Fuggle (1992: 2-3). Environmental management is the formulation of goals and objectives inherent in the nine principles outlined below, and the execution of planned controls so as to achieve the desired outcome of a sustainable society based on these principles:

- respecting and caring for the community of life
- improving the quality of human life
- conserving the earth's vitality and diversity
- minimising the depletion of non-renewable resources
- keeping within the earth's carrying capacity
- changing personal attitudes and practices
- enabling communities to care for their own environments
- integrating development and conservation
- creating a global alliance.

Environmental management could thus be simply described as the deliberate and structured monitoring and directing of the human/environment interface towards a sustainable society.

Environmental engineering

In the United States of America the concept of environmental engineering developed out of the fields of water and sanitary engineering in response to the increasing occurrence of water pollution problems. Civil engineering and environmental engineering are thus seen to be closely related disciplines as borne out by the fact that many overseas university civil engineering departments have incorporated the words *environmental engineering* into their names. Although the pollution emphasis is still evident in the environmental engineering courses offered by American universities, the definition of the concept has broadened to:

> ... that branch of engineering which is concerned with
> (1) the protection of human populations from the effects of adverse environmental factors
> (2) the protection of the environment, both local and global, from the potential deleterious effects of human activities, and
> (3) the improvement of environmental quality for man's health and well-being (quoted by Patterson 1980: 524, 526).

In the context of this research environmental engineering differs from environmental management in that it is more concerned with the physical control and combating of pollution in the natural environment than with the broader socio-economic environmental issues that environmental management deals with.

1.4 Summary

Having sketched the background against which this research takes place, the objectives of the research may be summarised as follows:

(a) To investigate the scope and depth of environmental education regarded as desirable for members of planning professions.

(b) To assess the extent to which environmental education at a tertiary level is currently available to members of the planning professions in South Africa.

(c) To suggest a basis for the development of an environmental curriculum for members of the planning professions.

In addressing these objectives a study has been designed which is reported on as follows:

- Chapter 2 covers a review of the literature dealing with environmental concerns, the philosophical underpinnings of environmentalism and environmental education, and the implications of these for the planning professions.

- In Chapter 3 the survey methodology employed towards attaining the above objectives is described.

- Chapter 4 is a description and discussion of the information resulting from the said surveys.

- In Chapter 5, against the background of the information obtained, environmental education proposals for the planning professions are put forward.

- In conclusion Chapter 6 highlights the core proposition of this research.

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CHAPTER 2

LITERATURE REVIEW

> Hardly a day passes but we read in our newspapers or see on our TV screens reports of environmental problems. Poisonous industrial wastes kill fish and contaminate drinking water. The unwise use of pesticides kills plants and animals we would rather preserve. Manmade chemicals are damaging the ozone layer above our heads. We are altering the world's climate by burning coal, wood and oil. Tropical forests are being cleared to supply us with timber and to produce beef, while the citizens of the formerly forested countries live in the direst poverty amid the ruins of what should have been untold natural wealth. The list is endless and no sooner has one fear been aired than another appears. How are we to evaluate all these alarms? How can we know which are genuine, which imagined, which serious, which trivial? Yet we must know, must make decisions, for we are told that our very survival is at risk and we must take action (Allaby 1989: 11).

Echoes of this lament may be found in many environmental writings, and indeed, in a decisive sense, it is the *raison d'être* for this research. This chapter is a review of literature dealing firstly with the fundamental issue(s) underlying this parlous state of affairs, and then working towards suggested mitigative actions, particularly from the point of view of the planning professions.

2.1 Why the Environmental Crisis?

It has been argued that environmental problems are due, at least in part, to the technological excesses and over-consumption in the first world, and the effects of these on various peoples across the globe.

> Behind all the reasoning is the spectre that any attempt at continued economic growth in its current wasteful and highly inegalitarian form will not only result in very real and imminent resource scarcities, but will necessarily lead to environmental destruction and serious poverty and social hardship. The worse consequences will fall disproportionately

> upon those who are least able to help themselves and whose indigenous abilities to cope with resource scarcities and environmental stress are already being eroded by forces mostly beyond their control, and whose voices in the halls of political power are either not heard at all or are extremely faint (O'Riordan 1981: 4).

In the sixties Rachel Carson (1965) in her celebrated work, *Silent Spring*, exposed the excessive use of chemicals as herbicides and pesticides, and warned against the consequential hazards to human health and the environment. Since then many writers have entered the debate on the impact of technology on the environment, and many of the issues in this arena have become well known. Roberts and Sheail (1993: 47-70) address the issue of acid rain while Brimblecombe and Nicholas (1993: 72-84) look at air pollution in general. Roberts (1993: 86-102) investigates the problems brought about by the use of nuclear power from an international perspective, while Gandar (1991: 101-102) does the same in the South African context. Also from a South African point of view Koch *et al.* (1990: 43-55) and Lukey *et al.* (1991: 160-173) investigate the issue of waste. Miller (1991: 240) points out that the impoundment of rivers for the purposes of water supply could produce a varied array of environmental impacts, for example, the perturbation of the natural flow regime, the displacement of people, the flooding of land, the disruption of fish migrations, increased seismic movements, raising of the water table and estuary degradation. Cummings (1990) explores some of these issues in a Brazilian case study. Rivers and estuaries are also impacted on by bridge crossings - these and other related issues are reviewed by O'Keefe *et al.* (1989: 266-289) and Heydorn (1989: 290-297).

Although the above references are by no means comprehensive, they are sufficient to indicate that there is widespread concern about these issues. An implication particularly important for the purposes of this research, and which arises out of the technological dimension of these environmental issues, is the implied inability of planners in general, and engineers in particular, to fully perceive the environmental consequences of their designs. It has been said, for example, that the signing of the National Environmental Policy Act into law in the United States of America in 1970, was "due in part to the

inability of engineers to assimilate the effect of their projects on other species and nature generally" (Gunn & Vesilind 1990: 35). However it is evident from Chapter 1 that planners are aware of and concerned about this accusative implication. It is also evident that some feel unfairly accused. Maxey (1991: 62) states that "the blind acceptance of Carson's claims are chilling" and goes on to question the validity of some of the environmental arguments against chemical and nuclear pollution. Alexander (1991: 12-13) feels that the problems faced by planners are not understood by environmentalists who are seldom in a position where **they** have to make major planning decisions. Yevjevich (1992: 190) accuses environmentalists of using (natural) environmental issues as a smoke screen for solving philosophical, political and social dilemmas.

It is not the intention here to pronounce on the merits or demerits of the arguments outlined above. Instead the aim is to demonstrate the belief of many writers that, on a more fundamental plane, our environmental problems (at least in the first world context) are largely due to us being educated into an inappropriate world view. Capra (1983) wrote at length on this theme, explicating the pervasiveness of the *Cartesian-Newtonian* world view in Western thought, outlining its shortcomings in our modern times, and calling for a paradigm shift to a new *systems* view of life.

> What we need, then, is a new 'paradigm' - a new vision of reality; a fundamental change in our thoughts, perceptions and values (Capra 1983: xviii).

> The new vision of reality we have been talking about is based on an awareness of the essential interrelatedness and interdependence of all phenomena - physical, biological, psychological, social, and cultural. It transcends the current disciplinary and conceptual boundaries ... using whatever language becomes necessary to describe different aspects of the multileveled, interrelated fabric of reality (Capra 1983: 285).

Sterling (1985: 204 & 1990: 82) juxtaposes the dominant Western world view and an *ecological* world view - the former characterised by *objectivist, linear, reductionist, mechanistic* thought, and the latter by its *participative, systemic, holistic, organic* approach. Capra, more so than Sterling, does not deny the value of Cartesian thinking, but asserts, as does Sterling, that its dominance to the exclusion of systemic/holistic

thought is at our peril.

Buzzati-Traverso (1977: 16), recognising the need for a new approach, puts it as follows,

> our entire way of living will have to change, replacing competition with co-operation, eliminating commercial publicity, rescuing science from its present prostitution to war and discovering new motivations to replace individual profit.

Milbrath (1984: 113-114) is similarly concerned about the value structures of modern industrial market societies, *inter alia* the belief that material wealth defines quality of life and that with science and technology we can dominate nature for the good of all. He calls for a new *sustainable society* which is based on the central values of justice and compassion. Brennan (1991: 281) explains that our thinking is shaped by *frameworks,* or patterns of thought into which we have been educated. He concludes that it is our failure to reflect on the multiplicity of frameworks available to us, and on the frameworks themselves, that has led to our environmental predicaments (Brennan 1991: 287-289). Kothari (1990: 20), writing on the environment, technology and ethics, suggests that "perhaps there is something wrong with the *basic model of life* humankind has created in the modern age."

If it has now been established that the present dominant world view is inadequate to address the environmental crisis, and that a fundamental paradigm shift is required, we next need to consider how this can be brought about.

2.2 Environmental education - the solution?

It has already been noted that an analysis of societal problems often leads to the view that the solution lies in education of the right type (Brennan 1991: 279). It is in this context that one may understand Irwin's (1991: 19) claim that environmental education ranks in importance with basic literacy and numeracy. Thus it appears that environmental education may be the vehicle through which the requisite fundamental change in world

view may be brought about. To quote Buzzati-Traverso (1977: 13) again:

> As our understanding of the interrelationships between human activities and environmental problems progresses, the core of environmental education, when properly developed, may well become the pivot around which future strategies of general education will turn; it should provide citizens of the world with a new outlook and a new attitude, better suited to the needs of man and nature.

Speaking of environmental education O'Riordan (1981: 16) asserts that "we may have to educate for a wholly different approach to life, to work, to leisure, to social relations, to money, to communal maintenance and to **technology**" (writer's emphasis).

It is necessary here to point out that these writers are not referring to education **about** the environment, but rather to a fundamental re-orientation to life as implied by the definition given to environmental education in Chapter 1. To repeat the words of Orr (1990: 351), "it is not education that will save us but education of a certain kind." It will have to be the kind of education that is founded on an *ecocentric* world view (O'Riordan 1991). In order to reflect the quintessence of that new world view it will have to be holistic and systemic. Gough (1987: 50) asserts that "this profoundly ecological understanding of education [requires that] we must shift our attention from **objects** ... to **interrelationships**". In order to maintain this ecological understanding Robottom (1987: 85 *et seq.*) warns against the "technocratisation of environmental education". He continues:

> By conserving and reproducing a technocratic view of the world - one centred on rationality, objectivity, truth and control - environmental education as education **about** the environment creates the impression that environmental problems are susceptible to resolution through technical, applied science means ... and result(s) in teachers and students rarely progressing from an 'awareness development' phase to the 'action' or participation phase prescribed in the accepted guiding principles of environmental education (Robottom 1987: 103-104).

In similar vein Irwin (1991: 17-18) cautions against the mechanistic approach of *positivism* in environmental education.

The literature reviewed thus far points to the need for an ecocentric world view that has to be brought about by the right kind of environmental education. It is now appropriate

to investigate how this applies to the planning professions.

2.3 Environmental education for the planning professions

To an increasing degree environmental education is being built into the training programmes of the planning professions. Patterson (1980: 524) indicates that prior to the 1970s four American universities offered baccalaureate degree programmes in environmental engineering. By 1988 the number had risen to twelve (Turner 1990: 642). Soon Haing Cho (1987: 200) notes the existence of fourteen environmental engineering departments in Korea in 1985. Environmental engineering courses in Britain numbered ten in 1980 (Potter 1981: 277). Information from the Australian Embassy in Pretoria indicates that in 1993 seventeen Australian universities were providing courses at various levels in environmental engineering. This research will show that there are no undergraduate environmental engineering programmes in South Africa, and that six universities offer postgraduate programmes that could be regarded as environmental to a greater or lesser degree, and which are designed to accommodate graduates from at least some of the planning professions (see Appendix E).

The professions themselves are also promoting environmental education. The Engineering Council (1992) of the United Kingdom has drawn up an "embryo" Code of Good Practice on *Engineers and the Environment* which states, *inter alia*, that "engineers should keep up-to-date by seeking appropriate education and training on environmental issues and associated techniques" (*Ib.* 4). FIDIC[1] proposes a comprehensive strategy for consulting engineers (Stewart Scott 1993). FIG[2] believes that "environmental issues should figure prominently in the education of surveyors and universities should be encouraged to provide the appropriate courses" (FIG 1991: 7). In South Africa the

[1] International Federation of Consulting Engineers

[2] International Federation of Surveyors

Environmental Engineering Division of the SAICE[3] is at present investigating the introduction of environmental engineering into undergraduate civil engineering curricula (Waelbers 1993, pers. comm.).

It is now necessary to ask whether the environmental education being provided is of the fundamental nature that was described earlier (see §2.2). The following writers are mainly engineering educators. Dracos (1992: 188), in reference to the education of civil engineers, says that "the traditional fields ... must make way for new forms of engineering which put more emphasis on a system's approach to the problems around engineering, thus including subjects like environmental impact, etc." While this seems reasonable he then also says that "it does not mean that we have to stop development and turn civilization backwards" (*Ib.* 186), and one feels that the environmental implications of issues like technological excess and over-consumption may have been missed. Samson (1990: 721-727) investigates the "weak or missing links" in civil engineering education, stresses the systems approach and addresses some interaction between elements of the curriculum, but does not suggest any fundamental changes and makes no direct reference to the environment. In discussing the calls for change in the civil engineering curriculum Smith and Samson (1990: 677-683) appear to be more concerned with "where do we put what", than with the type of change that would suggest a fundamental re-orientation. An article by Parker *et al.* (1990: 684-694) calls for a "substantive, fundamental, and in some aspects radical" restructuring of the civil engineering curriculum. It further states that the "effective curriculum should ... integrate the backgrounds in basic subjects and socio-economics and humanities into concepts and analysis pertinent to the design of solutions for civil engineering problems" *(Ib.* 690). Despite these seemingly positive statements with respect to a fundamental re-orientation, the omission of any reference to the environment does again raise some concern. One also needs to take into account that all of the above are fairly recent **proposals**, which implies that the actual situation may still fall short of these ideals.

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[3] South African Institution of Civil Engineers

It must be obvious that the education and practice of the planning professions in general, and of engineers in particular, have traditionally fallen very much in the sphere of the Cartesian-Newtonian world view. "Engineers are utilitarians and positivists, and have been functioning as applied physical scientists, where decisions are made on an object-subject basis, and where values do not enter the decision making machinery" (Vesilind 1990: 893). Thus one may doubt whether the changes called for in the writings quoted above represent a major paradigm shift of the order suggested by Gough (1987: 50-54). Kahn (1986: 95-108) for example, writing on " engineering curricula design", suggests that engineering students be educated in a "sympathetic understanding of economic and social conditions", yet he still speaks of the "control of nature" and makes no clear reference to **interaction** with the environment in general. Turner (1990: 637-643) investigates whether environmental engineering courses are separable from civil engineering courses, but it is clear that his investigation does not delve into any deep fundamental differences that may exist between these courses, and that he views them as pedagogically similar. Together with Stimpson (1991: 375) one feels that the type of question that really needs to be asked is, for example, how "within the confines of an ... engineering program(me), ... can the paradigm of a covenantal stewardship with all life and matter be inculcated?"

Priscoli (1983: 139), a social scientist, suggests that the fundamental "retraining of modern civil engineers" requires a new paradigm in planning, where, *inter alia*, planning "creates as much as predicts the future", involves "an inter-subjective transfer of knowledge", "is as much political as it is technical", and needs to be done "with" rather than "for" people. In contrast Wates (1993: 3, 6), a civil engineer, says that while environmental "sensitisation is a fundamental requirement", "no one can reasonably expect civil engineers to adopt 'political positions'".

One feels that Stimpson, an engineering geologist, is perhaps more in harmony with the new paradigm when he states:

> The socio-economic issues raised by the recognition that our small planet is under stress from environmental mistreatment should surely

> cause the engineering profession to ponder its purpose and future,

and

> At this fundamental level, the engineering profession needs to develop a modern engineering ethic and purpose in keeping with the globalization of its activities and of technology's environmental impact, and to reclaim the high ground now occupied, in the public eye at least, by environmental groups (Stimpson 1991: 372).

2.4 Curriculum considerations

To the extent that this research may lead to curriculum proposals it may be useful to introduce a very brief overview of curriculum theory. Schubert (1986: 181), drawing on the work of Habermas and Hultgren, presents three curriculum paradigms, the traditional *empirical/analytical*, the *hermeneutic* based on interaction, and the *critical* with its emancipatory emphasis. In an historical overview of curriculum innovation House (1979: 1-13) identifies three perspectives that developed progressively, the first being the *technological*, followed by the *political* and finally the *cultural*. Stenhouse (1979) presents a critique on the *objectives* curriculum model and as an alternative proposes a *process* model. Giroux (1988: 11-20) proposes a "new sociology of curriculum" to replace the traditional curriculum paradigm, which is based on the natural sciences model. Papagiannis *et al.* (1982: 245-290) are proponents of the *radical* paradigm to replace the *functionalist-modernity* perspective. Lacey (1987: 87-103) calls for a new curriculum that should be in the critical paradigm and socialist in its thrust. Gough (1987: 49-67) favours the *ecological paradigm* of education over the *epistemological*.

Despite their differences in nomenclature these writers are unified in their criticism of the conventional paradigm that dominates educational thought at present. Using the taxonomy of Habermas (see above) for the moment, that would be the empirical/analytic paradigm. In their view it stands accused as being positivist, technocratic, knowledge-dominated, teacher-centred and ostensibly value-free, and is considered inadequate to meet the demands of our time. In the alternatives that they propose these writers are far

more divergent, but in general they favour a more interpretative, experiential, participative, student-centred curriculum model.

At a more practical level one could consider teaching models, of which Brady (1985) describes five. Some of these models, for example the *exposition* and *behavioural* models, may fit more comfortably into the conventional or dominant curriculum paradigm whereas others, for example the *interaction* and *transaction* models might suit the new curriculum paradigm better. The following statements by Brady (1985: 218), in the opinion of the writer, are significant:

> No single model is superior to others. It should be understood that each model offers valuable approaches to enrich teaching. There is at least *prima facie* logic in the argument that using a variety of models may better help realise the multiplicity of ... [educational] objectives.

Thus in a situation where the transfer of facts is intended the learning objectives (behavioural) approach (Brady 1990: 74-91) may be adequate. For example, in the area of environmental demographics, success might readily be measured by a correct listing of numeric responses, which could be suitably reinforced by the awarding of high marks for such responses. However in the field of environmental ethics success might be gauged by the ability to formulate a consistent personal value position, rather than the reproduction of given facts. Teaching models that are more student centred would therefore seem more appropriate; the interaction model of Brady (1985: 140-180) comes to mind.

It is the opinion of the writer that this eclectic approach applies equally well to educational paradigms. Howe (1992: 243) puts it as follows:

> In summary, positivism is untenable and interpretivism is incomplete. The kind of epistemological perspective that supplants them - which I call "compatibilism" ... - borrows features from both the natural science model and from interpretivism. In very broad strokes, compatibilism borrows from the natural science model by acknowledging the uneliminable role of *mechanistic* explanations ...; compatibilism borrows from interpretivism by acknowledging the uneliminable role of *intentional* explanations ...

Pascal, the 17th century French scientist, who is still being honoured today through our use of the term *pascal* as the SI unit of pressure, was not only a gifted scientist but also a theologian of note. He is quoted by Vesilind (1990: 894) as saying:

> A man does not show his greatness by being at one extremity, but rather by touching both at once.

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CHAPTER 3

METHODOLOGY

> In summary ... the aim of methodology is to help us to understand, in the broadest possible terms, not the products of scientific inquiry, but the process itself (Cohen & Manion 1992: 42).

3.1 Introduction

Inter alia this research was aimed at assessing the need for environmental education amongst members of the planning professions, and determining the degree to which this need is being met (see Chapter 1). As this involved the obtaining of information and the gauging of opinions some form of survey was called for. Frankfort-Nachmias & Nachmias (1992: 215) suggest the mail questionnaire, the personal interview and the telephone interview as techniques of survey research. In this case time restraints ruled out the latter two options and it was decided to use mainly questionnaire surveys. In cases where the information sources were remote (overseas) and diverse (such as different types of educational institutions) and where the questionnaire technique was deemed inappropriate, the approach used was the *content analysis* of current documents (Mahlangu 1987: 17).

3.2 Outline

As the previous section indicated, this research was based on various surveys aimed at establishing viewpoints and baseline data in the area of environmental education for the planning professions. The following steps were followed:

(a) An opinion survey was conducted amongst members of the planning professions,

on the basis of a questionnaire sent to a convenience sample (Cohen & Manion 1992: 103) of persons selected from the said group.

(b) An opinion survey was conducted amongst the learned societies representing the various planning professions, on the basis of a questionnaire sent to each of these societies.

(c) An opinion survey was conducted amongst environmentalists, on the basis of a questionnaire sent to a purposive sample (Cohen & Manion 1992: 103) of persons selected from the said group.

(d) A survey was done of the existing programmes in environmental education open to members of the planning professions at selected tertiary educational institutions in South Africa.

(e) A survey was done of the existing programmes in environmental education open to members of the planning professions at selected tertiary educational institutions overseas.

3.3 The survey directed at the planning professions

In order to gauge the opinions of members of the planning professions towards environmental education in their profession, a survey was conducted amongst a sample of the planning professionals in the Port Elizabeth area. As the writer is resident in Port Elizabeth, this group of participants was selected as a matter of convenience, and can hence be classified as a *convenience sample* (Cohen & Manion 1992: 103). Viewing this group as an areal component of all the planning professionals in South Africa it could also be described as a *cluster sample* (Leedy 1974: 103-104). The local membership lists of the various planning professions were obtained and from these lists, participants were selected on a random basis, maintaining approximately however the proportions between

the various professions. From this perspective the sample group could also be described as a *proportional stratified sample* (*Ib.* 103). This led to the breakdown in numbers reflected in Table 3.1 (see p 3.5), showing that the majority of the members of the sample were civil engineers with correspondingly lesser numbers of the other planning professions represented. In some of these professional directions there are only small numbers of practitioners in the Port Elizabeth area. The extrapolation of their responses to their professions as a whole must therefore be treated with circumspection.

The sample selection procedures outlined above are designed to ensure *external validity* (Leedy 1974: 150) of the results of the research, that is the extent to which the results are generalisable. However given that the proposals which flow from this research are intended in the first instance to be locally applicable, the issue of external validity was not considered to be of critical importance.

The instrument used in this survey was the postal questionnaire, constructed on the basis of the guidelines given by Cohen & Manion (1992: 106-109), Mahlangu (1987: 80-81) and Leedy (1974: 81-83). Most of the questions used in the questionnaire were of a combined *closed-ended and open-ended* nature (Frankfort-Nachmias & Nachmias 1992: 242-244), allowing a respondent to provide an open-ended elaboration of his/her choice of the options given in the closed-ended part of the question. As the general aim of the questionnaire was to elicit opinions rather than factual information, it was considered that this compound nature of the questions would improve its *internal validity* (Leedy 1974: 150; Mahlangu 1987: 83-84). Internal validity refers to the capacity of the questionnaire to actually measure what it is intended to measure.

In Question 6 of the questionnaire the ranking technique was applied (Frankfort-Nachmias & Nachmias 1992: 249-250) in order to establish the degree of importance attached to various environmental topics. This approach was not entirely successful (see § 4.2, p 4.16-17). This, and such minor shortcomings as emerged retrospectively in some of the other questions will, where applicable, be discussed in the next chapter in which an analysis of the results is done on a question by question basis.

A *covering letter* was drawn up along the lines suggested by Sax (1979: 258-259) and Leedy (1974: 83) and a copy accompanied each questionnaire that was sent out. In the covering letter the option of responding anonymously was offered to each respondent. This, according to Mahlangu (1987: 84) and Sax (1979: 250), would improve the external validity of the questionnaire. In the end the need for anonymity did not appear to be an issue at all as the vast majority of the respondents included their names and addresses.

Before the questionnaires were sent out, a *pilot study* (Mahlangu 1987: 82; Sax 1979: 258; Leedy 1974: 81) was conducted amongst a sample of twenty individuals who were all qualified in one or other of the fields of the planning professions. As a result of this pilot survey the questionnaire was amended in some respects and also shortened. The results of the pilot survey were not included with those from the main survey, but most of the participants in the pilot study responded again in the main survey. Their individual results did not differ much between the two runs, confirming, to a degree the *reliability* (Mahlangu 1987: 84) or *replicability* potential (Leedy 1974: 67) of the questionnaire.

In line with the general objectives mentioned earlier (see §1.4) the main objectives of this questionnaire were the following:

- to determine how planning practitioners perceived the need for environmental education for members of their profession

- to probe the nature, content and format of such courses as may be developed to address the perceived need.

A copy of the questionnaire used in this survey together with a copy of the covering letter is included in Appendix B1. The returns of this questionnaire are summarised in Table 3.1.

TABLE 3.1 Returns of questionnaire sent to planning professionals

Target group/ profession	Number sent out	Number returned	% return
Civil engineers	96	57	59
Electrical and Mechanical engineers	36	20	56
Quantity surveyors	47	24	51
Building managers	30	14	47
Civil technicians	29	15	52
Architects	43	20	47
Town planners	10	7	70
Land surveyors	11	2	18
Landscape architects	1	1	100
TOTAL	303	160	53

According to Cohen & Manion (1992: 114) a "well-planned postal survey should obtain at least a 40% response rate." In the light of this figure the response rates achieved above were in general regarded as being satisfactory. Only in the case of the land surveyors can the response rate be regarded as being unacceptably low. As this group of professionals makes up a small minority of the planning professions, and as the general response rate was acceptable, and due to time constraints, no follow up actions were undertaken. Notwithstanding the bias introduced by the non-return of questionnaires on external validity (Leedy 1974: 107), the actual returns indicated such clear concern about and support for environmental education for the planning professions (see Chapter 4) that it, in the opinion of the writer, ensures a receptive audience for the proposals that may emanate from this research, even if then only in the Port Elizabeth area.

The results of these questionnaires to the planning professionals are summarised in Appendix B2.

3.4 The survey directed at the learned societies

It was thought that the learned societies representing the planning professions would provide an authoritative view on some of the issues raised in the questionnaire to the practitioners. Thus a very similar questionnaire was drawn up (see Appendix C1) and sent under a covering letter (also in Appendix C1) to the head offices of each of the learned societies of the relevant professions. They were the following:

S A Institution of Civil Engineers
S A Institute Civil Engineering Technicians
S A Association of Consulting Engineers
Institute of S A Architects
S A Institute of Electrical Engineers
S A Institute of Mechanical Engineers
S A Institute of Building
Association of S A Quantity Surveyors
S A Institute of Engineering Geologists
Institute of Landscape Architects of S A
S A Institute of Mining and Metallurgy
S A Institute of Town & Regional Planners
S A Federation of Civil Engineering Contractors
S A Institute of Agricultural Engineers
Institute of Topographical & Engineering Surveyors of S A

The objectives for the questionnaire to the learned societies were the same as those set for the questionnaire sent to the planning professionals (see p 3.4), but in addition, it was also hoped that the learned societies would be able to supply an overview of the range of environmental courses already in existence for each of the planning professions. Due to the similarity between the two questionnaires the methodological points raised in § 3.3 apply equally to the second questionnaire and need not be repeated here. By the

same token it was not considered necessary to run a pilot survey for the second questionnaire. The response rate for this questionnaire is given in table 3.2.

TABLE 3.2 Returns of questionnaire sent to learned societies

Number sent out	Number returned	% return
17	9	53

It had been the intention to use the information gained from the learned society of a particular profession as an authoritative baseline against which the information obtained from the practitioners of that profession could be assessed. In that sense a return rate sufficient to cover all the relevant professions was required. Complicating factors were firstly, that some of the learned societies represent only a section of the members of that profession (e.g. the Institute of Civil Engineering Technicians) and secondly, that some of the learned societies represent more than one profession (e.g. the S A Association of Consulting Engineers). Nevertheless it was hoped that these variations would provide detail and cross referencing which would enhance the survey.

When the returns from the learned societies were received and analysed a major shortcoming became evident. The expectation that the returns of these questionnaires would, having being answered by the governing bodies of the planning professions, represent the 'official' views of the profession concerned, was not realised. It was evident in most cases that the questionnaire had been completed by a single, albeit knowledgeable individual, who may have been requested to do so on behalf of the governing body. As a result the information received was more or less on the same level as that received from the individual practitioners in that profession, and not necessarily the authoritative, 'official' view that had been hoped and asked for.

In view of these developments it was decided not to pursue the ideal of obtaining a

response from the learned society of each of the professions involved. Instead the 53% return rate that was achieved was considered acceptable. As it turned out, these returns in any case covered those professions of immediate concern to the writer.

The results of the questionnaires to the learned societies of the planning professions are summarised in Appendix C2.

3.5 The survey directed at the environmentalists

The potential need for environmental education of members of the planning professions was a point of departure of this research. As has been explained above, it was attempted to assess this need by soliciting opinions from within the professions. However it may be argued that if members of the planning professions are in real need of environmental education, they will, as a result, not be sufficiently environmentally sensitised so as to be aware of this need. It would thus be appropriate to also ask environmentally qualified persons outside of the planning professions, whether they perceived a need for environmental education for these professions.

Consequently a third questionnaire was drawn up, again very similar to the previous two, but intended for completion by environmentally qualified persons in order to obtain an *ecological* perspective (Sterling 1990: 80-83) on the issues involved. (See Appendix D1 for a copy of this questionnaire and the covering letter.) This questionnaire was sent to some key environmentally qualified persons who, as a group, could be considered to constitute a purposive sample (Cohen & Manion 1992: 103). These persons were selected on the basis of their considerable reputations in various environmental fields. The list below, reflecting the positions held by these respondents, or the organisations by whom they are employed, or the fields in which they are active, was drawn up directly from their responses. In this report they will however be referred to, in short, as the 'environmentalists'.

Head, Environmental division
River ecology
Education, communication, social theory
Tertiary education
Environmental education
Nature conservation
Environmental management
Environmental management (Geology/Economics)
Human ecology, population dynamics
Environmental facilitation, mediation & training in environmental management
Environmental impact assessments, environmental management
Natural resource ecology, rangeland management
Environmental management
Human-environment system, eco-tourism
Environmental management
Environmental education, formal education
Environmental education, environmental psychologist, resource developer
Council for the Environment
Wilderness Leadership School
Coastal management (Botanical)
Ecology in development context (particularly aquatic systems)
Environmental education, environmental management
Environmental education
Plant ecologist, environmental education, urban nature conservation.

Again, due to the similarity between this questionnaire and the previous two, no new methodological issues arise which need to be discussed here, and for the same reason no pilot survey was conducted with this questionnaire.

The response rate to this questionnaire is given in Table 3.3.

TABLE 3.3 Returns of questionnaire sent to environmentalists

Number sent out	Number returned	% return
27	24	89

The excellent response rate to this questionnaire suggests that the environmentalists viewed the issues raised in the questionnaire rather seriously, a deduction which is borne out by the extensive comments which were added in most cases.

The results of this questionnaire to the environmentalists are summarised in Appendix D2.

3.6 The survey of South African tertiary institutions

In order to keep the investigation within manageable proportions the survey of the South African tertiary institutions was, in general, limited to environmental education open to civil engineering students. Thus, for example, the pure environmental science or geographical science programmes fell outside the scope of this investigation. As a consequence of this bias the conclusions drawn from this survey will be directly applicable to only the civil engineering profession. However the responses obtained from individual practitioners in the other planning professions (see § 4.2) indicate a fairly widespread need for environmental education in these professions. The assumption can thus be made that the remedial options that need to be investigated, should include those of a multidisciplinary nature.

3.6.1 South African universities

The main purpose here was to gather information that would reflect the present

status of environmental education for civil engineers at university level. Essentially the sources of information were threefold; responses to a letter sent to the Deans of Engineering at the eight South African universities with engineering faculties, a booklet, *South African Environmental Courses - 1993* (EPPIC 1993), compiled by the Environmental Planning Professions Interdisciplinary Committee, and university prospectuses. As the information from these sources was not uniformly structured, it required some conjectural analysis by the writer. Hence the data summaries given in Appendix E must be viewed as general trends rather than specific information. For the purposes of this analysis the data was grouped into two categories, namely that pertaining to undergraduate studies, and that pertaining to postgraduate studies.

3.6.2 South African technikons

EPPIC (1993: 24-27) lists eleven technikon diplomas or certificates which they categorise as environmentally orientated (see Appendix F). However most of these courses are application specific, for example Horticulture or Nature Conservation, and thus not suitable for the planning professions. There are only two entries that seem to have a direct bearing on the planning professions. The first of these is the Masters Diploma in Civil Engineering, but a scrutiny of its curriculum reveals that the environmental component is limited to mainly one subject, namely *Environmental Engineering T5* (NATED 1993b: 499). This subject which is directed towards pollution control, is an optional subject which, in the experience of the writer, is very seldom selected. Secondly there is the National Diploma in Chemical Engineering in which there is again only one 'environmental' subject, *Chemical Plant IIIA*, in this case dealing with aspects of industrial pollution (EPPIC 1993: 26).

Although not on the EPPIC list, one may mention the technikon architectural diplomas which, as is to be expected, deal extensively with the built environment.

However it is the considered opinion of the writer that the approach in these courses is more 'technocentric' rather then 'ecocentric' (O'Riordan 1981: 5). One may, for example, consider the subject, *Environmental Effects on Design T4* (NATED 1993b: 347), where the emphasis is on the influence of climatic conditions on architectural design, but there is little concern about the effects of architectural designs on the environment.

It is the opinion of the writer that one could safely conclude that the environmental education being offered for the planning professions at South African technikons is of minor consequence.

3.6.3 South African technical colleges

Perusal of the list of offerings at technical colleges (NASOP 1989, xi-xii, 57, 60, 63) reveals a very strong vocational orientation (as one would expect given the function of technical colleges), but also a complete lack of any reference to environmental education. This situation seems to be similar to the technical education scenario in the United Kingdom, where Potter (1981: 275-281) makes a strong plea for the inclusion of environmental studies into vocational training.

3.7 The survey of overseas tertiary institutions

The main sources from which the information in this category was obtained, were the responses received to letters sent by the writer to individual institutions. The institutions were selected on the basis of their involvement in environmental education for engineers, as firstly identified by the various foreign embassies approached by the writer, and secondly as could be ascertained from the publications, *The World of Learning* (1991) and *Higher Education in the United Kingdom* (1991), and from information provided by Patterson (1980). It is recognised that this information cannot be regarded as being

comprehensive, nevertheless it is felt that a sufficient number of institutions have been included in the analysis to reveal the general trends. The same note of caution as was raised in § 3.6.1. applies here as well. The data sources which were essentially university prospectuses received by the writer, were so diverse in their structure and content that it again necessitated a somewhat conjectural analysis of the data. However the writer feels that the major characteristics of environmental offerings for engineers at overseas institutions have been exposed, providing a useful background against which the South African practice in this regard can be analysed. Table 3.4 reflects the international spread of the institutions included in this survey.

TABLE 3.4 Overseas institutions surveyed

Country	Number of institutions surveyed
Australia	9
Belgium	1
Canada	1
Germany	1
Netherlands	2
United Kingdom	4
United States of America	15
TOTAL	34

The data has been grouped and summarised in two categories, firstly undergraduate programmes, and secondly postgraduate programmes. These summaries are contained in Appendix G.

3.8 Conclusion

All the data gathered from the various sources were summarised in the appendices already mentioned. Then the summarised data were analysed as described in the next chapter. Finally, in the light of all the information gathered, and the inferences drawn from the relevant data summaries, proposals are made in respect of environmental education for the planning professions in South Africa (see Chapter 5).

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CHAPTER 4

ANALYSIS OF DATA

> But statistics is not merely a science; the interpretation of statistics also conforms to the nature of an art ... It is, of course, in the interpretation of statistics that the real value of the subject exists (Reichmann 1971: 16).

4.1 Introduction

It must be noted at the outset that the principal aim of this analysis is to determine, from the data gathered in the surveys described in the previous chapter, whether an unsatisfied need for environmental education for the planning professions has been perceived, and if so, to order and interpret the data in such a way that it will facilitate the formulation of curriculum proposals towards meeting this need, particularly in the civil engineering discipline. Firstly the data gathered by means of the questionnaires (see § 3.3-5) will be analysed, and secondly the data obtained from the various educational institutions (see § 3.6-7) will be reviewed. As a caveat it needs to be stated that in most cases the data does not represent hard facts but rather opinions and points of view. Hence statistical tests for significance and statistical confidence limits have not been applied, and the conclusions drawn are tentative to a greater or lesser degree in sympathy with the strength of the underlying trends that have been identified in the data.

4.2 Analysis of data obtained from the questionnaires

There are three versions of questionnaire involved, the differences between them arising from the three distinct target groups to whom they were addressed. In most cases these

differences are inconsequential, but there are a few instances where a particular question has no relevance to a particular target group, and hence has been omitted in the questionnaire addressed to that group. Full copies of the questionnaires and summaries of the results obtained from them appear in the appendices listed below:

- questionnaire to planning professionals : Appendices B1 & B2
- questionnaire to learned societies : Appendices C1 & C2
- questionnaire to environmentalists : Appendices D1 & D2

The discussion and analysis of the data obtained from the returned questionnaires is mainly directed through two perspectives which are as follows:

Perspective 1: This perspective is based on a comparison of the views of the various planning professions, as obtained through the first of the questionnaires listed above. The main objective here is to assess the degree of commonality between the environmental perspectives of the various planning professions in order to identify areas where interdisciplinary solutions could be applied. Three of the professions, the town and regional planners, the land surveyors and the landscape architects are not included in the graphic comparisons due to the relatively small number of respondents in these groupings. However where appropriate, comments specific to these professions, are made.

Perspective 2: This perspective is based on a comparison of the views of the planning professions, the learned societies and the environmentalists, and is derived from the returns of **all** of the above types of questionnaires. The chief objective here is to examine the degree of disagreement between the views of the groups that constitute this perspective, mainly the planning professionals and the environmentalists. In the design of this research it was suggested that there could be areas where the views of the planning professionals and those of the environmentalists

differed significantly, and it is thus necessary to establish whether this is the case or not. In such areas where significant discordance is identified further investigation may be called for before any curriculum or other proposals in respect of these areas can be made. The problems evident in the responses obtained from the learned societies (see § 3.4) have rendered these returns ineffective with respect to their initial objective. As their numbers are also relatively small (n = 9), it is not entirely unexpected to note, in some cases, somewhat large divergences between their responses and those from the other groups included in this perspective. Any conclusions drawn for the learned societies must therefore be viewed with circumspection as they probably are of low significance, and the inclusion of this group in perspective 2 is now only of peripheral interest.

The civil engineers are included as a separate entity in perspective 2 because of their particular interest to the writer. An equally interesting inclusion in this perspective would have been the civil engineering technicians group. However to avoid the obfuscation of the main objective of this perspective, as given above, and as their numbers are relatively small (n = 15) and their responses not too dissimilar from those of the civil engineers, they have not been included.

The analysis and discussion of the questionnaire returns, on a question by question basis, now follow. For the sake of convenience the discussion of the results obtained from a question is preceded by a full quotation of the question concerned. These quotations are taken verbatim, except for minor editorial amendments, from the questionnaire addressed to the planning professionals. The numbers of the corresponding questions from the other questionnaires are noted, in brackets, in the question headings.

Question 1 (1.1)

Are the professionals in your discipline ***adequately educated*** *(i.e. thoroughly informed*

as to the impact of their professional activities on the environment in its broadest sense) in environmental matters? [Yes / no / not sure]

The overt purpose of this question was to assess the perceived need for environmental education in the planning professions. More indirectly it was also intended to set the tone and direction for the rest of the questionnaire. The summarised responses to this question are depicted in figures 4.1 and 4.2.

It is abundantly clear from these responses that the planning professionals are largely of the opinion that the environmental education within their professions is inadequate. Figure 4.2 shows that the environmentalists and the learned professions share this assessment. These results confirm the need for this research.

In summary it may said that more than 70% of the planning practitioners, more than 80% of the civil engineers and more than 90% of the environmentalists perceived the environmental education of the planning professions to be inadequate.

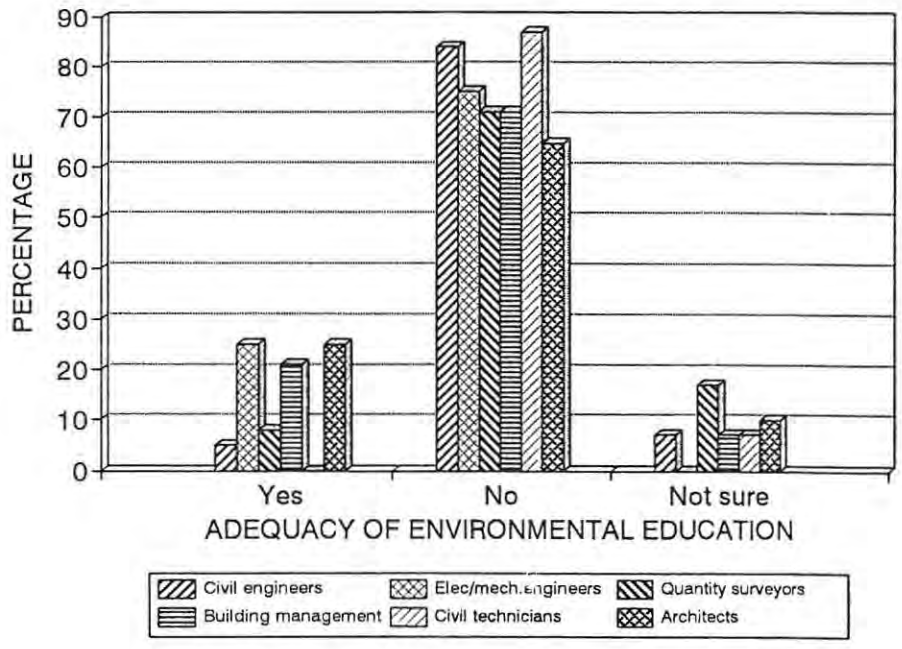


FIGURE 4.1 The adequacy of environmental education for the planning professions - Perspective 1

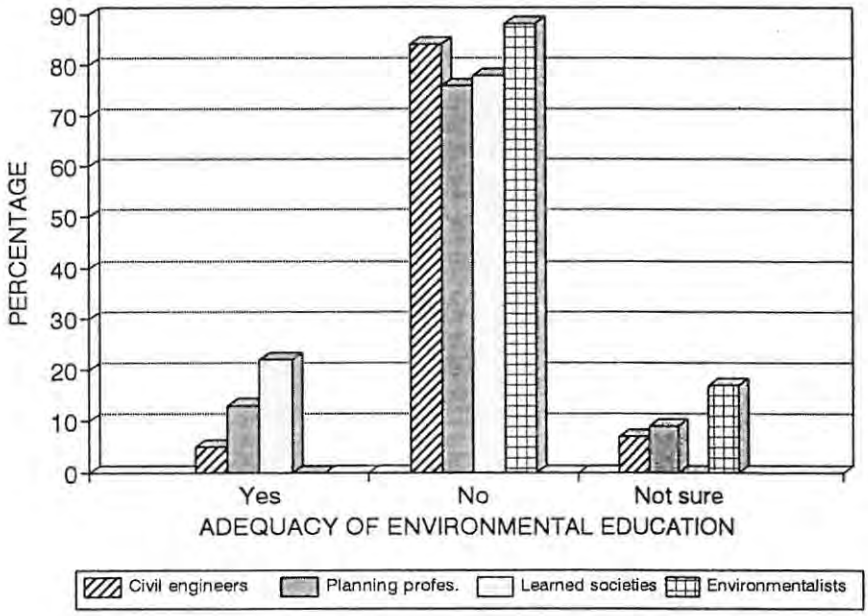


FIGURE 4.2 The adequacy of environmental education for the planning professions - Perspective 2

Question 2 (2.2)

Could the inadequacies in the environmental education of the professionals in your discipline be addressed by means of:

(a) an optional, post-first qualification (i.e. postgraduate or post-diploma) course specialising in environmental matters?

(b) amendments to the present curricula of the existing first qualification courses?

(c) both of the above

(d) any other (please specify).

The purpose of this question was to determine a suitable level at which remedial actions in respect of the environmental education for the planning professions could be introduced. Option (b) above is, by definition not available to persons already qualified, but it was hoped that the other options in this question would allow such persons sufficient scope to express their need. The responses to this question are summarised in figures 4.3 and 4.4.

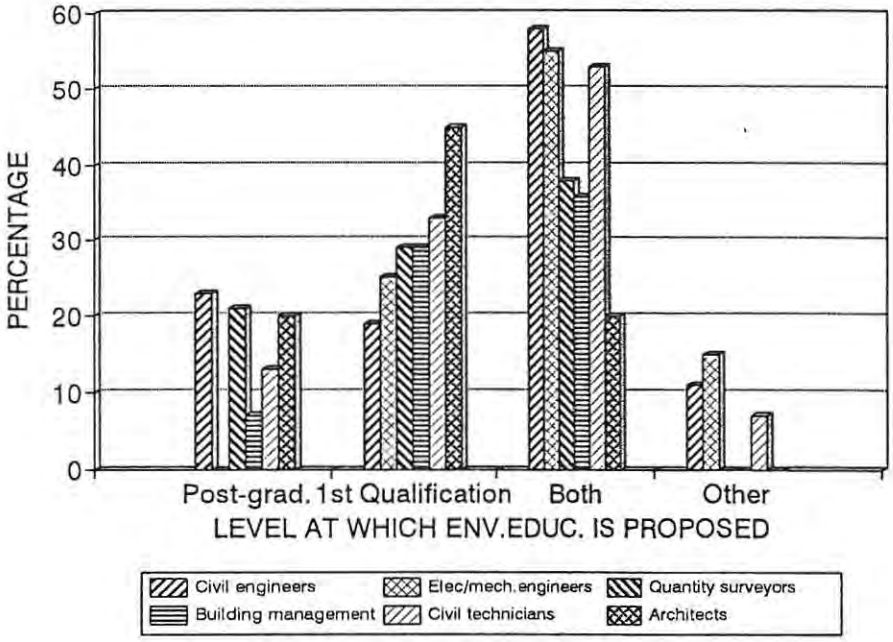


FIGURE 4.3 Levels at which environmental education for the planning professions is proposed - Perspective 1

There is some divergence amongst the planning professions in respect of the results obtained from this question, as reflected in Figure 4.3. However, the option of introducing environmental education for planners at both the first and post-first qualification levels receives the most support from all the professions with the exception of the architects. In their case, it may be argued that as their discipline is intimately involved with the built environment, they find it more desirable to have environmental education built in at the undergraduate[1] level. From Figure 4.4 it appears that the planning professions as a group and the environmentalists are in reasonable agreement on all the options. The results indicate a perceived need for environmental education at both the undergraduate and postgraduate levels, with perhaps more emphasis on the former. At the first of these two levels the needs of planners in training could be met,

[1] In this report the terms *undergraduate* and *postgraduate* are used as synonyms of the terms *first qualification* and *post-first qualification*, although it may be argued, from a strictly technical point of view, that the former do not apply to non-degree awarding institutions.

while the needs of those in practice could be addressed at the second level. This approach will allow a twofold emphasis: firstly the need for a general environmental sensitisation of **all** planners could be satisfied at the undergraduate level, and secondly there may also be a limited need for environmental specialisation for **some** planners, that could be met at the postgraduate level (see §5.4 & §5.5). (See Turner (1990: 638) for the approaches adopted at American universities.) Other options mentioned by some of the respondents included seminars, short courses, symposia and in-house training.

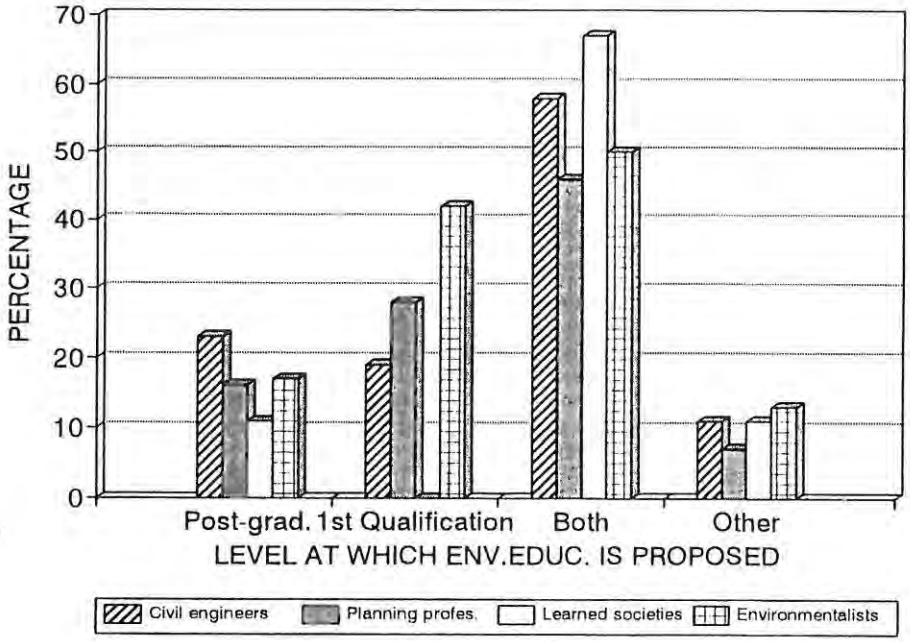


FIGURE 4.4 Levels at which environmental education for the planning professions is proposed - Perspective 2

In summary it may be said that remedial actions in terms of the environmental education of the planning professions is perceived to be required on both the postgraduate and undergraduate levels, with more emphasis on the latter.

Question 3 (3,3)

Should the inadequacies in the environmental education of the professionals in your discipline be addressed in the areas of:

(a) knowledge about the natural, and social environment?

(b) environmental concern, values and accountability?

(c) ability to communicate and work in a team in an interdisciplinary manner?

(d) any other (please specify).

This question was included in order to develop what could be the major themes in an environmental course for the planning professions. It was necessary, in the writer's opinion, to pose the **social environment** as a legitimate theme of environmental education, against the more common acceptance of conservation of the natural environment as **the** main theme of environmental education. It was also considered necessary to test the more humanistic concerns of **values and ethics** against a general perception that the planning professions operate largely, if not exclusively, in the arena of objective empirical facts. Speaking of engineers one writer put it as follows:

> The ... problem engineers have in interacting with society is that engineers are without exception positivists. ... Positivists believe that ... science is value-neutral, and ethical concerns are only expressions of emotions. ... [and further] that since true science is objective, and since ethics cannot be 'done' using the scientific method, ethical considerations have no bearing on science (Vesilind 1990: 890-1).

Another theme mooted in this question, was that of **interdisciplinary action**. The professional education and practice of planners normally takes place within clearly, and sometimes even legally, defined disciplines. In the light of this situation, and the writer's own experience, it may reasonably be concluded that most of the interdisciplinary actions that do occur within the planning professions, occur as a result of circumstances rather than a generally held belief in the value of interdisciplinarity.

None of the options given in this question were intended to be mutually exclusive, and respondents were therefore not restricted in their choice. The results obtained from this question are summarised in figures 4.5 and 4.6.

Although all the suggested themes received reasonable support, it is evident from Figure 4.5 that there was some divergence amongst the various professions with no clear pattern

emerging. Notwithstanding this variance, the theme of values and ethics surprisingly received the most support in each of the professions. This result would suggest that planners themselves are becoming aware, as is society according to Capra (1983: 30-31), of the shortcomings of the positivistic stance on a value-free science. One must also be reminded that this theme refers to **environmental** ethics, and that the planners have already indicated their general lack of environmental education in Question 1.

A number of the professions gave their least support to the theme of interdisciplinary action, it being of the order of only 20% in the fields of electrical and mechanical engineering and building management. These lower levels of support suggest some validity for the perception that planners are somewhat indifferently disposed towards interdisciplinary actions. It is the civil engineers, the quantity surveyors and the architects who record the highest levels of support in this category, which probably reflects the relatively close association in which they operate on building projects.

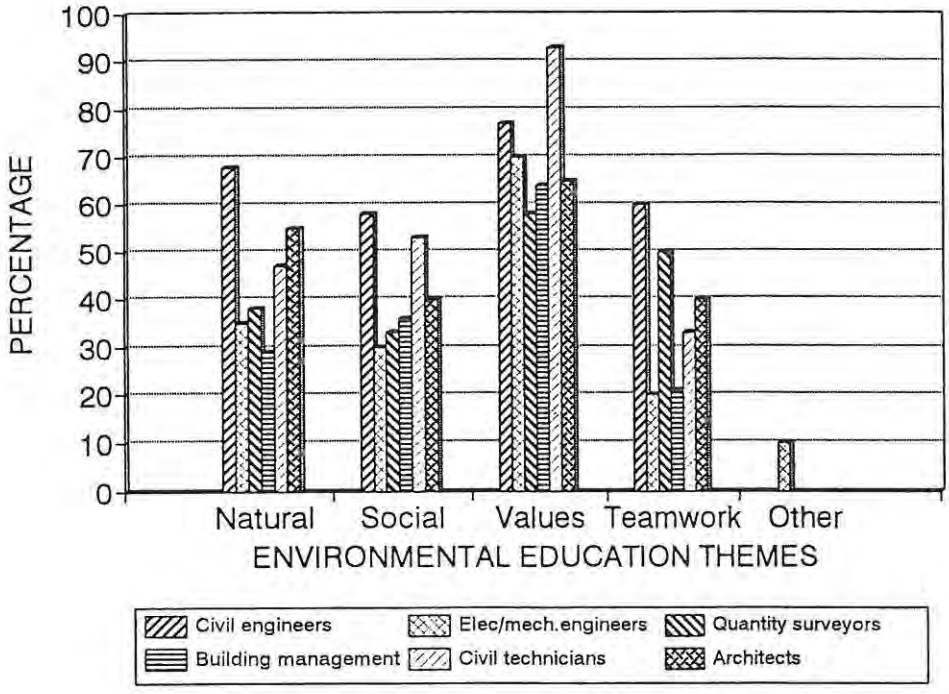


FIGURE 4.5 Environmental education themes thought necessary for the planning professions - Perspective 1

The civil engineers and the civil technicians are in relatively close agreement on most of the themes, and from Figure 4.6 it can be seen that the views of the environmentalists and the civil engineers also correspond rather well. It may be significant to note that the environmentalists lend support to all of the themes at levels in excess of 70%, which in each case noticeably exceeds the support from the planning professionals. This may be interpreted as confirmation by experts of the suggested environmental education themes for the planning professions. The 20% support by the environmentalists for the category *other* is not significant. Except for the theme of *holism,* their comments in this respect revolve mainly around ideas which fall into the *environmental topics* category of Question 6. The holism theme is taken up in Question 5 of the questionnaire.

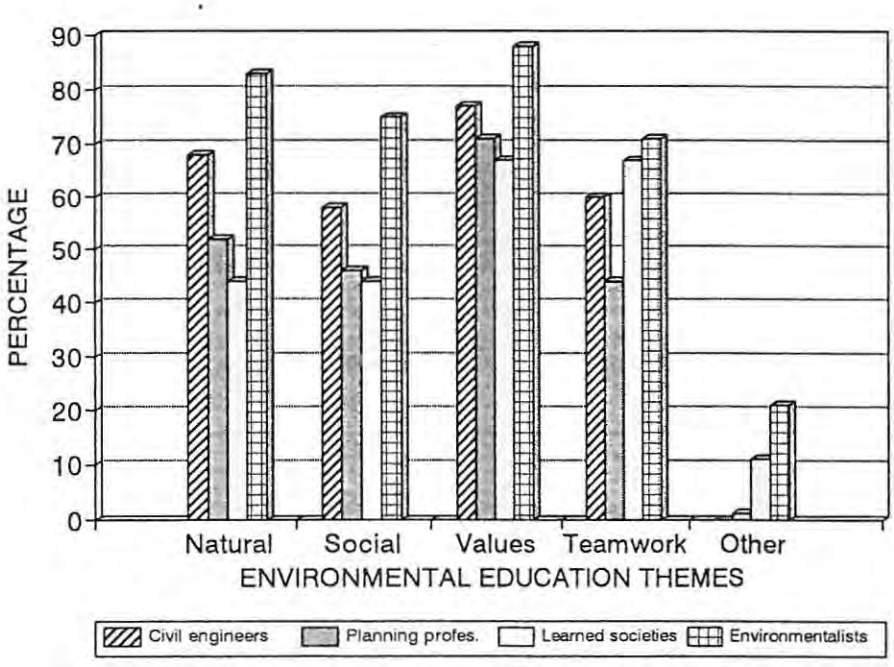


FIGURE 4.6 Environmental education themes thought necessary for the planning professions - Perspective 2

The results of Question 3 may be summarised by concluding that all the themes received reasonable support. At the bottom end of the scale the teamwork theme received just

over 40% support from the combined planning professions, with most support, just over 70%, going to the theme of values and ethics. The environmentalists strongly support, at levels of 70% or higher, all of the themes. Generally the strength of their support considerably exceeds that of the planning professions, possibly indicating an area for further investigation.

Question 4 (4.4)

If a post-first qualification specialist environmental course is indicated in question 2, could your professional discipline be accommodated in the same course as the different engineering and other related disciplines? [Yes / No / Not sure]

Although the previous question raises the notion of interdisciplinarity, it is the acceptability of a particular application of this notion, that of the multi-disciplinary composition of the attendance of an environmental course for professional planners, that is being tested here. While there may be a theoretical principle at stake here, the practical feasibility of such an arrangement also comes into question. From the point of view of a teaching institution such interdisciplinary courses should offer increased financial viability. The results of Question 4 are duly summarised in figures 4.7 and 4.8.

Figure 4.7 shows a positive response rate of between 30% and 50% to this question while the negative response rate was of the order of 10% or less. There was however a relative large grouping in the 'not sure' category, between 10% and about 40% per profession. The interpretation put to this response pattern is that the majority of the planning professionals accept the interdisciplinary approach in principle while a sizable group remain concerned about the feasibility of this approach. One respondent put it quite succinctly as follows, "While this [the interdisciplinary approach] is desirable, for practical reasons it may not be possible." In retrospect one may conclude that the construction of this question would have been better had it made explicit allowance for responses on the levels of principle as well as practice.

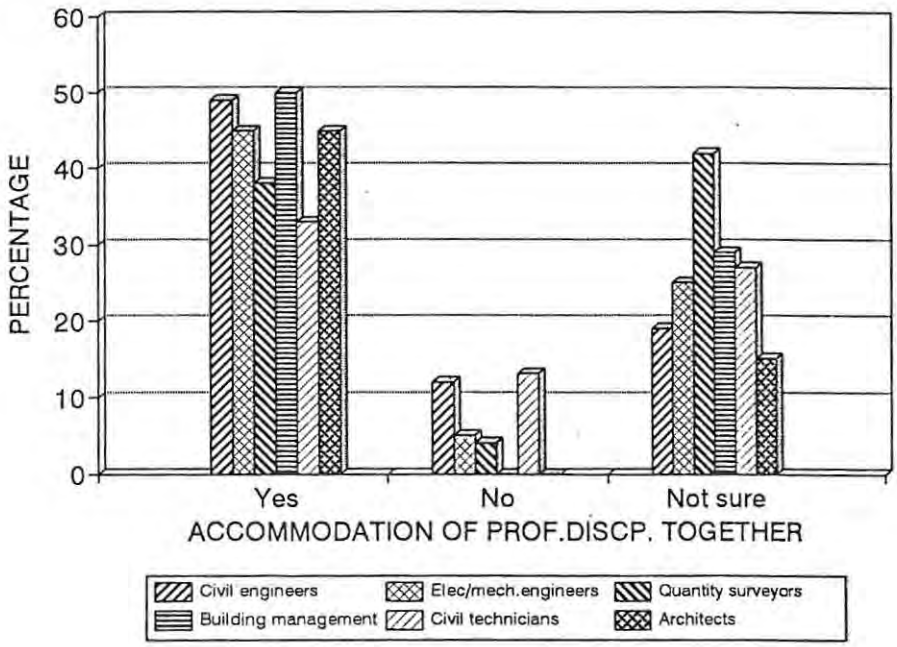


FIGURE 4.7 Accommodation of the different professional disciplines in the same environmental course - Perspective 1

From Figure 4.8 it is evident that while more than 50% of the environmentalists were in favour of the interdisciplinary approach, a surprisingly large percentage of them, 25%, were against it. This high negative response rate was more than that recorded for any of the planning professions. The comments from the environmentalists in this regard revealed their concern about being able to meet the disparate needs of the various planning professions in a common course. It was also clear from their comments however, that interdisciplinary action remained a highly desirable goal. Again one can surmise that with a better phrasing of this question the meaning of this two-levelled response from the environmentalists would have been more explicit.

To summarise: the majority of the respondents favour the interdisciplinary approach inherent in a common environmental course for the various planning professions, but there are some reservations about its feasibility.

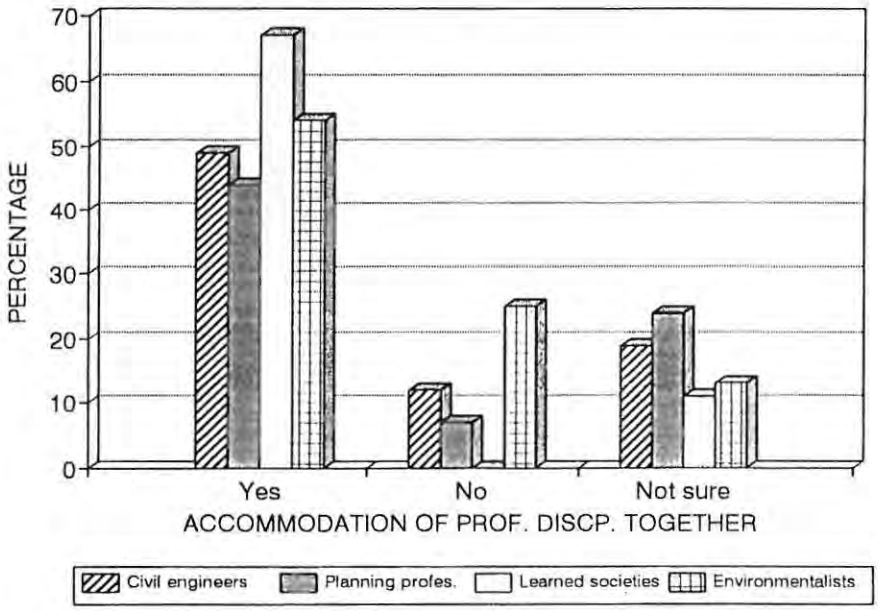


FIGURE 4.8 Accommodation of the different professional disciplines in the same environmental course - Perspective 2

Question 5 (5,5)

Is the following statement acceptable to you?

> *Special environmental courses for engineers and those from related disciplines should be* ***holistic, interdisciplinary*** *and* ***issue-based*** *to enable such persons to appreciate the fundamental significance of the* ***relationship between humans and their environment.***

To increase the reliability and the validity of the data resulting from this question the concepts, *holistic*, *interdisciplinary* and *issue-based* were defined in the questionnaires. These definitions are not repeated here, but the reader may refer to them in one of the appendices B1, C1 or D1. It may be mentioned that the concepts were defined to correspond to the context of this research.

This question attempted to test the acceptability of the given concepts as underlying principles of the environmental education of the planning professions. To some extent

these concepts echo the themes and ideas broached in questions 3 and 4, and this correspondence between the questions may be used as an indicator of *consistency* (Leedy 1974: 82). The responses to these questions do not indicate any problems in this regard.

In the writer's experience the above mentioned principles do not normally feature very strongly in the traditional training programmes of the planning professions. Notwithstanding, by far the majority of the respondents found the proposition stated in Question 5 quite acceptable. The summarised responses to this question are reflected in figures 4.9 and 4.10.

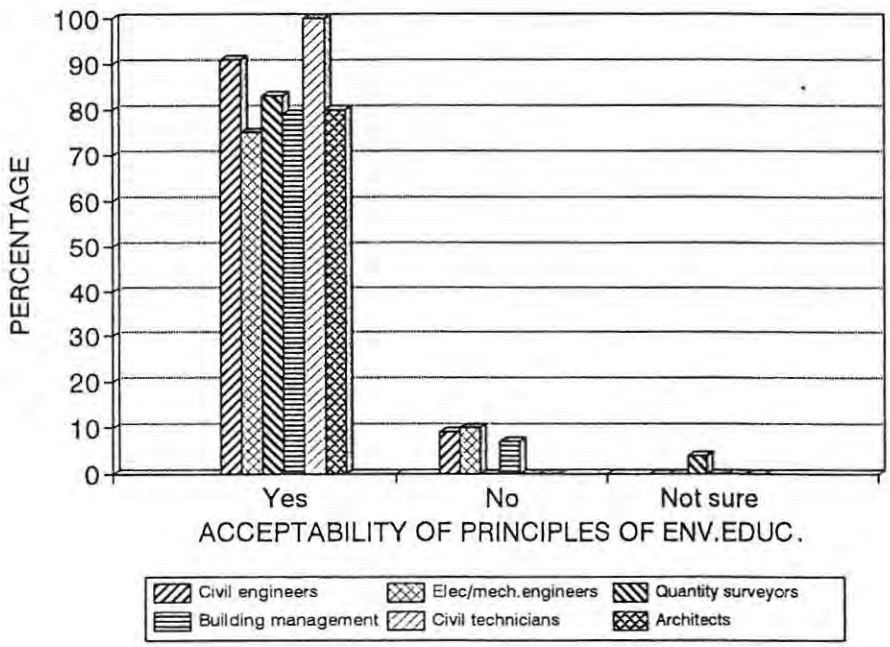


FIGURE 4.9 The acceptability of a statement of the principles of an environmental course for planners - Perspective 1

With acceptability ratings of the order of 90% in most cases, the interpretation of the responses to question 5 falls back somewhat on the comments made by the respondents. Those made by the planning practitioners were rather sparse and brief, and they generally suggested that the given statement was perhaps vague and that it needed to be

more specific. The comments from the environmentalists were far more numerous and voluminous ranging from approval of the statement to severe criticisms such as "[it is] a meaningless mix of current rhetoric that needs to be clarified". It seems reasonable to suggest that the difference between the environmentalists and the planners in respect of the extent and the nature of the comments they made in response to question 5, reflects the greater understanding that the environmentalists may have of the current discourse on environmental education, and their familiarity with the terminology.

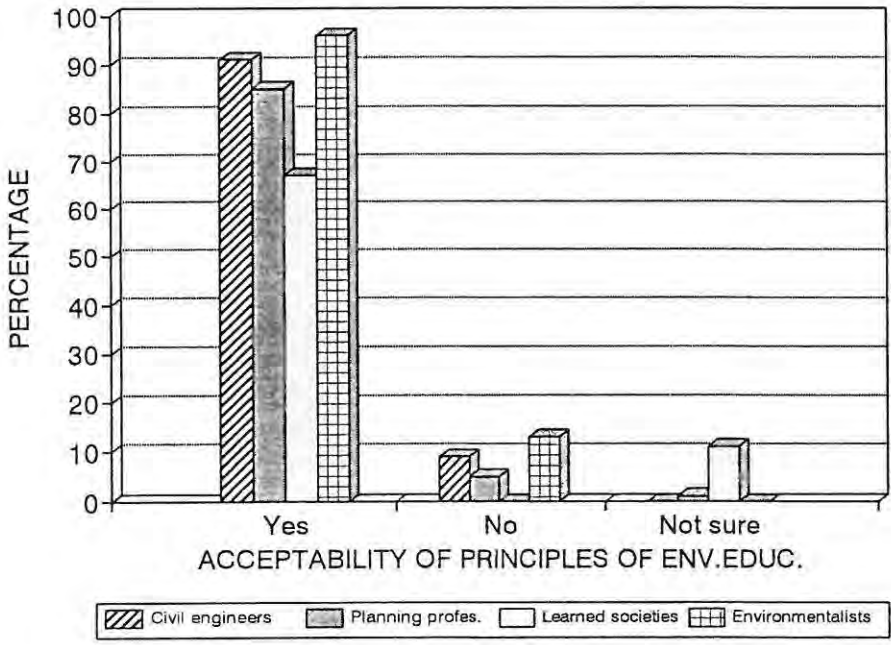


FIGURE 4.10 The acceptability of a statement on the principles of an environmental course for planners - Perspective 2

A criticism that may be levelled against this question, especially from the point of view of the planning professionals, is that it may be regarded as a leading question (Cohen & Manion 1992: 108) to which respondents, who are unfamiliar with the field of the question, may feel constrained to respond positively in order to avoid an appearance of ignorance. Notwithstanding this comment the writer feels that one may still conclude that the planners and the environmentalists generally accept the suggested underlying

principles of the environmental education of the planning professions.

Question 6 (6.6)

The list of topics below may form part of the environmental curriculum aimed at members of your profession. You may wish to add a few more. Number all the topics in order of importance as you see it, with 1 being most important, 2 the second most important, etc.

Solid waste management	*Water pollution*
Atmospheric pollution	*Nuclear pollution*
Environmental management	*Social issues*
Environmental ethics	*Environmental economics*
Ecology	*The built environment*

The purpose of this question was to gain some insight into the possible content of an environmental course for professional planners. By inviting respondents to rank the topics it was hoped to gauge the relative importance of a topic. These levels of importance could, in practice, translate into subject time allocations, or priority listings of subject electives. The list was intentionally open-ended so as to allow respondents to add, according to their own insights, important topics omitted from the original list. Thus it was hoped to acquire some idea not only of the depth, but also of the scope required of an interdisciplinary environmental course aimed at the planning professions. Although a number of respondents contributed additional topics, these contributions were not sufficiently similar to warrant their inclusion into this analysis. They will still be useful, however, when the details of the said environmental course are considered at a later stage. The data resulting from this question was summarised by averaging the rankings accorded to each topic, and these averages are depicted in figures 4.11 and 4.12.

In retrospect it appears that the ranking approach adopted in this question was not entirely successful as, in the context of the question, the rankings proved to be somewhat artificial. Although quite a few respondents gave the same rank to different topics where, in their opinion, these topics were of the same importance, it appears from the responses

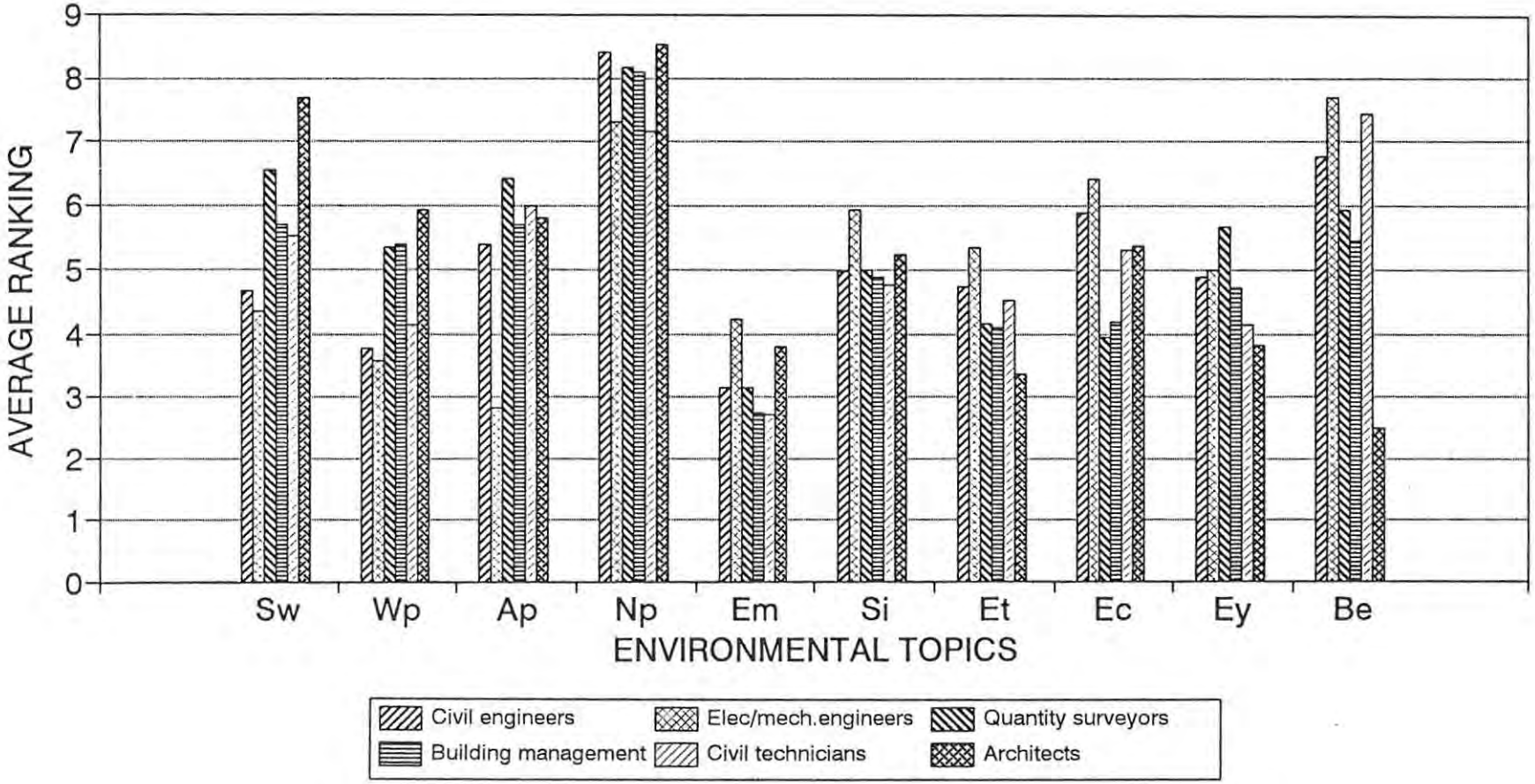
of the majority of the respondents that they may have felt constrained to maintain a ranking order of one topic per rank. This clearly is not realistic, and to the extent that respondents were inhibited by this mode of expression, the phrasing of the question must have been inadequate. Furthermore it may be argued that the resolution of a ranking scale from 1 to say 10, is unrealistically fine for the subject matter of this question. For example how does one decide on, or interpret the difference between rankings of say '3' and '6'? To suggest that the first topic is twice as important as the second seems a rather mechanical and inaccurate interpretation. The writer is of the opinion that the purpose of this question would have been better served by the use of a response scale (Cohen & Manion 1992: 316). Such an instrument could reduce the number of categories, accommodate more easily different topics in the same category, and add meaning to each of the categories. A response scale that could have been used is the following:

Very important	Important	Of less importance	Unimportant	Unsure

A further weakness of Question 6 may lie in the differing interpretations that respondents could attach to the given topics. It would have rendered the results more reliable had the topics been defined more rigorously.

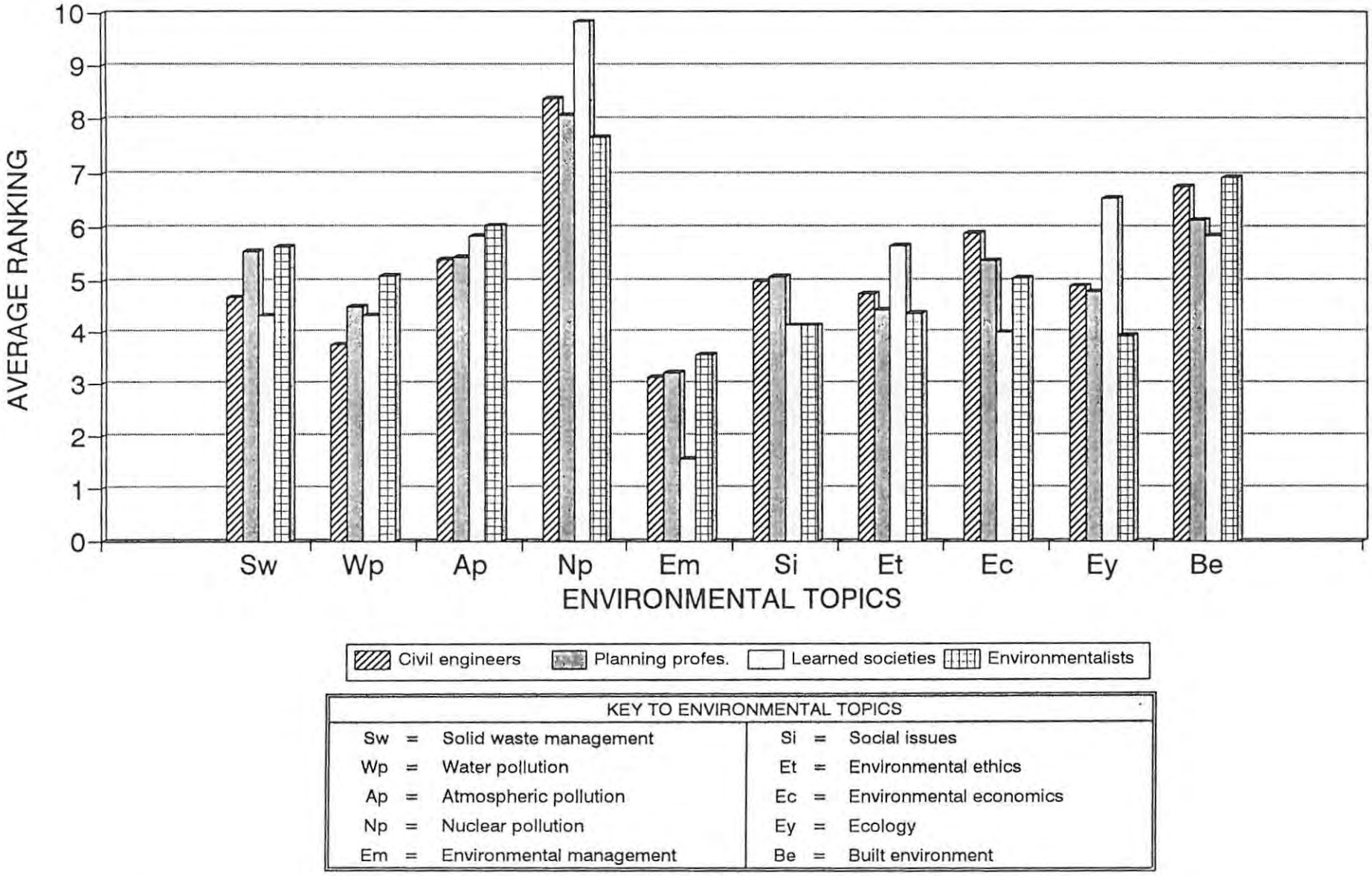
Referring to Figure 4.11 the average responses obtained from the planning professions appear to follow expected patterns, with the respondents in each discipline generally favouring those topics which are close to their professional fields. For example civil engineers rate solid waste management and water pollution highly, mechanical and electrical engineers rate air pollution as important, quantity surveyors put emphasis on economics, and architects place a high premium on the built environment. To thus meet the needs of the various professions in a common interdisciplinary environmental course will require careful thought, and possibly subject electives.

In general it can be seen that nuclear pollution did not have much support (possibly due to its lack of immediacy in South Africa), and that most of the highest ratings were accorded to environmental management. It is also important to note that some non-



KEY TO ENVIRONMENTAL TOPICS			
Sw =	Solid waste management	Si =	Social issues
Wp =	Water pollution	Et =	Environmental ethics
Ap =	Atmospheric pollution	Ec =	Environmental economics
Np =	Nuclear pollution	Ey =	Ecology
Em =	Environmental management	Be =	Built environment

FIGURE 4.11 The average ranking of topics to be included in the curriculum of an environmental course aimed at the planning professions - Perspective 1



KEY TO ENVIRONMENTAL TOPICS					
Sw	=	Solid waste management	Si	=	Social issues
Wp	=	Water pollution	Et	=	Environmental ethics
Ap	=	Atmospheric pollution	Ec	=	Environmental economics
Np	=	Nuclear pollution	Ey	=	Ecology
Em	=	Environmental management	Be	=	Built environment

FIGURE 4.12 The average ranking of topics to be included in the curriculum of an environmental course aimed at the planning professions - Perspective 2

traditional subject areas for planners, such as environmental ethics, social issues, environmental economics and ecology, enjoyed considerable support. There is sufficient congruence here to suggest that these areas might be the common areas in an interdisciplinary course for professional planners.

From Figure 4.12 it is interesting and significant to note that the emphases of the environmentalists and the planning professions are in close accord. In fact the correlation between the civil engineers, the planning professions as a whole and the environmentalists is mostly within one point on the 10-point scale. This may be interpreted as sufficient unanimity on the range of topics, as well as their relative importance, to suggest that one could have some confidence in using the listed topics as the core content around which an environmental programme for planners could be developed.

In summary it may be said that of all the given topics environmental management was considered to be the most important for inclusion in an environmental course for professional planners, and nuclear pollution was considered to be the least important. In general the traditional 'non-planner' topics such as environmental ethics, social issues, environmental economics and ecology received enough support, and sufficiently similar rankings from the planners, to suggest a common, interdisciplinary core for an environmental course aimed at the planning professions. Otherwise the topics were rated more or less in accordance with the closeness of their association to a particular discipline, suggesting areas of elective components in the said environmental course. This may appear to go against an interdisciplinary approach and may be a reflection of the reservations expressed in Question 4.

Question 7 (7.-)

What in your opinion is the preferable format for a specialist environmental course aimed at members of your profession:

(a) full time?

(b) part-time, e.g. evening classes?

(c) block release, e.g. one or two intensive weeks per term or semester?

(d) any other (please specify).

This question assumed that a specialist (post-first qualification) environmental course for professional planners would be implemented, and given that point of departure it was necessary to determine what the desirable presentation format of such a course would be. As this enquiry is directly related to the planners for whom the course would be made available, it was considered inappropriate to address this question to the environmentalists. The results obtained from this question are summarised in figures 4.13 and 4.14, the latter representing perspective 2 without any input from the environmentalists.

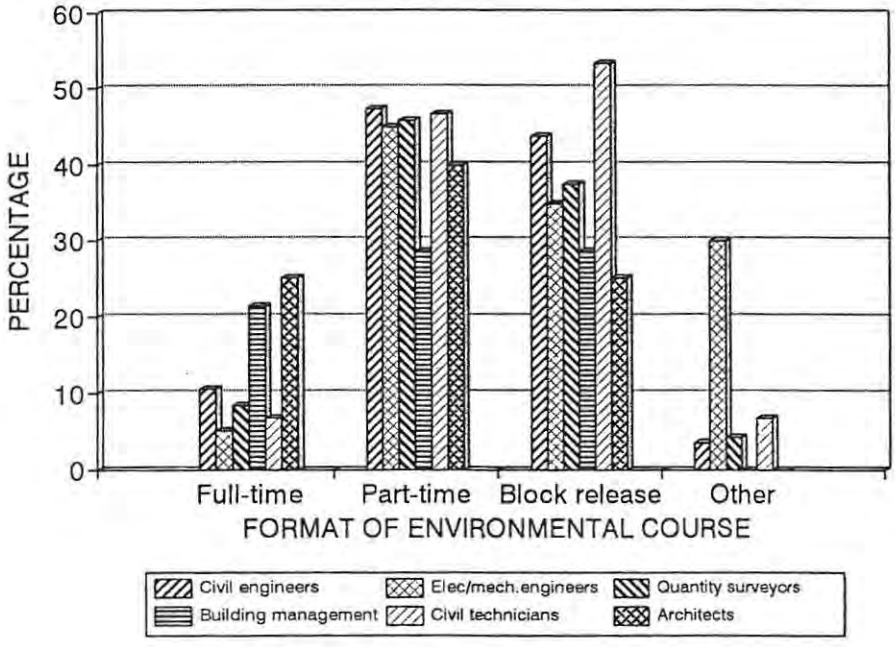


FIGURE 4.13 Desired format of environmental course(s) for professional planners - Perspective 1

It is immediately evident from Figure 4.13 that the full-time option was the least

popular, and that the part-time and block release options received the most support, with the part-time option being slightly more favoured, if only marginally so. The civil technicians were the only group which gave more support to the block release option. This could probably be explained by the format of the professional education received by the civil technicians which is of the 'sandwich' type, that is, periods of theoretical training at a technikon interspersed by periods of practical training at professional/industrial firms. Other options, suggested mainly by the electrical and mechanical engineers, include short courses, one-day or two-day seminars, correspondence courses and distance tuition. It is the writer's contention that most of these options can be accommodated to some degree within the block-release format.

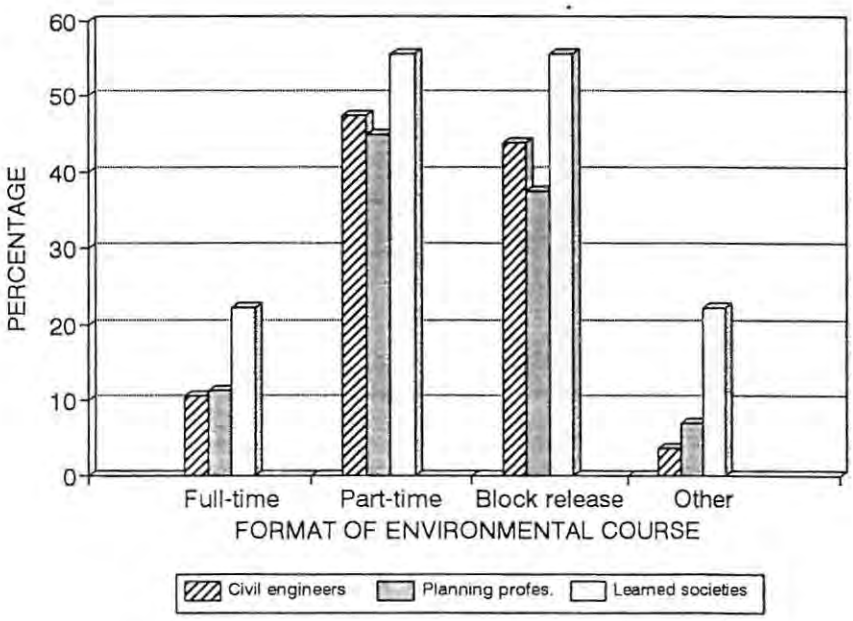


FIGURE 4.14 Desired format of environmental course(s) for professional planners - Perspective 2

From Figure 4.14 it can be seen that the learned societies do not differ substantially from the planning practitioners and that they also favour the block release and part-time options. The other options which they suggest are similar to those noted above.

In summary it may be concluded that special environmental courses aimed at the planning professions will have to be based on a part-time or block release format in order to enjoy reasonable support from these professions.

Question 8

Do you deem it necessary that you or other persons in your organisation should attend such a specialist environmental course? [Yes / No / Not sure]

This question was aimed at establishing the viability of such environmental courses as may be designed and offered to the professional planners, by directly gauging what the level of support for such courses would be. Because of its specific nature this question was only addressed to the planning practitioners and not to the learned societies or the environmentalists. The results are summarised in Figure 4.15.

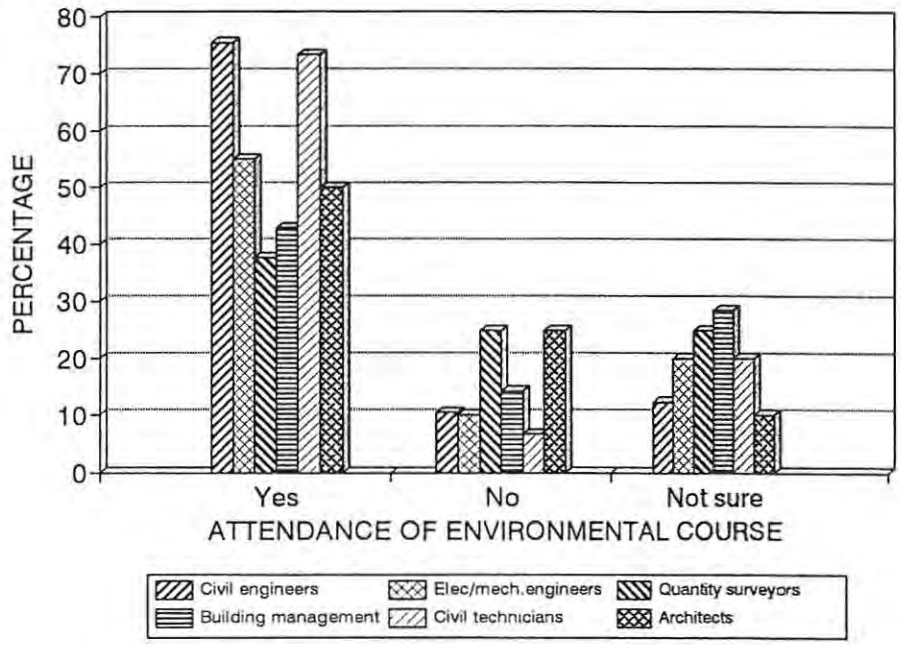


FIGURE 4.15 Potential support for attending environmental courses for the planning professions

From Figure 4.15 it is evident that the majority of the respondents support attendance

of an environmental course aimed at the planning professions. This is particularly so in the case of the civil engineers and the civil technicians, the positive response rate from both of these groups being in excess of 70%. This high level of support is attributed, at least in part, to the civil engineering origins of this research, which were made clear to all the respondents in the covering letters that accompanied the questionnaires.

Question 9 (8.7)

Do you think it appropriate for practitioners in your professional discipline to act as environmental managers, as opposed to say biological scientists? [Yes / No / Not sure]

The purpose of this question was to gauge reactions to the possibility of planning practitioners moving into areas of operation outside their traditional fields of expertise. It was thought that negative reactions could emanate from within the planning professions themselves, for example from those with a strong disciplinary bias. It was also considered possible and even likely that there might be negative reactions from those outside of the planning professions, in much the same way as planners would probably be negatively disposed towards outsiders penetrating their professions. The results to this question are summarised in figures 4.16 and 4.17.

From the figures it is quite evident that the negative responses are generally in the minority, and upon closer inspection it emerges that it was only the quantity surveyors who responded contrary to this trend. The reason for this aberration might be implicit in some of the comments received from the quantity surveying respondents. These comments were to the effect that quantity surveyors are not primarily responsible for the designs and constructions that form the basis of their professional activity, but that their work is based on the designs and constructions created by other professions within the planning fraternity.

From Figure 4.17 one can see that the environmentalists are somewhat less enthusiastic about the professional planners acting as environmental managers. While more than 70% of the respondents in most of the planning professions supported the idea, as did the

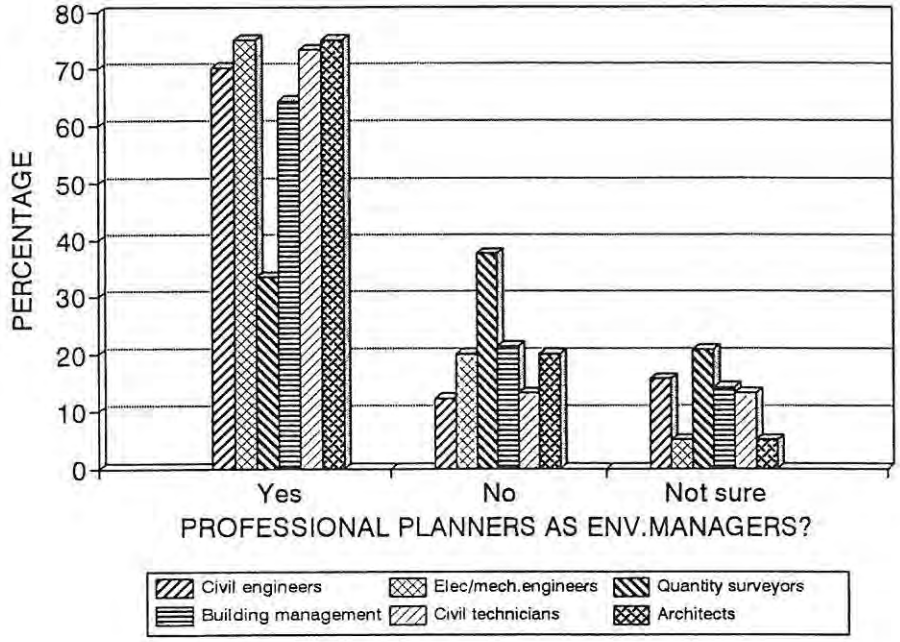


FIGURE 4.16 The acceptability of professional planners acting as environmental managers - Perspective 1

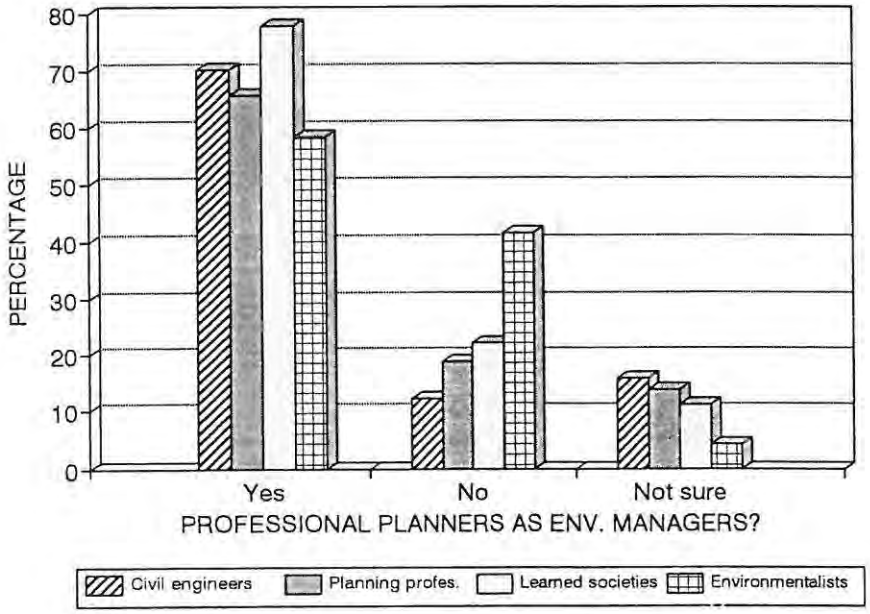


FIGURE 4.17 The acceptability of professional planners acting as environmental managers - Perspective 2

majority of the environmentalists, about 40% of the respondents from the latter group chose to oppose it. This may indicate that the concerns that motivated this question, and that were described above, were not entirely misplaced. Perhaps some of the environmentalists who function as environmental managers are indeed concerned, for whatever reasons, about planners moving into 'their' field.

In summary however it may be concluded that more than 60% of the planning professionals and more than 50% of the environmentalists were favourably disposed towards the proposition that professional planners could also act as environmental managers.

Question 10 (10,8)

What is your profession?

This question was merely included for control purposes and does not merit any further discussion.

Question 11 (11,9)

Do you wish to receive further information about the results which may flow from this investigation? [Yes / No]

The purpose of this question was to assess the demand for feedback on the progress in the establishment of an environmental course(s) for the planning professions. It also served as a useful barometer of the general interest in these matters. Extracts from this report will form the basis of the feedback that will be sent to each of the respondents who expressed the wish to receive further information. Merely as a matter of interest response rates received to this question are depicted in Figure 4.18. The positive response rates of between 80% and 100% reflected there clearly demonstrate the constructive and sometimes enthusiastic spirit in which most of the questionnaires seem to have been completed.

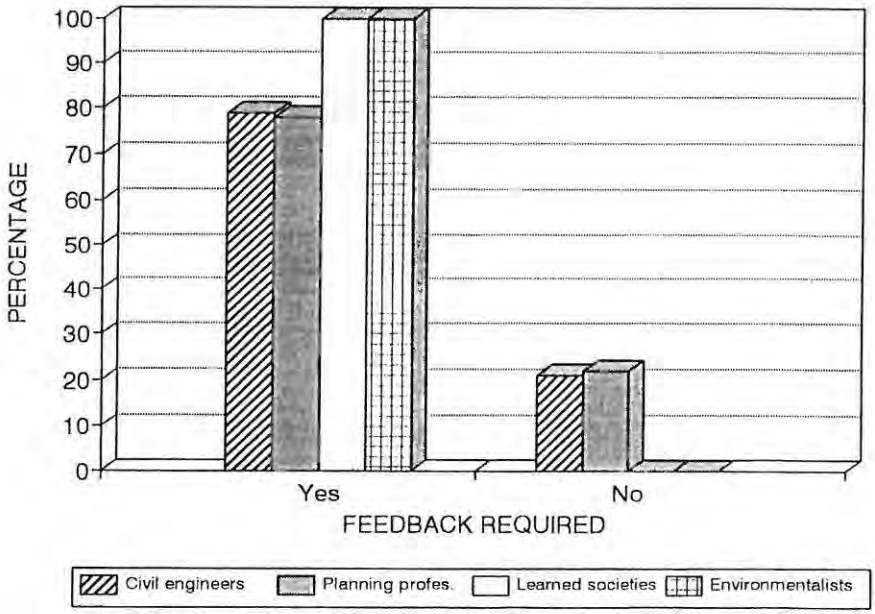


FIGURE 4.18 Requests from the respondents for feedback

4.3 Analysis of data obtained from educational institutions

The capture of the data has been explained in § 3.6 and § 3.7 and the data are summarised in appendices E and G. In view of the discussions in § 3.6.2 and § 3.6.3 no further comment is necessary on the data pertaining to South African technikons and technical colleges.

4.3.1 Undergraduate environmental engineering education at universities

As far as undergraduate courses in engineering are concerned, it is evident that South African universities have not as yet introduced bachelor degree qualifications in environmental engineering. The South African undergraduate data are thus derived from civil engineering programmes, and consequently are not comparable to the data on undergraduate studies at overseas universities, which are based on

engineering programmes.

There are six undergraduate civil engineering programmes at South African universities which incorporate a designated environmental component into their curricula, that is over and above such traditional engineering areas as water and waste water treatment. The average academic credit accorded to these components only amounts to 1,7% of the total required credits. The environmental component is mostly introduced into the curriculum in the subject areas of environmental management or project planning in the third or fourth year of the course concerned.

Attention will now be focused on the undergraduate environmental engineering programmes at overseas universities, some of the more salient features of which are summarised in the following three figures. Figure 4.19 indicates that the full-time format is the most prevalent with more than 90% of the programmes in this survey being run on that basis. This trend is almost equally strong in the various postgraduate programmes investigated (see Figure 4.22) and contrasts strongly with the need expressed in the survey conducted amongst the planning professionals (see figures 4.13 and 4.14). This discrepancy suggests an area for further investigation.

Figure 4.20 depicts the main thrust or direction of the environmental engineering programmes at the overseas universities that were included in this survey. The given categories are not mutually exclusive but rather suggest leading tendencies within the programmes concerned. In the context of these categories environmental engineering refers to an environmental problem-solving approach which focuses mainly on pollution abatement. Not unexpectedly, this was the most prevalent direction amongst the programmes surveyed. A more traditional civil engineering approach, that is broad-based with more emphasis on conventional civil engineering subjects, was also quite strongly in evidence. The other categories of environmental science, resource engineering and water engineering only featured as the main focus in a minority of programmes.

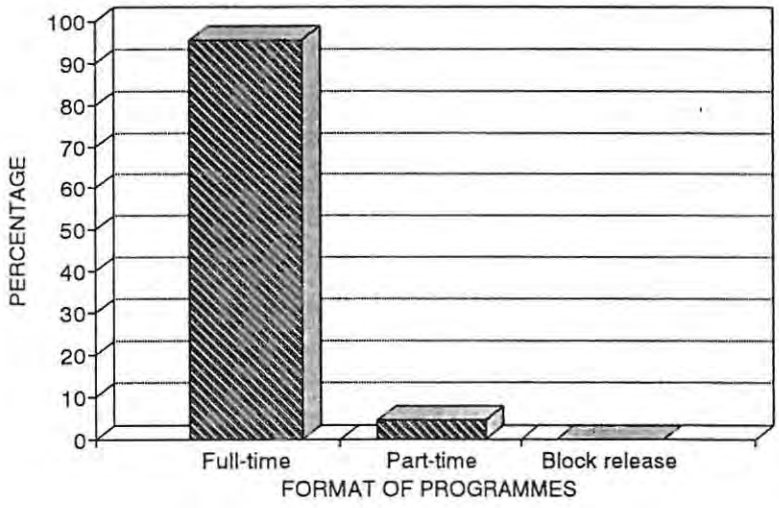
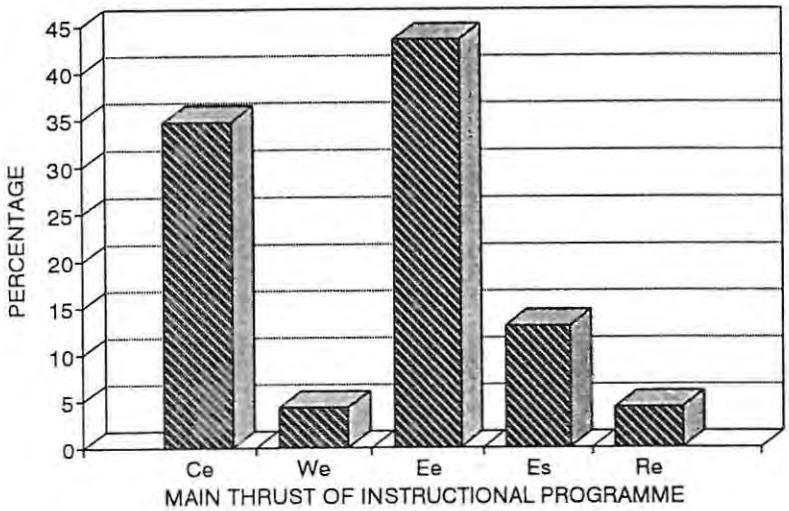


FIGURE 4.19 Format of the undergraduate environmental engineering programmes at overseas universities



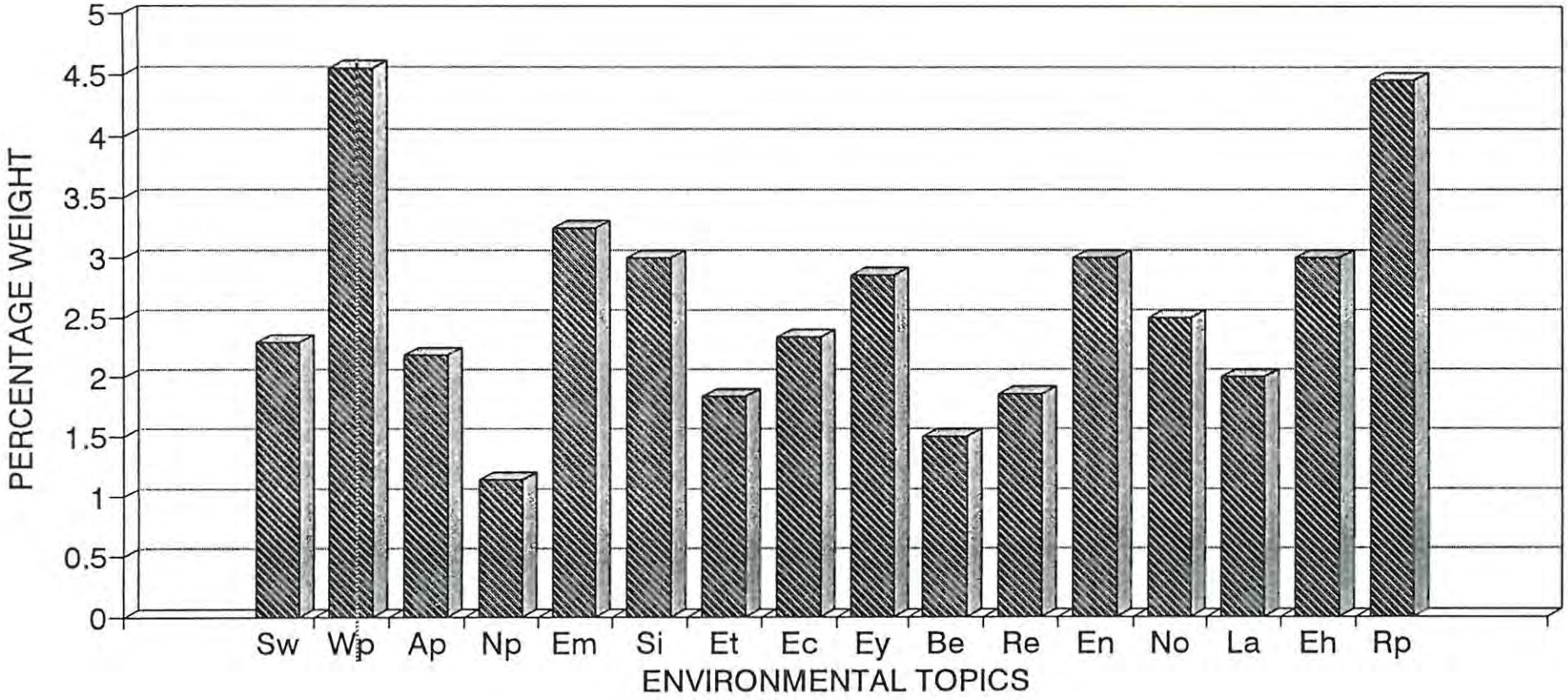
KEY TO PROGRAMME DIRECTIONS	
Ce = Civil engineering	We = Water engineering
Ee = Environmental engineering	Es = Environmental science
	Re = Resource engineering

FIGURE 4.20 Main thrust of the undergraduate environmental engineering programmes at overseas universities

Figure 4.21 depicts the academic credit weighting (as obtained from institutional prospectuses) of selected environmental topics in the undergraduate environmental engineering programmes that were reviewed. These are average weights but it is necessary to raise a word of caution here. The average for a given topic is derived only from those programmes that have that particular topic included in their curricula. No zero weights were accorded on the grounds of there being insufficient information to make such assessments. The result is that Figure 4.21 can be described as the average of the best of all the programmes and as such almost represents an ideal rather than real situation. The wide spread of topics that feature and their relatively even credit weighting is indicative of strong multi-disciplinary approaches. Water pollution emerges as the topic with the highest credit weighting, and this is not entirely unexpected, as it could be a component in all of the categories given in Figure 4.20. Although the research project components of the curricula also received relatively high credit weights, the required content of such projects was mostly not defined in the sources consulted. However, given the nature of these programmes, it is safe to conclude that the projects will be based on environmental issues.

4.3.2 Postgraduate environmental engineering education

The results from the investigation into postgraduate environmental engineering education is presented as a three dimensional comparative analysis. The position at South African universities is compared to the positions at American and non-American universities. The latter division comes about due to the heavier emphasis that the American postgraduate programmes place on pollution abatement procedures, and this changes the character of these programmes somewhat compared to the non-American programmes. A word of caution is also necessary in respect of the South African data, which, being derived from a small number of sources ($n = 6$), could be sensitive to the influence of extreme values.



KEY TO ENVIRONMENTAL TOPICS					
Sw	=	Solid waste management	Ey	=	Ecology
Wp	=	Water pollution	Be	=	Built environment
Ap	=	Atmospheric pollution	Re	=	Resource engineering
Np	=	Nuclear pollution	En	=	Energy
Em	=	Environmental management	No	=	Noise
Si	=	Social issues	La	=	Law & legislation
Et	=	Environmental ethics	Eh	=	Environmental health
Ec	=	Environmental economics	Rp	=	Research project

FIGURE 4.21 Average academic weight of environmental topics in the curricula of undergraduate environmental engineering programmes at overseas universities

Figure 4.22 depicts the postgraduate programme formats, and as in the previously mentioned cases, the full-time option is again by far the most prevalent, and South African universities are very much in line with their overseas counterparts. The reader is reminded that the South African planning practitioners surveyed indicated their preference for the part-time or block-release formats (see Figures 4.13 & 4.14).

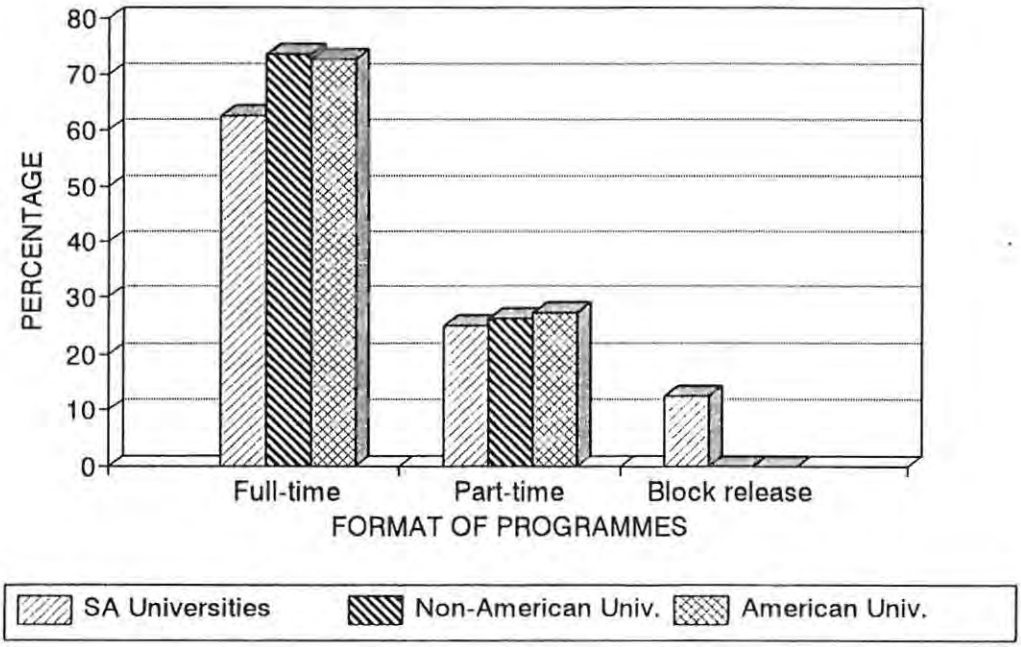


FIGURE 4.22 Format of postgraduate environmental programmes for engineers

Figure 4.23 compares the disciplines that allow entry into the environmental education programmes that were surveyed. Given that the programmes were selected on the basis of their availability to engineers one would expect engineering disciplines to feature prominently, which indeed they do for South African and American universities. However, the non-American institutions are more open in this respect as only about 25% insist on an engineering background, 40% accept either engineering or science backgrounds, and about 34% are open to various

disciplines which may include the social sciences. As an aside it may be noted that overseas universities appear on the whole less discipline bound than South African universities seem to be. Many of the overseas institutions have humanities credit requirements in their engineering curricula. Ardis (1990: 19) reports that on average a 15% component of the undergraduate civil engineering programmes at American universities is devoted to humanities and social sciences.

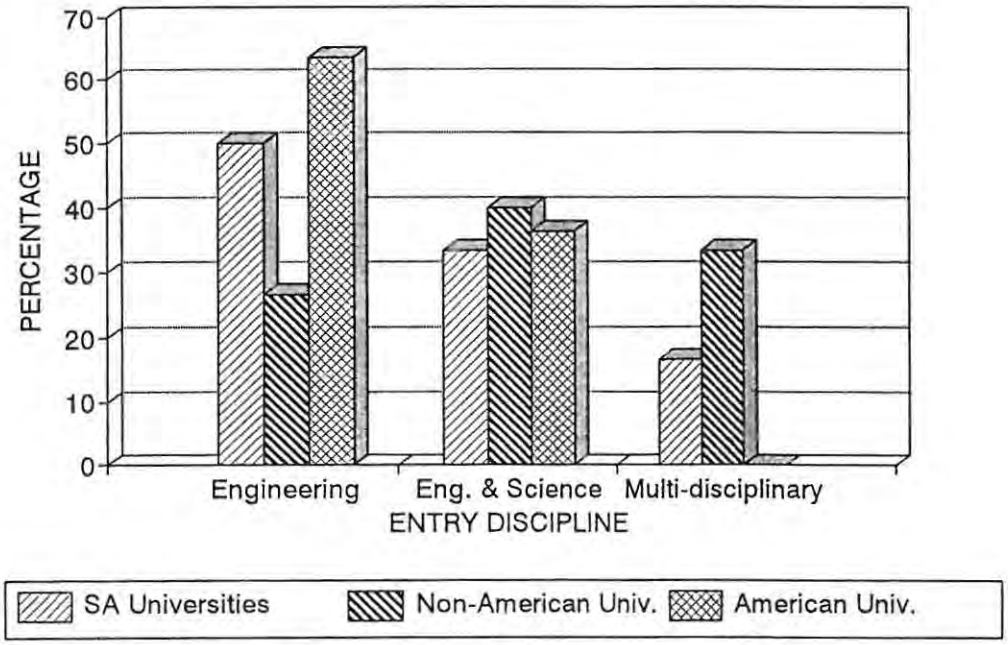
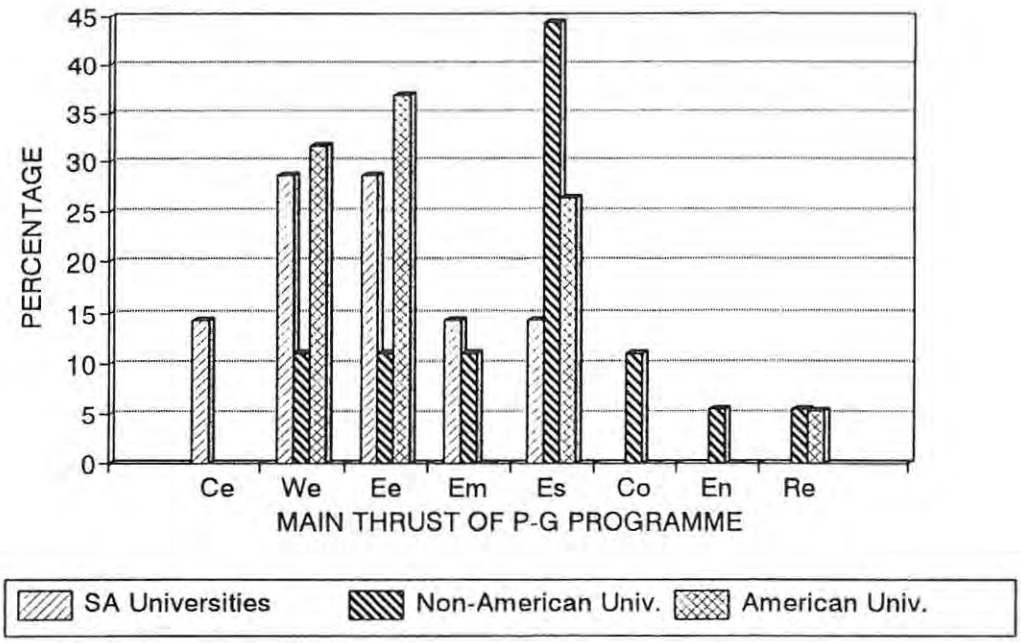


FIGURE 4.23 Postgraduate entry discipline requirements

When comparing the main direction of the postgraduate programmes surveyed (see Figure 4.24), the non-American institutions again exhibited different emphases. Both the American and South African universities had a stronger engineering bias, while the non-American universities tended towards an environmental science orientation with correspondingly less emphasis on the engineering directions. It emerged from this survey that South African universities offered postgraduate environmental education mainly through civil engineering programmes, but

overseas institutions did so chiefly through environmental engineering or science programmes. Turner (1990: 642-3) confirms this trend for American universities. This could be a pointer for the South African environmental education practice in respect of the civil engineering discipline.



KEY TO PROGRAMME DIRECTIONS					
Ce	=	Civil engineering	Em	=	Environmental management
Co	=	Conservation	Es	=	Environmental science
Ee	=	Environmental engineering	Re	=	Resource engineering
En	=	Energy	We	=	Water engineering

FIGURE 4.24 Main thrust of postgraduate environmental engineering programmes

A feature of some of the overseas institutions which seemed to be a more recent development, is the establishment of environmental departments as entities in their own right, separate from other university departments. A particular characteristic of these departments is their strong multidisciplinary commitment. They accept, for

example, graduate students from various disciplines for postgraduate study, they make use of the staff from a variety of departments within the university, and they have formal access to many departmental laboratories across the university campus.

Figure 4.25 depicts the average academic credit weighting accorded to various environmental topics in the postgraduate programmes surveyed. (The same caution in the interpretation of 'average' applies here as was raised earlier - see p 4.30) The heavier emphasis of the American universities on pollution control is again evident in the credit weights they average in these areas (see also their preference for environmental engineering in Figure 4.24). The non-American universities follow a more 'balanced' approach, with a wider array of topics, most of which are given fairly even academic credits. The South African universities are comparable to their non-American counterparts in the relatively lower emphases that they place on the issues of pollution. On the other hand, they are somewhat limited in the range of topics that they offer. A research project weighting of between 20% and 30% seems to be the general norm.

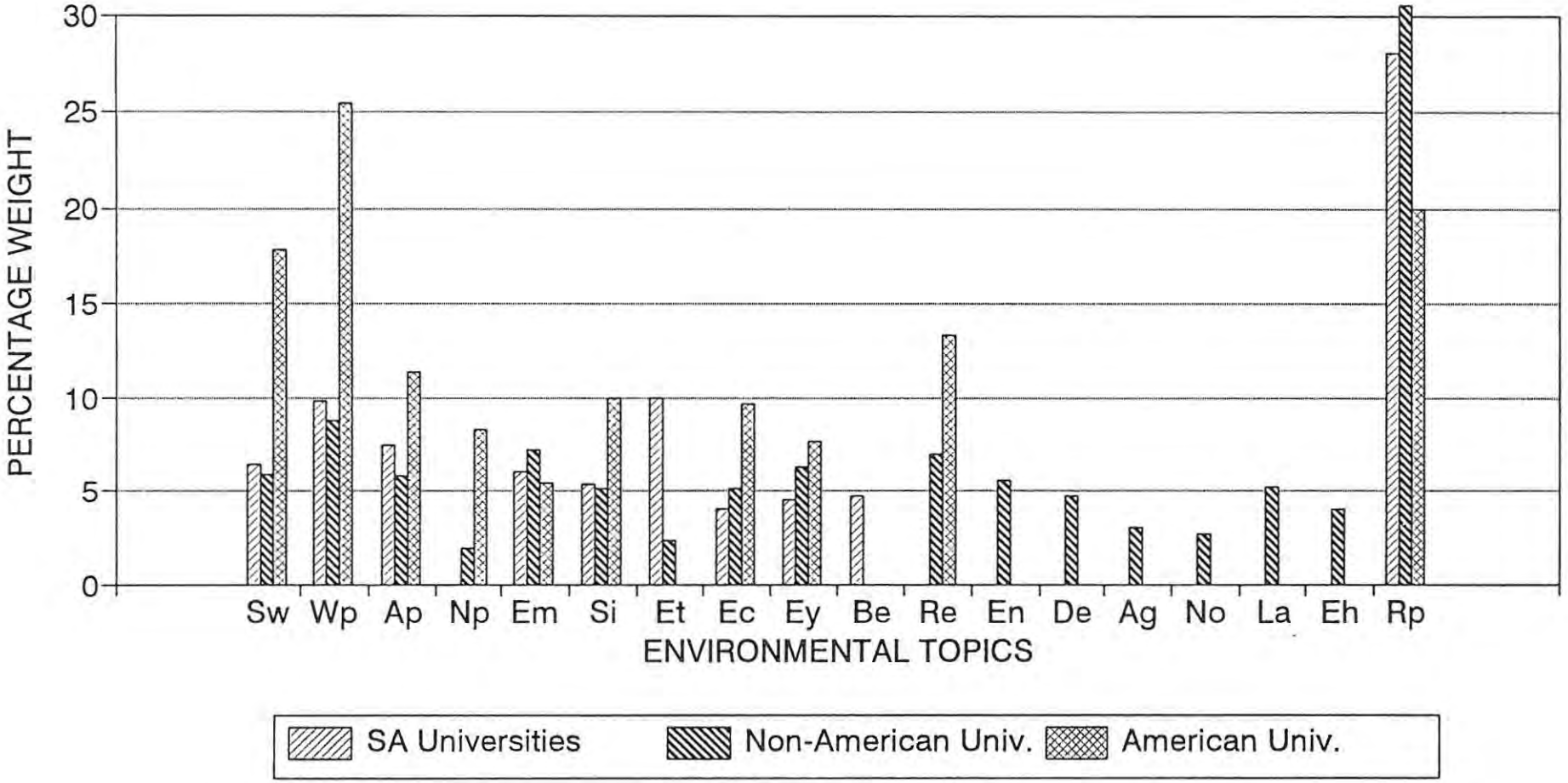
4.4 Main findings

This chapter is concluded with a summary of the main findings arising from the surveys.

1. There was amongst the respondents a widely held perception that environmental education for the planning professions was needed.

2. This perceived need for environmental education in the planning professions was regarded by most respondents to be best addressed on **both** the first qualification and post-first qualification levels.

3. That environmental education for the planning professions should encompass the natural and the social environments was generally accepted by the respondents.



KEY TO ENVIRONMENTAL TOPICS		
Ag = Agriculture	Em = Environmental management	Np = Nuclear pollution
Ap = Atmospheric pollution	En = Energy	Re = Resource engineering
Be = Built environment	Et = Environmental ethics	Rp = Research project
De = Development	Ey = Ecology	Si = Social issues
Ec = Environmental economics	La = Law & legislation	Sw = Solid waste management
Eh = Environmental health	No = Noise	Wp = Water pollution

FIGURE 4.25 Average academic weight of environmental topics in the postgraduate curricula offering environmental education to engineers at overseas universities

4. There was general support amongst the respondents for the proposition that specialist environmental courses for the planning professions should be holistic, interdisciplinary and issue-based.

5. The respondents generally supported, with some variance between the disciplines, the following topics for inclusion into an environmental course for planners:

environmental management	environmental ethics
social issues	ecology
environmental economics	pollution
built environment.	

6. The full-time course format was the most common existing format amongst the institutions surveyed, but the planners, in their survey, favoured the part-time or block release type courses.

7. In general the respondents were favourably disposed towards the suggestion that professional planners act as environmental managers.

8. While it can be said that the responses from the environmentalists were generally more 'environmentally orientated', the degree of agreement between the planning professionals and the environmentalists would not suggest a serious conflict of opinion.

9. The survey of environmental education programmes for engineers at tertiary institutions indicated:

   - that the overseas programmes, particularly at non-American institutions tended to be broader in scope than the South African programmes

   - that the programmes at American universities tended to concentrate on pollution control

- that there is a tendency towards allowing multi-disciplinary entry into postgraduate programmes, particularly at non-American universities.

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CHAPTER 5

CURRICULUM PROPOSALS

> ... it is evident that environmentalism can be learned and taught as a subjective, deeply committing personal exercise, or as an objective non-involving run-of-the-mill academic experience, or somewhere in the great void in between (O'Riordan 1981: 4).

5.1 Introduction

In this chapter proposals towards an environmental education curriculum for the planning professions will be made. These proposals are based on the survey results presented in the previous chapter, information gathered from various literary sources and the writer's own experience, both as a civil engineering practitioner and educator. The presentation of these curriculum proposals and the associated discussion is organised under the following headings:

- context
- main themes
- first qualification proposals
- post-first qualification proposals
- broader curriculum issues.

5.2 Context

The curriculum proposals in this chapter are made in a context determined largely by the educational practice of the writer. At its core this context is that of civil engineering

education as practised within the organisational structure of a technikon. This, in turn, can be seen against the larger background of the tertiary education of the planning professions in general. It is suggested here that the proposals which are developed within the micro-context of technikon-based civil engineering education, may have wider significance in the associated macro-context of the planning professions.

The official policy in respect of national instructional offerings at South African technikons is governed by the Department of National Education (NATED 1993a). One of the main requirements is that these instructional programmes should be vocational in character (*Ib.* 9-12). The qualifications obtainable from technikons are by and large national diplomas and certificates, the curricula of which are common to all the technikons that offer these particular qualifications (NATED 1993b). In general a curriculum lays down the structure of an instructional programme with particular emphasis on the subjects included within that programme. The subject syllabuses, while not part of the official NATED documentation, are required to be available at technikons and must contain "the broad subject content, properly arranged according to core themes in accordance with the needs of the vocation/industry in question and local circumstances but retaining the subject content's national character" (NATED 1993a: 8-9). In order to facilitate the procedures involved in establishing or amending curricula a chairing technikon is appointed for each field of study and/or discipline. Although any technikon is free to initiate changes to a curriculum, the chairing technikon will normally carry through the formal procedures necessary to legitimate these changes. (The Port Elizabeth Technikon is the chairing technikon for the civil engineering discipline.) Changes to curricula can only be effected after all the technikons, the industry and vocational bodies in question have been consulted. The chairing technikon will submit the consolidated curriculum proposals or amendments to the Committee of Technikon Principals from whence these are conveyed to the Department of National Education, the Universities and Technikons Advisory Council and eventually the Minister of National Education, for final approval (*Ib.* 22-23).

Such proposals as may emanate from this research, and which are aimed at establishing

a new environmental curriculum within the civil engineering discipline, will have to follow the path outlined above. To the extent that these proposals have an interdisciplinary character, it is possible that some of the environmental education needs of the other planning professions may be accommodated. It remains however for these professions to react to these proposals, or to the data gathered during the course of this research, as they see fit. As relatively autonomous institutions the South African universities may each develop their own unique responses to the environmental education needs of the planning professions. Indeed, from the information gathered during the course of this study, the writer has gained the impression that these actions are already under way.

5.3 Main themes

The main themes which are proposed for the environmental education of planning professionals, and which are derived from the general definition and principles of environmental education as outlined in chapter 1, have been accorded general acceptance through the questionnaire surveys previously described. A listing of the themes is given below and that is followed by a brief discussion of each. The themes are:

- the natural environment
- the social environment
- environmental ethics
- holism
- interdisciplinary action.

Environmental education which does not address the **natural environment** is quite unthinkable. Has not people's concern for nature been the historical springboard that has led to our modern perceptions of environmental education? This theme has particular relevance to the planning professionals, as it is, more often than not, the impact of their designs and constructions on the natural environment that causes them to be labelled as

environmental destructors. Speaking of engineers Khanna (1993: 6) says that they "have helped create, out of the natural resources of our planet, an urban civilization with a stupendous array of goods and services for our comfort and entertainment", but "they are leaving behind a trail of massive waste, poisoning and destruction of our natural world". Yet the civil engineering programmes at technikons, and perhaps to a lesser extent at South African universities, are virtually devoid of material pertaining to the conservation of the natural environment. The writer has reason to believe that in this respect, the training of most of the other planning professions may be deficient as well. To counter this situation a curriculum objective, aimed at developing a concern for the natural environment among planning professionals, is called for. This concern will spring, at least in part, from a base of factual knowledge about the natural environment and how the planning professions impact on this environment.

In relation to their impact on the **social environment** engineers generally perceive themselves as striving "to place the public good paramount in their professional practice ... [but] they often find themselves in conflict with the public" (Vesilind 1990: 887). It is suggested here that the seeds of this conflict are sown by default in the engineering training programmes where engineering students are inadequately exposed to the social sciences. The civil engineering programmes at technikons do address aspects of the social environment, but mainly in the context of the management of human resources towards the implementation of engineering goals. The broader social impact of engineering projects are not fundamentally considered. It is argued that this lack of a deeper social understanding allows engineers to define problems "more in terms of a narrow understanding of possible technical situations than broader social needs. Engineering then adopts the role of defining social limits rather than assisting social dreams" (Priscoli 1983: 137). While these comments are made in reference to engineering, the surveys conducted by the writer would suggest that they may apply more widely in the planning professions. Although one may expect more emphasis on the social environment in the training programmes of the architectural and the town and regional planning professions, Figure 4.11 suggest that there is not much difference between the various planning professions in this regard.

Writers such as Khanna (1993), Prendergast (1993), Stimpson (1991) and Gunn & Vesilind (1990) are all calling for a new **environmental ethic** for engineers.

> A truly professional engineer will infuse [environmental] ethics into his/her decision-making, and with the increasing pressure on the natural environment, a growing population, and accelerated technological development, environmental ethics will play an ever greater role in the engineer's role in society (Gunn & Vesilind 1990: 39)

Such ethical considerations as are currently included in the instructional programmes for the planning professions, normally find expression in a discussion on professional ethics where the Code of Conduct of a profession is the essential matter of concern. It appears that ethics in general, and more specifically environmental ethics, is seldom if ever explored to any great depth (Evans 1990:994). By highlighting ethics as a major theme of an environmental programme for professional planners one would hope to ensure a prominent role for it in the curricula concerned.

The principle of **holism** is fundamental to environmental education (see the definition and principles of environmental education in Chapter 1). Holism counters the tendency of engineers and planners towards reductionism where the whole is only understood to be the sum of its parts. Khanna (1993: 6) coins the phrase *holistic engineering*, which "implies treating the works of man and the natural environment in which they are embedded as a single system, a whole, so that the whole remains healthy". It could be argued that systems engineering is already an established concept and an accredited part of some engineering courses (Ardis 1990: 20), even though engineering educators may still be searching for more appropriate ways of incorporating it into engineering curricula (Samson 1990, Jewell 1990). It is, however, the writer's perception that the systems considered in systems engineering are generally still viewed too narrowly, usually excluding such components of the natural and social environments as are not amenable to numerical expression - hence Khanna's call for holistic engineering.

The **interdisciplinary nature** of environmental education flows from the principle of holism, and it is promoted by many authors (Buzzati-Traverso 1977: 13; Irwin 1991: 17; Clacherty 1990: 40; Blignaut 1991: 9). For the planning professions it can at the very

least improve communications and dilute prejudice between these various professions. This interdisciplinary stance should however not only prevail between the various planning professions but also between planning professionals and environmentalists. The suspicion that exists between these groups has been alluded to in chapters 1 and 2, and it should be resolved in order to promote combined environmental actions.

> Many projects which address complex problems ... will require specialists from many disciplines working together to solve the problems. Communication among team members, as well as the need for someone to integrate the efforts of the team members, will require more interdisciplinary education for civil engineers [or other planning professionals], if they are to be participants, let alone leaders, in these teams (Smith & Samson 1990: 678).

5.4 First qualification proposals

The questionnaire surveys conducted by the writer revealed that the respondents supported the introduction of environmental education for the planning professions at both the first qualification and post-first qualification levels. In this section curriculum proposals relevant to the first qualification level will be put forward.

It is proposed here that the general objective of environmental education for the planning professions at first qualification level should be to increase the **environmental sensitivity** of newly qualified professional planners (see p 4.7). This implies that the existing subject material in the training programmes of the planners needs to be handled in such a way as to promote environmental sensitivity. If this approach is followed it implies in turn that all lecturers in the planning disciplines should not only be capable of following such an 'environmental' approach but also willing to do so. It seems obvious that this will not be the situation initially. An alternative approach, which need not be mutually exclusive to the first approach, is to introduce additional (environmental) subject material into what are already perceived as crowded instructional programmes (Smith & Samson 1990). This may however be the more realistic approach initially as only a limited number of lecturers (even only one) need be involved. In any event it would seem highly desirable

that all planners emerge from their initial training thoroughly aware of the potential impacts of their professional activities on the natural and social environments.

It thus seems that a logical first step would be to include an environmental component into one or more of the subjects of the first qualification curricula of the planning professions. The information gathered from the South African universities indicates that this is being done in the undergraduate engineering programmes. The average academic credit value accorded to this environmental component has been shown to be 1,7% for the civil engineering courses. The extent of the demand for environmental education as revealed through the questionnaire surveys, and the move towards environmental engineering as a discipline in its own right at overseas universities, would suggest that this percentage is inadequate. It is also debatable to what extent one could address all of the themes outlined above within such a small credit allocation. On the other hand it needs to be remembered that the curriculum objective is only environmental sensitisation and not environmental specialisation.

The range of the following discussions and the proposals will now narrow, but where possible wider applications will not be ignored. As has been intimated earlier, attention will be focused on the first level qualification in civil engineering as offered at technikons. This is a three year full-time programme, one year of which is devoted to experiential training, and it leads to the award of a national diploma. The curriculum of this instructional programme is summarised in Appendix H. The entrance requirement is a standard 10 certificate with passes in mathematics and in general/physical science at prescribed levels.

Some of the conditions which, in the writer's experience, constrain curriculum development within the context mentioned above, and which may also have wider applicability, are the following:

- The curriculum is generally regarded as already being very full and it is suspected that there might be opposition from various quarters to suggestions of further

inclusions, as is suggested above.

- In order to cover the full curriculum requirements the programme has to adhere to a fairly strict timetable structure which severely inhibits interdisciplinary activities.

- The lecturing staff involved in the civil engineering programme are encouraged to specialise in one or two of the various technical subject fields and therefore tend not to be generalists. While they may possibly feel sympathetic towards the objectives of environmental education, they would probably regard themselves as insufficiently competent to become involved therein. At worst it may also be regarded as unwanted additional work load to be accommodated in their already heavy schedules of commitments.

Against the background of the above discussion specific proposals relevant to the technikon civil engineering programme, and aimed towards increasing the environmental sensitivity of the programme participants, will now be put forward:

Proposal 1

The environmental debate needs to be introduced formally at an early point in the programme. An introduction into **Integrated Environmental Management** (Department of Environment Affairs 1992) is suggested as a suitable vehicle for this purpose. All of the themes outlined above underpin the integrated environmental management process and could be introduced via this route, and yet all can be tied back to civil engineering practice, thus still conforming to the practical and vocational orientation required of technikon programmes. It is further suggested that this environmental introduction be incorporated into the subject *Construction IA*, the subject matter of which will provide a number of points of contiguity. To avoid displacing other learning material the time allocated to this environmental component may have to be limited. An arbitrary suggestion put forward here is two weeks, which would translate into an academic credit weighting of approximately 0,4%.

Proposal 2

During their period of experiential training students are required to submit a technical report. It is now suggested that, in addition, the students also be required to submit an environmental report which should critically reflect on the use of the integrated environmental management procedures, or the lack thereof, in the civil engineering projects with which they have been involved. A hands-on approach will be encouraged which will not only give the students confidence in applying integrated environmental management procedures but also reinforce their understanding of the environmental themes. (An ambitious, but perhaps not entirely unrealistic consequence of this proposal, is the possibility that the general level of environmental awareness in civil engineering circles outside of the technikon may increase.) Depending on the range of requirements laid down for it a project report at this level could warrant an academic credit weighting of up to about 3%.

Proposal 3

A third suggestion is that a series of structured guest lectures on a variety of environmental topics be arranged for the civil engineering students. To the extent that the guest lecturers will have different backgrounds, and that these lectures may be opened up to students from other disciplines, the interdisciplinary theme can be strongly served by this suggestion. As the total credit rating for proposals 1 & 2 is of the order of 3,4%, which is about double the average percentage gleaned from the university survey, it may or may not be decided to attach an academic rating to this proposal. This decision will obviously be based on the degree of student involvement required, which could perhaps range from mere attendance of the guest lectures to written or verbal reports thereon. Such lectures could in any event serve wider purposes; by inviting other staff members, post-first qualification students and even practitioners to attend, the general base and level of environmental awareness may be increased. The environmental topics could be dealt with on a level other than that of general knowledge, by for example, exposing conflicting and/or vested interests, or by clarifying underlying value positions.

In concluding this section it needs to be noted that these proposals may be seen as initial steps, and that as the environmental awareness and enthusiasm amongst members of faculty may become more widespread, the environmental inputs may be broadened and the interdisciplinary theme, particularly on the classroom level, strengthened. It is also the writer's opinion that this relatively modest beginning could be managed by a single member of staff, making it easier from a staff involvement point of view, to include these initiatives in the curriculum.

5.5 Post-first qualification proposals

Although the primary focus here is again on a technikon-based civil engineering programme, the proposals to be put forward have the potential of impacting over a considerably wider area. Two important inputs form the basis of the said proposals. The first of these is the passing in Parliament of the Technikon Act of 1993 which will allow technikons to offer degrees. The second is the practice of environmental education at Murdoch University, Australia as has been described by Newman (1981), and which will loosely form the basis of the model that will be proposed here below.

In essence the environmental education model at Murdoch University consists of three broad environmental streams which on the one hand overlap to create study areas of *integrated knowledge*, while on the other hand specialist study areas for each of the three main streams are still maintained (*Ib.* 110-4). The three streams generally run in parallel, but at specific levels in the curriculum interdisciplinary bridges are built. The strength of the model, in the opinion of the writer, lies in its deliberate interdisciplinary constructions which, in essence, are courses based on an integrative problem-solving approach. Newman provides details and insights on these interdisciplinary courses, based on their experience at Murdoch University (*Ib.* 114-121), which could be useful in the design and implementation of the local model.

The general curriculum objective at the post-first qualification level is more than the

environmental sensitisation that was suggested at the first qualification level. The aim here is **environmental specialisation** (see p 4.7). The essence of the model proposed below is a professional entrance qualification which serves as the foundation for a multi-disciplinary, post-first qualification specialisation degree in an environmental field. The proposal also reflects three main streams similar to those in the Murdoch University model. However this research has no pretensions or mandate to speak for disciplines other than those which constitute the planning professions. While it thus may seem presumptuous to propose a local model which involves non-planning disciplines, it is done in this case merely to indicate the multi-disciplinary potential of the model, and in the full realisation that in respect of these non-planning disciplines the proposal can at best be speculative. In this sense the proposed model is by no means a final product and it will require further research and investigations, involving especially the non-planning disciplines, before it could be fully implemented.

What is being presented is an attempt to model a programme that addresses not only the major environmental themes outlined above, but also the perceived needs and requirements of the planning professions as revealed by the previously described questionnaire surveys, while maintaining sufficient flexibility to permit the incorporation, albeit somewhat speculatively at this stage, of some non-planning disciplines and professions. As this is still a conceptual model, existing physical and organisational constraints should not be allowed to dominate or even sabotage the idea. The concept must be considered in principle and if acceptable then imaginative thinking must be applied to overcome such constraints.

An objection in principle which may be directed at this model, is that it involves a degree of fundamental theorising and critical thought which places it outside the educational arena of applied knowledge and vocational training that has been designated for technikons. This objection may be answered on a number of levels. Firstly it needs to be said that the proposed model, like the Murdoch prototype, will be developed around a problem-solving approach, and fundamental theorising must not be allowed to overshadow this emphasis. In the second instance it must be remembered that the model

is being developed for the planning professions, and in that sense it can lose viability if it does not maintain some relevant vocational orientation. Thirdly it must be noted that the model is aimed at a technikon degree, the exact nature of which has not yet emerged in practice, and while policy makers accentuate the distinctive character of the technikon degree (as opposed to a university degree), it is not unrealistic to assume that it will probably not follow the applied knowledge approach as strictly as could be the case with traditional technikon qualifications. In the last instance the reader is reminded that the reason why this model has been developed within the context of technikon-based education is not one of principle but one of convenience, and it is thus suggested that critics evaluate the model on its inherent worth, as its institutional location has only been a secondary consideration in its design.

The model is depicted graphically in Figure 5.1. If it appears rather bold and ambitious at first, it needs to be pointed out that initially it will only be aimed at the civil engineering discipline. In time, as more resources become available, and as experience develops, the other planning professions can be drawn in, and eventually it may be possible to build out the practice to the full potential suggested by the model. Greater detail will now be provided with respect to various aspects of the model.

Structure

The structure of the programme is a 3- or 4-year tertiary entrance qualification followed by a specialisation year (if taken full-time), consisting of various subject electives, and leading towards a technikon baccalaureate degree.

Entrance qualification

The model purposely allows for a wide variety of entrance disciplines to enhance the multi-disciplinary nature of the programme. The emphasis is on inclusivity rather than exclusivity, which implies that the list of acceptable entrance qualifications will intentionally grow. A further attempt at inclusivity is to accept technikon diplomas as well as university degrees as entrance qualifications. The experiential background of applicants should also be taken into account.

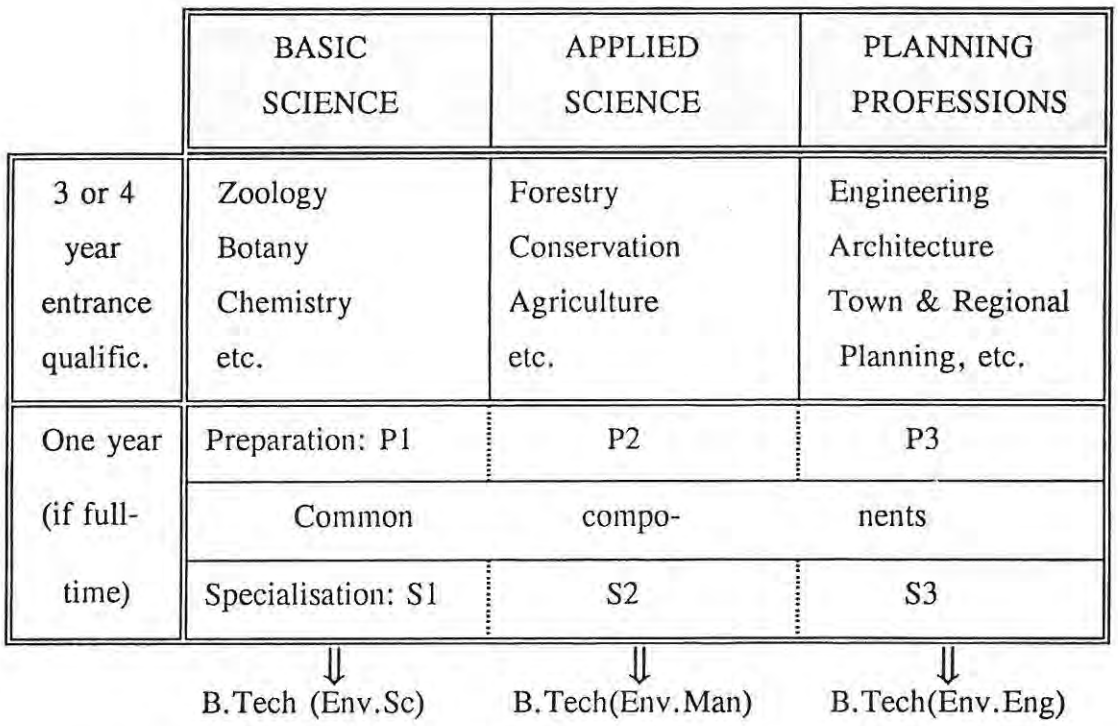

FIGURE 5.1 Post-first qualification environmental education model for *inter alia* the planning professions

Concluding qualification

The suggested name of the qualification is somewhat speculative, as the technikon degree nomenclature is still under discussion. It appears though that the word *Technology* and its abbreviation *Tech.* will be generic components of the qualification name, and that the study field or area of specialisation will be indicated in brackets after the degree designation. As it is the baccalaureate degree that is being proposed in this model the full designation may be: *B.Tech. (Area of specialisation)*. Without being prescriptive it is suggested that there might be three broad areas of specialisation, namely environmental science, environmental management and environmental engineering. In the first area of specialisation the focus might be the investigation and quantification of environmental degradation, while in the second instance integrated environmental management

procedures may be the core of an area as diverse as the protection of endangered species on the one hand through to the conservation of cultural resources on the other. In the third instance the emphasis would be on the application of engineering solutions to mainly pollution problems. The overseas' trends seem to indicate that water conservation may be an important area of study which may find expression in all three of the main streams.

Preparatory courses

These preparatory courses are designated P1, P2 and P3, but there is no major significance in these different designations other than to indicate that the preparatory courses for each of the three main entrance streams would probably be different to some degree. The common environmental components of the programme which are to follow the preparatory courses, will require certain levels of pre-knowledge in various fields of study. As it is expected that students from the three entrance streams will meet these requirements only to varying degrees, one looks to the preparatory courses to make up the shortfalls. For example, entrants from the planning professions may require introductory courses in zoology and botany, while those from the basic or applied sciences may require courses in basic engineering design and surveying.

It may also be that students from within the same stream have to do courses to bring them more in line with other members of that stream. For example architects may have to do some basic engineering courses such as water treatment, and engineers will have to learn more about the built environment. There may also be groups of students from any or all of the entrance streams that need some foundation work in areas such as statistics and economics. Having done the preparatory courses students from rather disparate backgrounds are intended to be in a position to proceed with the common components of the programme.

Common components

In this section of the programme two stages are envisaged. Firstly there will again be courses of a preparatory nature, but which will be common to all the entrance

disciplines. For example one would imagine basic courses in the human sciences such as sociology and psychology as being appropriate here. The second and probably the more dominant stage in this section will deal more directly with environmental issues, particularly in those areas which have emerged as important from the questionnaire surveys previously reported. Thus courses in water, soil and air pollution, integrated environmental management, environmental ethics and environmental economics would typically be offered at this stage. It is felt that all the major environmental themes that were identified earlier will come into play here, but perhaps none more so than the interdisciplinary theme due to the structure of the model. One suspects that the potential for interdisciplinary action will be significantly enhanced when students from diverse backgrounds jointly ponder and investigate the environmental issues which (as part of the teaching strategy) they will be confronted with, and then together plan and devise sustainable strategies for the management of these environmental issues.

The above arguments should not be taken to suggest that interdisciplinary education is without problems or critics. "In the present state of pedagogical knowledge, interdisciplinarity has been shown to have negative aspects: loss of know-how and of specialized knowledge, ... [and] when poorly assimilated, [it] can sow confusion in the learners' minds" (UNESCO 1985: 41). Newman (1981:114) warns against "multidisciplinary 'fruit salad' courses which just highlight problems and show a multiplicity of individuals burrowing into their own little solution." Ackerman (1989: 33-37) relates the case of an attempted interdisciplinary programme that failed. While the practical problems which confront an interdisciplinary approach, such as those of timetabling, classroom space and teacher inexperience, are reasonably obvious, Pring (1970: 265-272) shows that this approach also faces certain philosophical arguments which may be raised against it. However it is clear from many sources referred to previously that the interdisciplinary theme is fundamental to environmental education, and the intention here is not to argue for its rejection, but merely to point out that there are problems associated with it. Further reading of the works quoted earlier in this paragraph will reveal that most of the writers are in fact only qualifying their support for interdisciplinarity.

Specialising courses

The three possible areas of specialisation, S1, S2 and S3 indicated in Figure 5.1 derive from the three main streams in the model, and it follows that there may be courses of specialisation for each of the streams. For example in environmental engineering advanced courses dealing with pollution abatement might be offered, while in environmental science there may be specialised courses on developing new standards of environmental degradation assessment. In environmental management there could be specialisation in natural or cultural resource management. It is conceivable and likely that within the designated broad areas of specialisation there would be smaller, more specific areas of specialisation. For example within the area of environmental engineering there could be specialisation in either waste water management or solid waste management, in environmental management there might be a focus on either sustainable development or nature conservation, and in environmental science, global warming or environmentally sensitive pest control may be areas of specialisation.

The point made earlier about inclusivity remains valid. Students must be encouraged to follow study programmes that meet their specific vocational needs, and the boards of faculty should seek inter-departmental co-operation to meet these needs. In the context of this model the term *specialisation* must not be interpreted too narrowly. Instead one might argue that environmental graduates should be "integrationists as distinct from generalists and specialists" (UNESCO quoted by Newman 1981: 113).

Format of programme

In line with the information gained from the questionnaire surveys it is suggested that this programme should be run on a block-release format. Briefly this format could be described as a short period of approximately a week or two of full-time, concentrated lectures, followed by a lengthier period of perhaps three or six months of part-time involvement consisting of self-study, assignments and projects. If necessary a final week of consolidation followed by an examination could conclude the course. There are many variations possible and the above is not intended as a prescription. The main advantage of this format is its flexibility and the increased likelihood it has of drawing practitioners

into the programme, both as participants and as study leaders. As the periods of full-time involvement are relatively short it is likely that there will potentially be more participants who could fit this commitment into their schedules. In addition the suggested format must be more suitable especially to mature students from distant localities, who would find part-time studies in the form of evening classes or full-time studies very inconvenient if not impossible.

Another advantage of courses run on the block-release format is their potential to serve as concurrent short courses. Increasingly planning professionals are being expected to participate in continuing education. Josephson (1981: 1264), referring to an American study, states that "short course training is viewed by government and industry managers and leaders as a vital part of their efforts to upgrade and broaden the knowledge and qualifications of professional and technical staff personnel". Professional planners could attend the courses offered on a block-release format without having to register for the full programme, or without doing the assignments and examinations if these were not considered essential. Thus environmental education in the planning professions could also be promoted on a non-formal basis.

Of course a programme run on the block-release format (and for that matter the part-time format) may be expected to take longer to complete than the case would be with a full-time presentation. This might be a disadvantage to a student who wishes to qualify sooner, but it does not weigh up, in the writer's opinion, against the advantages mentioned above.

5.6 Broader curriculum issues

Describing the curriculum process Brady (1990: 144) suggests that curriculum developers should not "feel constrained by models or blueprints." The model outlined above has been devised and formulated in this spirit and it would only be consistent if its implementation were to follow the same approach. One may nevertheless find value

in considering these curriculum proposals and their setting from a paradigmatic point of view in order to gain a more fundamental understanding of their philosophical grounding.

It has been argued earlier that the traditional engineering approach is strongly positivist (see p 2.8). There is no reason to believe that civil engineering programmes at technikons would be any different. They adhere to an approach of "putting into practice existing knowledge, technology, results and formulas" (NATED 1993a: 12), and do not allow much space for reflection and introspection. The educational emphasis is on learning objectives, the transfer of knowledge and standardised evaluation, all of which are characteristics of a Tylerian curriculum (Schubert 1986: 171). One would thus reasonably conclude that the existing civil engineering education practices at technikons (and possibly those at universities too) reflect the *empirical/analytical science* paradigm of Habermas, which is essentially a paradigm of positivism (*Ib.* 180-2).

Schwab criticised the dominant empirical/analytical paradigm and suggested a new approach: the practical (*Ib.* 173-6). This approach emphasises enquiry based on real problems rather than abstractions, interaction with the real state of affairs rather than objective observation, situational answers rather than law-like generalisations, and meaningful outcomes affecting quality of life rather than knowledge for the sake of knowledge. In terms of the Habermas terminology the Schwabian approach is labelled as the *hermeneutic science* paradigm (*Ib.* 181-2). It is contended here, in the light of the above description, and on the basis of the arguments put forward by many writers (see Chapter 2), that the effectiveness and success of the environmental curriculum proposals outlined earlier depend greatly on the extent to which their implementation may reflect the hermeneutic paradigm.

If, as it now appears from the above arguments, the new curriculum reflects a paradigm different to that of the educational system it is intended for, tensions will arise which may negatively affect the achievement of the objectives that have been proposed for the new curriculum. These tensions may be more evident in the case of the first qualification

proposals, which were devised within the context of an existing technikon programme, and less evident in the case of post-first qualification proposals which represent entirely new programmes. It is hoped that these tensions would not obstruct the implementation of the proposals or too radically change their character towards technocentrism on the *ecocentrism-technocentrism* spectrum (O'Riordan 1981: 5). On the other hand one could also hope that the ethos of these proposals would permeate beneficially, from an environmental point of view, through the existing courses and their setting.

One may note that Schubert (1986: 181-2) also described a third paradigm, the so-called *critical sciences* paradigm, to use the terminology of Habermas again. This paradigm serves emancipatory political interests. Given that planning professionals traditionally adopt a politically neutral stance, and that in contrast some environmental issues may require a degree of political activism (O'Riordan 1981: 14-15), one may even argue for overt association with the critical paradigm. It is the feeling here that these paradigmatic arguments are useful to improve one's understanding of problem situations, such as may arise in the acceptance and implementation of a curriculum, and which superficially may seem to derive from more mundane and pragmatic issues.

In this context it must also be remembered and recognised that the formal curriculum proposals are only part of the picture, and that the teaching milieu itself also plays an important role - that of the so-called hidden curriculum. Silberman is quoted as saying (Wiles & Bondi 1989: 44):

> What educators must realise, moreover, is that how they teach and how they act may be more important than what they teach. The way we do things, that is to say, shapes values more directly and more effectively than the way we talk about them. ... These lessons are far more powerful than verbalizations that accompany them and that they frequently controvert.

While the discussion of suitable teaching models may not be regarded as of immediate concern, they are an integral part of curricula and need to be noted. Brady (1985) describes five such models. In order to promote a consistent message the teaching model devised and used must be compatible with the curriculum paradigm in which it operates. It is contended here, on the basis of Brady's exposition, that his *interaction* model

(Brady 1985: 140-180) may be quite suitable for the hermeneutic paradigm that has been favoured above.

In conclusion it may be useful to consider briefly the topic of values education which, in the opinion of the writer and the respondents in the previously reported surveys, is an important component of environmental education for the planning professions. Values education cannot escape the query: whose values? Too often, one suspects, values education degenerates into a biased exposition of the instructor's values. Gayford (1987: 8-9) warns against "environmental indoctrination" and proposes methods such as *values clarification*, *situation ethics* and the *critical issues* approach to overcome this problem. These approaches have in common their avoidance of a prescriptive value position. Instead these approaches attempt to expose students to different value systems, based on which they can form their own value perspectives. This is not to imply a position of *ethical relativism* where all values are equally acceptable. Yes, "students should be taught *about* the range of values in any situation and how to clarify their own position in relation to them" (Fien 1993: 65), but they must also be exposed to "the direct teaching of particular values within an atmosphere of free and critical discussion" (*Ib.* 65).

The suggested approach to values education does also not imply that the instructor should not have or explain his or her own values. All instructors and teachers have values and it would be false to pretend that these do not exist or have no influence on the way in which other values are presented. Fien (*Ib.* 66) presents arguments in favour of the honest disclosure of the instructor's views in an atmosphere of open and critical discussion.

In the final analysis all individuals, including environmentalists, cannot avoid adopting, either by design or by default, an ethical stance. In this connection Merchant (1990: 45-68) provides very useful insights by reducing this complex theoretical problem to three possible ethical approaches to the environment: an *egocentric* ethic, the *homocentric* ethic or the *ecocentric* ethic. The environmental values held by people range across the

whole spectrum. For example, Krauthammer (1991: 66) asserts that,

> A sane environmentalism, the only kind of environmentalism that will win universal public support, begins by unashamedly declaring that nature is here to serve man.

In contrast Arne Naess contends that,

> Not only will we feel sad when our brother or a dog or a cat feels sad, but we will grieve when living beings, including landscapes, are destroyed (quoted by Devall & Sessions 1985: 75).

The challenge, indeed the ethical imperative, to the environmental educator is to do justice to all such viewpoints.

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CHAPTER 6

CONCLUSION

> That which comes to be always does so as a whole; so that if a man does not count the whole among realities he ought not to speak of substance or of coming-to-be as real. (Plato quoted by Smuts 1936)
>
> This [approach], therefore, has its roots in that all-embracing philosophy of nature whereby the relationship between things matters more than the things in themselves. In any social system, the whole can be greater or less than the sum of its parts, depending on whether there is harmony or discord between them, The Chinese talk of the 'yin' and the 'yang', the Africans speak of 'ubuntu' and a former Prime Minister of South Africa, Jan Smuts, called it 'holism'. (Huntley, Siegfried & Sunter 1989: 119)

6.1 Reflection on this research

This research has succeeded, in the opinion of the writer, in establishing that a need for environmental education amongst members of the planning professions does exist. It has also led to the formulation of curriculum proposals (see §5.4 and §5.5) that suggest the form in which this need may be met. While it cannot be claimed that the proposals flowing from this research have been fully validated through the empirical surveys done, it is suggested that their broad thrust is consistent with the data that has been gathered and the literature that has been surveyed. Despite the tentative nature of these proposals at this stage, it is believed that they are feasible within the context of their setting (i.e. technikon based education), and that as such they could form the basis of an environmental curriculum, not only for the civil engineering profession, but also for the other planning professions.

Wider exposure of these proposals will follow in due course as it is intended that they will form part of the feedback promised to interested respondents by the researcher.

Some measure of their acceptability will be found in the reaction that they may elicit from the recipients of the feedback report. The formal steps required in the technikon curriculum development process will allow further scope for the refining and detailing of these proposals. In the opinion of the writer an important area of further investigation will be that of the interdisciplinary approaches mooted in the proposals. It is recognised that there are practical problems associated with such approaches, and in this connection concerns were expressed by a number respondents. The formalisation of the proposals in this report must not prohibit their on-going development to meet such challenges as interdisciplinarity and the broadening of their application to other professions.

During the execution of this research some problems, both of a design and a practical nature, became apparent, and these have already been discussed where appropriate in this report. However the problem of response bias which is almost inevitably attached to all postal questionnaire surveys (Leedy 1974: 107) still needs to be noted. In the case of this research it could be argued that the respondents were, irrespective of their professions, mainly those with some affinity towards the environment, while the non-respondents were those with less concern for the environment. Such a situation must introduce some bias in the results. However the high return rates of more than 50% for the planning professions (see Table 3.1) and nearly 90% for the environmentalists (see Table 3.3), which were achieved without follow up actions, would suggest that the results are at least reasonably representative of the populations concerned.

The significant correspondence that was evident between the responses from the planning professionals and the environmentalists did not support the hypothetical conflict of interests between these groups which underlay the inclusion of the environmentalists in this research on the planning professions. The high level of agreement between the planning professionals and the environmentalists would suggest further that planners are sufficiently environmentally aware to appreciate the need for environmental education amongst their professions, and this would lead one to believe that the above mentioned curriculum proposals do have potential viability.

It has been argued in this research that the resolution of the environmental crises around us require societies to change their world views. It has further been noted that professional planners, who in the course of their duties inevitably impact on the environment, are often associated with positivist and reductionist perspectives. On the other hand the literature surveyed suggests that a paradigm shift to a more holistic perspective is required. The final merit of this research will, in the opinion of the writer, be found in the degree to which it contributes to a more holistic approach amongst planners. This required movement in emphasis towards holism is, to the mind of the researcher, the core proposition flowing from this research. As such it is fitting to conclude this report with a description of an environmental education model that focuses on the central role of holism.

6.2 The core proposition of this research

In his book *What's Worth Teaching?*, Marion Brady analyses education in American schools and comes to the conclusion "that the traditional general education curriculum is not doing the job" (Brady 1989: 1). It is in need of fundamental reform, and as a solution Brady proposes a "coherent, integrated curriculum ... [that is] based on a coherent, integrated structure of meaning" (*Ib.* 23). He goes on to suggest that "since meaning is based on culture ... [and] cultures are the ... most comprehensive entities in which all elements can be related systematically ... the concept of the sociocultural system provides the broadest possible conceptually integrated base for the general education curriculum" (*Ib.* 23). It appears that what Brady expects from a curriculum based on socio-cultural systems is a changed world view, and this is not very different from what many environmentalists expect from environmental education. The writer is of the opinion that these two approaches, Brady's socio-cultural systems approach, and the environmental education approach as outlined earlier in Chapter 2, are not contradictory but are in fact compatible. However it is not the intention to expand here on this proposition but rather to use the conceptual depiction of Brady's curriculum model (*Ib.* 28) expressed as an environmental education model to illustrate the centrality

of holism to environmental education.

The derived model, shown in Figure 6.1, is based on five dimensions or "kinds of information", four of which correspond to the environmental education themes which were highlighted in Chapter 5.

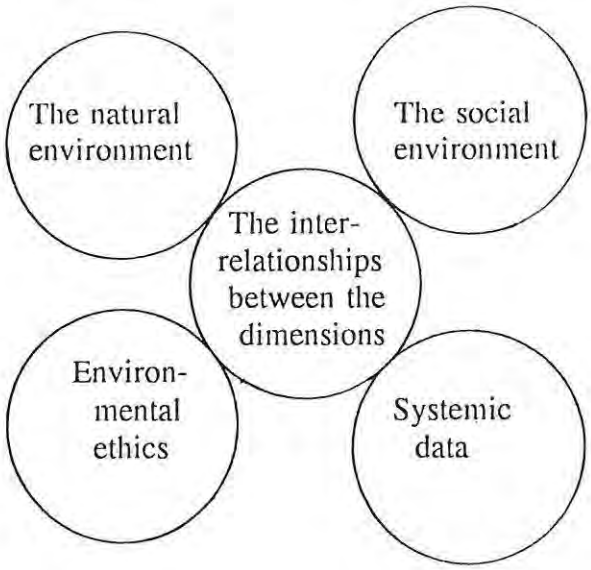

FIGURE 6.1 An environmental education curriculum model (Adapted from Brady 1989: 28)

The dimensions or themes of the model are as follows:

1. The natural environment

It has already been claimed earlier that the natural environment is the historical base of environmental education. Some of the world's most pressing environmental problems, for example, rain forest destruction, are evident in the natural environment.

2. The social environment

As has been explained above this dimension is the point of departure of Brady's model. If it is one's understanding that all meaning is socially constructed (Berger & Luckmann 1976), then one can appreciate his stand.

3. Environmental ethics

It has already been stated that one cannot escape having an ethical stance, and Milbrath (1984: 113) states that "values are fundamental to everything we do". Given these statements one must conclude that environmental problems are essentially problems of values. Thus it is very important for environmentalists to be well informed in this respect.

4. Systemic data

This is an elaboration of Brady's dimension of *demographics*. It says simply that one's understanding and appreciation of the other dimensions is a function of the data, particularly numeric data, that one has of these dimensions. This was not discussed as a separate environmental education theme in chapter 5, but was subsumed under the other themes. It is shown as a separate dimension here merely in conformance with Brady's model.

5. Inter-relationships between dimensions

Depicted at the centre of the model are the inter-relationships between its various dimensions. These inter-relationships are such a major characteristic that together they are considered the fifth dimension of the model.

While the above model may aid one's understanding of environmental education it does not claim perfection, and it may well be deficient in some respects. However, in the context of this research, its significance lies only in the central role that it casts upon the **inter-relatedness** of phenomena. It is clearly evident from Figure 6.1 that the inter-relatedness of phenomena is the central link that ties all the other dimensions of the model together. It is clearly the fulcrum of the model. Without this central linkage of inter-relatedness the other dimensions fall apart into almost meaninglessness. This inter-relatedness of things, which derives from the principle of **holism**, gives meaning in its own right. It is the core element of Brady's model; it is the core element of environmental education, indeed of all education. It is, inescapably, the core element of environmental education for the planning professions.

The whole-making, holistic tendency, or Holism, present in particular wholes, is seen at all stages of existence. ... With its roots in the inorganic, this universal tendency attains clear expression in the organic biological world, and reaches its highest expressions on the mental and spiritual planes of existence. ... Wholeness is the most characteristic expression of the nature of the world in its forward movement in time (Smuts 1936: 97).

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APPENDIX A

MEMBERSHIP OF EPPIC

The membership of the Environmental Planning Professions Interdisciplinary Committee (EPPIC) is currently as follows:

Corporate members:

Institute of South African Architects
SA Institution of Civil Engineers
SA Association of Consulting Engineers
SA Institute of Ecologists
SA Institute of Electrical Engineers
SA Institute of Engineering Geologists
SA Institute of Forestry
Institute of Landscape Architects of SA
SA Institute of Mining and Metallurgy
SA Institute of Town and Regional Planners

Associate member:

Environmental Earth Science Group

In addition, the Department of Environment Affairs is represented on the Central Committee and liaison is maintained with the Council for the Environment.

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APPENDIX B1

SURVEY DIRECTED AT THE PLANNING PROFESSIONS

Copies of the covering letter and questionnaire sent to members of the planning professions (see § 3.3) are contained within following pages of this appendix.

Private Bag X6011 Privaatsak
Port Elizabeth
6000
tel: (041) 5043911
fax: 533644

12 June 1993

Dept.: CIVIL ENGINEERING

Ref./Verw.:

Addressed to:
Practitioners in the
planning professions

Dear Sir

ENVIRONMENTAL EDUCATION AT TECHNIKONS

Through the Department of Civil Engineering at the PE Technikon an investigation is being launched into the need for **environmental education for members of the engineering and related professions**. This investigation is being done in view of accusations of environmental insensitivity that are sometimes being levelled against the said professions. The objective is the possible development of a special environmental course (or courses), and/or the amendment of our existing curricula in order to meet, as best we can, the perceived need.

Environmental education in the context of this investigation is construed in its widest context. It certainly involves the traditional emphasis on the natural environment, but it is suggested that issues of the broader environment also need to be addressed. This includes the social and cultural environments in both first and third world contexts. It is felt that some of the issues in these areas are so important and pervasive, both locally and globally, that we ignore them at our peril.

This investigation springs forth from our involvement in the field of civil engineering education. It is nevertheless thought that the thrust of the investigation should be broadened to include all the other engineering disciplines and the related professions in order to expose the possibility of common needs which could lead to more broadly based 'solutions'. The other engineering disciplines and related professions being considered here are: electrical engineering, mechanical engineering, agricultural engineering, architecture, building management, quantity surveying, land surveying, town and regional planning, etc.

I am approaching you as a member of the target professions, trusting that you will be kind enough to spare a few minutes of your time to fill in the enclosed questionnaire, returning it in the enclosed envelope at your earliest convenience. Despite its bulky appearance the questionnaire only contains twelve questions. Thank you very much for your co-operation. Although you are requested to supply your name and address you may, if you wish, treat the questionnaire anonymously. The content of each questionnaire will in any event only be used in an anonymous manner. Respondents' names and addresses are merely to be used for control purposes and in those instances where respondents have requested follow-up information.

I am sure that you will agree that education in general, and education for the said professions in particular, must be responsive to the demands of the times. I am hoping that you may feel it part of your professional concern to assist us in this information gathering exercise. Thank you once again.

Yours sincerely

S.S.Long Pr.Eng.
HEAD OF DEPARTMENT

TECHNIKON-BASED ENVIRONMENTAL EDUCATION
aimed at the
ENGINEERING AND RELATED PROFESSIONS

INSTRUCTIONS:

° Please complete the questionnaire by placing ticks in the appropriate blocks or by responding in whatever other ways the questions may indicate.

° You are encouraged, where you feel it necessary, to qualify or elaborate on your answers in the spaces provided, or even by using additional sheets of paper. All types of responses, even those in the 'Not sure' categories will provide useful information for the purposes of this investigation.

° You may wish to peruse the whole questionnaire first in order to understand its general thrust.

Thank you.

---

1. Are the professionals in your discipline *adequately educated* in environmental matters?

Yes	No	Not sure

[adequately educated = thoroughly informed as to the impact of their professional activities on the environment in its broadest sense]

.....

.....

.....

(If your answer to this question is an unqualified 'yes', please move on to question 9.)

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2. Could the inadequacies in the environmental education of the professionals in your discipline be addressed by means of:

(a) an optional, post-first qualification course* specialising in environmental matters? ☐

(b) amendments to the present curricula of the existing first qualification courses? ☐

(c) both of the above ☐

(d) any other (please specify). ☐

*post-graduate or post-diploma

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3. Should the inadequacies in the environmental education of the professionals in your discipline be addressed in the areas of:

(a) knowledge about the natural ☐ and social ☐ environment?

(b) environmental concern, values and accountability? ☐

(c) ability to communicate and work in a team in an interdisciplinary manner? ☐

(d) any other (please specify). ☐

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4. If a post-first qualification specialist environmental course is indicated in question 2, could your professional discipline be accommodated in the same course as the different engineering and other related disciplines?

Yes	No	Not sure

.....

.....

.....

5. Is the following statement acceptable to you, and if not, why not?

*Special environmental courses for engineers and those from related disciplines should be **holistic, interdisciplinary** and **issue-based** to enable such persons to appreciate the fundamental significance of the **relationship between man and his environment.***

[where: holism = a philosophical stance which places emphasis on the whole as opposed to the constituent parts.

interdisciplinary = an educational approach that seeks to break through the boundaries of subject disciplines to reinforce the principle of holism.

issue based = a characteristic of curriculums which emphasize issues rather than knowledge or techniques, e.g. pollution is an issue, but chemistry is not.]

☐ Acceptable ☐ Not acceptable ☐ Not sure

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6. The adjacent list of topics may form part of the environmental curriculum aimed at members of your profession. You may wish to add a few more. Number all the topics in order of importance as you see it, with 1 being most important, 2 the second most important, etc.

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Topic	Rank
Solid waste management	
Water pollution	
Atmospheric pollution	
Nuclear pollution	
Environmental management	
Social issues	
Environmental ethics	
Environmental economics	
Ecology	
The built environment	

7. What in your opinion is the preferable format for a specialist environmental course aimed at members of your profession:

(a) full time? ☐

(b) part-time, e.g. evening classes? ☐

(c) block release, e.g. one or two intensive weeks per term or semester? ☐

(d) any other (please specify). ☐

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8. Do you deem it necessary that you or other persons in your organisation should attend such a specialist environmental course?

Yes	No	Not sure

.....

.....

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.....

9. Do you think it appropriate for practitioners in your professional discipline to act as environmental managers as opposed to say biological scientists?

Yes	No	Not sure

.....

.....

.....

10. What is your profession?

.....

11. Do you wish to receive further information about the results which may flow from this investigation?

Yes	No

12. Your name and address:

.....

.....

.....

.....

.....

Please return to: The Head of Department: Civil Engineering
PE Technikon
Private Bag 6011
PORT ELIZABETH
6000

THANK YOU!

APPENDIX B2

SUMMARISED RESULTS FOR THE SURVEY DIRECTED AT THE PLANNING PROFESSIONS

Summarised results obtained from the questionnaires sent to members of the planning professions (see § 3.3) are contained within following pages of this appendix.

KEY FOR THE TABLES IN THIS APPENDIX:

A	=	Architects
Ap	=	Atmospheric pollution
B	=	Building managers
BR	=	Block release
Be	=	Built environment
C	=	Civil engineers
CT	=	Civil engineering technicians
Ec	=	Environmental economics
Em	=	Environmental management
EM	=	Electrical & mechanical engineers
Et	=	Environmental ethics
Ey	=	Ecology
FT	=	Full-time
LA	=	Landscape architects
LS	=	Land surveyors
N	=	No
Np	=	Nuclear pollution
Q	=	Quantity surveyors
O	=	Other
PT	=	Part-time
Si	=	Social issues
Sw	=	Solid waste management
T	=	Town planners
U	=	Not sure
Wp	=	Water pollution
Y	=	Yes

QUES-CIV
20/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Civil Engineers

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1		1		1				1	1	1			1			1			3	1	8	10	2	6	7	9	4	5			1		1			1			C	1
2		1				1		1	1						1	1			7	6	9	10	2	1	3	4	5	8		1				1		1			C	1
3		1				1		1	1	1	1		1			1			8	7	9	10	2	5	6	4	1	3			1		1			1			C	1
4		1				1	1	1		1	1		1			1			5	2	6	10	1	8	3	7	4	9	1	1	1		1			1			C	1
5	1					1					1		1				1							3	1	2	4					1				1			C	
6		1		1			1	1	1	1	1			1		1			7	3	4	10	1	6	2	8	5	9			1		1			1			C	1
7		1		1				1	1	1	1		1			1			3	1	2	4	7	8	9	10	5	6			1		1			1			C	1
8		1				1		1			1		1			1			10	8	7	9	2	3	1	4	5	6		1			1						C	1
9		1				1	1	1	1	1	1		1			1			2	1	8	9	5	6	8	4	3	7			1			1				1	C	1
10		1				1		1	1	1	1					1			7	8	9	10	2	1	3	4	5	6			1		1			1			C	1
11			1			1		1	1	1	1				1	1			4	2	3	5	6	7	9	8	1	10		1			1					1	C	1
12		1		1				1	1	1	1		1			1			6	7	5	11	1	8	9	10	3	2			1		1			1			C	1
13		1				1		1	1	1					1	1			3	2	8	10	1	7	9	4	6	5		1			1			1			C	1
14		1				1		1	1	1	1		1			1			8	6	7	10	1	2	3	5	9	4		1					1	1			C	1
15		1			1					1					1				2	1	4	10	3	7	6	8	5	9		1			1				1		C	1
16		1				1		1		1			1			1			5	4	6	10	1	8	9	2	3	7		1	1		1			1			C	1
17		1				1		1	1	1	1				1	1				1	2	11								1			1			1			C	1
18		1				1		1							1	1			4	6	9	10	1	8	3	2	7	5	1				1					1	C	1
19		1			1	1			1	1	1		1			1							4	2	3	1					1			1		1			C	
20	1										1			1			1		2	1													1				1			C	
21		1				1				1					1	1			2	4	6	10	7	9	1	5	3	8			1		1			1			C	
22		1				1		1	1	1	1		1			1			6	4	3	5	7	2	1	9	10	8			1		1			1			C	1
23					1						1					1			1	2	3	10	5	4	6	7	8	9			1		1			1			C	1
24			1		1			1	1	1	1					1			7	4	5	8	1	2			3	6			1				1	1			C	1
25		1				1	1	1		1	1		1			1			1	2	3	10	5	8	4	6	7	9		1			1			1			C	1
26		1		1				1	1	1				1			1		6	7			1	2	3		4	5		1	1				1			1	C	1
27		1				1	1			1			1			1			7	7	7	7	1	2	3	4	5	6		1			1			1			C	1
28		1		1				1	1	1	1		1			1									1								1					1	C	1
29		1				1		1	1	1	1					1			8	6	4	10	1	5	2	3	7	9			1		1			1			C	1
30		1			1			1	1	1						1			3	1	2	6	4	7	8	10	5	9		1			1			1			C	1
31		1		1				1	1	1	1		1			1			4	3	7	10	1	8	9	2	5	6			1		1			1			C	1
32		1			1					1						1			1	1	8	9	2	7	6	5	3	4			1				1	1			C	
33		1				1		1	1	1	1			1		1			8	7	6	10	2	4	3	9	5	1		1			1			1			C	1
34		1			1					1			1			1			4	2	3	1	5	7	8	10	6	9	1				1			1			C	
35			1			1				1				1			1		4	4	4	4	1	2	5	3	6						1			1			C	
36		1				1		1	1	1			1			1							1	5	6	2	3	4		1	1		1			1			C	
37		1				1				1	1			1		1			4	5	6	7	3	8	1	2	9	10		1			1			1			C	1
38		1				1		1	1	1			1			1			9	8	7	10			1	2	3	6			1		1			1			C	1
39			1		1						1					1			5	3	2	1	6	4	8	7	9	10		1			1				1		C	1
40		1				1				1	1		1			1								1	2					1			1			1			C	
41		1		1					1	1					1	1			1	2			3	4					1				1				1		C	1
42		1				1		1	1	1					1	1			3	1	4	10	5	2	8	9	6	7			1		1					1	C	1
43	1				1			1	1	1	1		1			1			2	1	6		8	5	4	7	3	9				1		1			1		C	1
44						1		1	1		1				1	1			7	6	8	10	3	2	1	5	4	9	1				1				1		C	
45		1			1						1					1			2	5	1	10	9	4	7	8	6	3		1					1	1			C	1
46		1				1					1		1			1			6	7	4	5	1	2	3	10	9	8	1				1					1	C	
47		1				1		1	1	1	1		1			1			7	6	8	10	1	2	5	9	3	4		1			1			1			C	1
48		1				1		1	1	1	1		1			1			6	6	6	6	1	5	2	3	4	10		1	1		1					1	C	1
49		1		1			1	1	1							1			3	2	5	9	8	4		1	7	6		1					1	1			C	1
50		1			1			1	1							1			5	4	6	9	2	3	7	8	1				1		1			1			C	1
51		1				1		1	1	1	1		1			1			6	5	7	10	1	4	2	9	3	8			1		1			1			C	1
52		1		1						1			1			1			4	1	2	9	7	8	3	10	5	6		1					1	1			C	1
53		1				1		1		1					1	1			2	1	3	5	4	6	7	8	9	10		1			1			1			C	
54		1		1				1	1		1		1			1			5	6	9	10	1	7	2	3	8	4		1			1			1			C	1
55		1				1				1	1				1	1			5	1	2	3	6	9	8	10	4	7		1			1				1	C	1
56		1		1				1		1				1		1			4	3	8	10	2	5	9	7	1	6		1			1			1			C	1
57		1		1				1		1			1			1			5	2	4	10	3	9	7	6	1	8			1		1			1			C	1
No	3	48	4	13	11	33	6	39	33	44	34	0	28	7	11	52	5	0	51	52	49	48	51	53	52	50	51	48	6	27	25	2	43	6	7	40	7	9	57	45
%	5	84	7	23	19	58	11	68	58	77	60	0	49	12	19	91	9	0	47	38	54	84	31	50	48	59	49	68	11	47	44	4	75	11	12	70	12	16		79

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ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Electrical & Mechanical engineers

No	Q1			Q2				Q3					Q4			Q5			Q6									Q7				Q8			Q9			Q 10	Q 11
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U		
1		1				1						1			1		1		3	4	5	6	1	2	8	7	9	10				1	1			1			E	1
2		1			1					1			1			1			7	2	3	9	4	6	5	10	1	8			1			1		1			M	
3		1				1		1		1					1	1			2	3	4	8	5	9	6	7	1	10			1		1			1			M	
4	1																																			1			E	
5		1				1				1					1	1			2	3	1	10	4	9	6	5	7	8		1					1	1			M	1
6		1				1	1	1	1	1	1	1			1	1			7	4	4		3	6	1	2				1		1	1			1			E	1
7		1				1			1	1	1		1			1			8	2	1	3	7	4	5	6	9	10			1		1			1			M	1
8		1				1				1			1			1			3	2	1	6	5	7	8	9	4	10		1			1				1		E	1
9	1					1				1			1			1			4	6	5	10	1	9	3	7	2	8				1	1			1			E	1
10		1			1				1							1			4	3	5	1	8	6	9	10	2	7		1			1				1		E	
11	1																																			1			E	
12		1				1				1			1			1			6	10	1	9	7	8	2	3	5	4			1				1		1		M	1
13	1						1			1				1			1		8	9	2	10	5	3	4	6	7	1				1		1			1		E	1
14		1				1		1	1	1			1			1			2	3	4	10	1	5	6	7	8	9		1	1		1			1			M	1
15	1																																			1			M	1
16		1				1		1	1	1	1		1			1			3	3	3	3	2	1	1	3	2	3	1	1	1	1	1			1			M	1
17		1			1		1	1		1			1			1			3	1	2	9	5	4	6	8	7	10		1		1	1			1			M	1
18		1				1				1					1	1			3	1	2	10	6	4	7	5	8	9		1					1			1	M	1
19		1			1			1	1	1	1					1			5	3	4	10	1	8	9	6	2	7			1		1			1			M	1
20		1			1			1					1			1			4	2	1	3	7	10	5	8	6	9		1					1	1			M	
No	5	15	0	0	5	11	3	7	6	14	4	2	9	1	5	15	2	0	17	17	17	16	17	17	17	17	16	16	1	9	7	6	11	2	4	15	4	1	20	14
%	25	75	0	0	25	55	15	35	30	70	20	10	45	5	25	75	10	0	44	36	28	73	42	59	54	64	50	77	5	45	35	30	55	10	20	75	20	5		70

QUES-Q-S
19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Quantity Surveyors

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1		1			1			1	1	1	1		1			1			7	9	5	10	4	2	6	3	8	1			1		1			1			Q	
2		1			1					1	1		1			1			7	8	6	10	1	4	5	3	9	2			1		1			1			Q	
3		1		1						1					1	1			7	8	9	10	4	6	3	1	5	2		1					1			1	Q	1
4		1			1					1					1	1			9	7	6	8	1	4	2	3	5	10		1					1		1		Q	1
5		1		1							1		1			1			1	2	4	10	5	3	7	6	8	9		1		1		1			1		Q	1
6		1				1		1	1	1	1				1	1			8	7	9	10	3	5	1	2	4	6		1			1			1			Q	1
7		1				1		1	1		1		1			1			7	8	9	10	5	4	2	3	6	1		1					1			1	Q	1
8		1			1			1	1	1	1					1			9	8	7	10	6	3	4	1	5	2			1		1			1			Q	1
9		1				1				1			1			1														1				1			1	Q	
10		1				1				1					1	1			9	7	8	10	2	5	1	3	4	6			1		1				1		Q	1
11	1																																			1		Q	
12		1				1		1	1	1	1				1	1			9	3	2	4	5	7	6	8	1	10	1					1			1		Q	1
13																																				1		Q	1
14		1				1					1				1	1			5	1	9	8	2	6	10	3	7	4		1			1			1			Q	1
15		1			1			1	1						1	1			6	1	2	3	4	7	8	9	5	10		1			1			1			Q	1
16		1		1						1			1			1			7	6	8	10	1	5	2	3	4	9			1		1						Q	1
17		1			1					1			1			1			8	6	7	9	2	5	1	4	3	10						1					Q	1
18		1				1		1	1	1	1			1		1			9	7	8	10	1	5	2	3	4	6	1	1				1		1			Q	
19			1			1				1	1				1	1			8	6	7	10	1	5	3	2	9	4			1				1			1	Q	
20	1																																			1		Q	
21			1			1					1				1	1			5	1	3	2	4	7	6	9	10	8		1	1			1		1			Q	1
22			1		1			1			1				1			1	6	7	8	9	10	5	4	1	2	3			1			1			1		Q	
23			1	1						1			1			1			3	4	5	2	1	7	6	8	9	10			1			1		1			Q	
24		1		1				1	1				1			1			1	1			1							1			1				1		Q	1
No	2	17	4	5	7	9	0	9	8	14	12	0	9	1	10	20	0	1	20	20	19	19	20	19	19	19	19	19	2	11	9	1	9	6	6	8	9	5	24	15
%	8	71	17	21	29	38	0	38	33	58	50	0	38	4	42	83	0	4	66	54	64	82	32	50	42	39	57	59	8	46	38	4	38	25	25	33	38	21		63

QUES-BLD

19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Building Management

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1	1																																			1			B	1
2		1				1		1	1	1	1		1			1			2	2	2	4	1	1	1	3	3	3	1	1			1			1			B	1
3		1				1				1			1			1			5	9	8	10	1	6	7	2	3	4			1		1			1			B	1
4		1		1					1				1			1			10	9	8	7	1	5	3	2	6	4			1				1	1			B	
5	1								1		1					1			7	6	8	10	5	1	2	3	9	4		1				1			1		B	1
6		1				1		1	1	1			1			1			5	5	5	5	1	10	2	3	4	9					1			1			B	
7		1			1			1		1	1				1	1			10	11	9	12	4	8	2	7	1	3		1			1			1			B	1
8	1																																				1		B	1
9		1			1					1			1			1			2	1	2	9	5	6	7	8	4	3			1		1			1			B	1
10		1				1				1			1			1			9	8	7	10	1	3	2	4	5	6	1						1	1			B	1
11			1												1		1																	1			1		B	
12		1				1		1	1	1					1	1			4	2	3	7	6	1	9	5	10	8	1						1			1	B	1
13		1			1					1			1			1			3	1	5	7	4	9	8	6	2	10		1			1			1			B	1
14		1			1					1					1	1							1	4	2	3	5	6			1				1			1	B	1
No	3	10	1	1	4	5	0	4	5	9	3	0	7	0	4	11	1	0	10	10	10	10	11	11	11	11	11	11	3	4	4	0	6	2	4	9	3	2	14	11
%	21	71	7	7	29	36	0	29	36	64	21	0	50	0	29	79	7	0	57	54	57	81	27	49	41	42	47	55	21	29	29	0	43	14	29	64	21	14		79

QUES-CET
19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Civil Engineering Technicians

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1		1				1				1					1	1			3	2	4	1	5	7	8	9	6	10		1			1			1			CT	1
2		1				1		1	1	1	1		1			1			1	2	7	10	3	4	9	6	5	8		1		1	1			1			CT	
3		1				1			1	1					1	1			5	4	9	7	1	2	3	10	6	8		1			1			1			CT	1
4		1				1				1			1			1			4	2	3	1	5	10	8	6	7	9			1		1			1			CT	1
5		1				1		1	1	1	1		1			1			9	7	8	10	2	1	5	6	3	4			1		1				1		CT	1
6		1				1				1			1			1						1						2		1				1		1			CT	1
7		1		1						1				1		1			5	3	8	9	6	3	1	4	2	7			1		1			1			CT	1
8		1				1				1					1	1			6	4	5	9	2	8	1	7	3	10			1				1	1			CT	1
9		1			1			1	1	1	1					1			9	7	8	10	3	4	2	5	1	6			1		1				1		CT	1
10		1				1		1	1					1		1			7	7	7	7	1	2	4	3	8	9	1	1			1			1			CT	1
11		1			1			1	1	1						1			9	8	7	10	1	3	2	5	4	6		1			1			1			CT	
12					1			1	1	1						1			1	1	1	8	3	6	4	2	5	7			1			1			1		CT	1
13		1			1					1	1				1	1				3	4		2				1				1			1	1				CT	1
14		1			1		1	1	1	1	1					1			8	6	7	10	1	4	2	5	3	9			1		1				1		CT	1
15			1	1						1			1			1			5	2	6	7	3	8	10	1	4	9		1			1			1			CT	1
No	0	13	1	2	5	8	1	7	8	14	5	0	5	2	4	15	0	0	13	14	14	14	14	13	13	13	14	14	1	7	8	1	11	1	3	11	2	2	15	13
%	0	87	7	13	33	53	7	47	53	93	33	0	33	13	27	100	0	0	55	41	60	71	27	48	45	53	41	74	7	47	53	7	73	7	20	73	13	13		87

QUES-ARC
12/10

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Architects

No	Q1			Q2				Q3					Q4			Q5			Q6									Q7				Q8			Q9			Q 1O	Q 11
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U		
1		1		1				1	1	1			1			1			10	8	7	9	1	6	3	5	4	2		1	1		1			1			A	1
2	1				1			1	1	1	1								8	7	6		1	9	2	5	4	3	1				1			1			A	1
3		1		1				1	1	1	1		1			1																		1			1			A	1
4	1																																			1			A	1
5			1		1			1	1	1	1		1			1			2	2	2	2	1	1	1	1	1	1	1					1			1		A	1
6		1			1					1	1					1			9	8	6	7	1	10	2	4	5	3	1					1		1			A	1
7		1			1					1	1					1			8	7	6	10	1	9	3	4	5	2	1					1		1			A	1
8		1				1		1	1	1	1		1			1			8	7	6	10	5	3	4	9	2	1	1	1			1			1			A	1
9		1			1					1					1	1			9	8	7	10	6	1	3	5	4	2			1		1			1			A	1
10	1			1				1	1	1			1			1			9	7	8	10	6	5	1	3	4	2		1				1			1		A	1
11		1			1			1	1						1	1			9	8	7	10	6	1	3	4	5	2			1		1			1			A	1
12	1																																			1			A	1
13		1				1				1			1			1			10	3	4	5	6	8	7	9	1	2		1			1			1			A	1
14		1		1				1					1			1			9	2	3	11	5	10	4	8	1	7			1		1			1			A	1
15			1			1		1	1				1			1			1	2	3	10	5	7	4	6	9	8		1			1			1			A	1
16		1			1						1				1	1			8	7	9	10	1	3	5	6	4	2		1			1			1			A	1
17		1				1		1		1	1		1			1			8	7	6	9	10	4	2	3	5	1		1			1				1		A	1
18		1			1			1		1						1			9	8	7	10	2	4	3	6	5	1			1			1				1	A	1
19	1																																			1			A	1
20		1			1					1						1			6	4		5		3	7	8	2	1		1					1		1		A	
No	5	13	2	4	9	4	0	11	8	13	8	0	9	0	3	16	0	0	16	16	15	15	15	16	16	16	16	16	5	8	5	0	10	5	2	15	4	1	20	19
%	25	65	10	20	45	20	0	55	40	65	40	0	45	0	15	80	0	0	77	59	58	85	38	53	34	54	38	25	25	40	25	0	50	25	10	75	20	5		95

QUES-TRP

19/ 11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Town & Regional Planners

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1		1				1		1	1	1					1	1			8	7	9	10	4	3	1	5	2	6		1			1			1			T	
2	1																																				1		T	1
3		1			1					1					1	1			9	7	8	10	1	3	4	5	6	2		1			1			1			T	
4		1			1		1	1		1	1					1			3	2	9	10	1	5	7	6	8	4			1	1	1			1			T	1
5		1		1				1	1				1			1			5	1	2	6	4	9	7	8	3	10		1			1			1			T	1
6		1				1				1	1					1			10	9	8	7	1	3	2	4	5	6		1			1			1			T	1
7			1			1		1	1	1	1		1			1			6	6	6	6	2	3	1	5	3	10		1					1			1	T	1
No	1	5	1	1	2	3	1	4	3	5	3	0	2	0	2	6	0	0	6	6	6	6	6	6	6	6	6	6	0	5	1	1	5	0	1	5	1	1	7	5
%	14	71	14	14	29	43	14	57	43	71	43	0	29	0	29	86	0	0	68	53	70	82	22	43	37	55	45	63	0	71	14	14	71	0	14	71	14	14		71

QUES-SUR

19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Land Surveyors

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1			1			1		1	1				1					1	9	7	8	10	4	2	3	6	5	1		1					1	1			LS	1
2		1			1			1	1	1	1					1				7			1	6	3	2	5	8			1						1	LS	1
No	0	1	1	0	1	1	0	2	2	1	1	0	1	0	0	1	0	1	1	2	1	1	2	2	2	2	2	2	0	1	1	0	0	0	1	1	0	1	2	2
%	0	50	50	0	50	50	0	100	100	50	50	0	50	0	0	50	0	50	90	70	80	100	25	40	30	40	50	45	0	50	50	0	0	0	50	50	0	50		100

QUES-L-A

19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Landscape Architects

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
1	1																																			1			LA	1

QUES-PP
20/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Summary - Planning Professions

No	Q1			Q2				Q3					Q4			Q5		
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U
C	3	48	4	13	11	33	6	39	33	44	34	0	28	7	11	52	5	0
EM	5	15	0	0	5	11	3	7	6	14	4	2	9	1	5	15	2	0
Q	2	17	4	5	7	9	0	9	8	14	12	0	9	1	10	20	0	1
B	3	10	1	1	4	5	0	4	5	9	3	0	7	0	4	11	1	0
CT	0	13	1	2	5	8	1	7	8	14	5	0	5	2	4	15	0	0
A	5	13	2	4	9	4	0	11	8	13	8	0	9	0	3	16	0	0
T	1	5	1	1	2	3	1	4	3	5	3	0	2	0	2	6	0	0
LS	0	1	1	0	1	1	0	2	2	1	1	0	1	0	0	1	0	1
LA	1																	
Σ	20	122	14	26	44	74	11	83	73	114	70	2	70	11	39	136	8	2
%	13	76	9	16	28	46	7	52	46	71	44	1	44	7	24	85	5	1

No	Q6										Q7				Q8			Q9			Q	Q
	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
C	5	4	5	8	3	5	5	6	5	7	6	27	25	2	43	6	7	40	7	9	57	45
EM	4	4	3	7	4	6	5	6	5	8	1	9	7	6	11	2	4	15	4	1	20	14
Q	7	5	6	8	3	5	4	4	6	6	2	11	9	1	9	6	6	8	9	5	24	15
B	6	5	6	8	3	5	4	4	5	5	3	4	4	0	6	2	4	9	3	2	14	11
CT	6	4	6	7	3	5	5	5	4	7	1	7	8	1	11	1	3	11	2	2	15	13
A	8	6	6	9	4	5	3	5	4	3	5	8	5	0	10	5	2	15	4	1	20	19
T	7	5	7	8	2	4	4	6	5	6	0	5	1	1	5	0	1	5	1	1	7	5
LS	9	7	8	10	3	4	3	4	5	5	0	1	1	0	0	0	1	1	0	1	2	2
LA																		1			1	1
Σ	746	617	713	1043	438	694	603	721	646	812	18	72	60	11	95	22	28	105	30	22	160	125
%	56	45	54	81	32	51	44	54	48	62	11	45	38	7	59	14	18	66	19	14		78

APPENDIX C1

SURVEY DIRECTED AT THE LEARNED SOCIETIES

Copies of the covering letter and questionnaire sent to the learned societies of the planning professions (see § 3.4) are contained within following pages of this appendix.

Private Bag X6011 Privaatsak
Port Elizabeth
6000
tel: (041) 5043911
fax: 533644

12 June 1993

Dept.: CIVIL ENGINEERING

Ref./Verw.:

Addressed to:
Learned societies representing
the various planning professions

Dear Sir

ENVIRONMENTAL EDUCATION AT TECHNIKONS

Through the Department of Civil Engineering at the PE Technikon an investigation is being launched into the need for **environmental education for members of the engineering and related professions.** This investigation is being done in view of accusations of environmental insensitivity that are sometimes being levelled against the said professions. The objective is the possible development of a special environmental course (or courses), and/or the amendment of our existing curricula in order to meet, as best we can, the perceived need.

Environmental education in the context of this investigation is construed in its widest context. It certainly involves the traditional emphasis on the natural environment, but it is suggested that issues of the broader environment also need to be addressed. This includes the social and cultural environments in both first and third world contexts. It is felt that some of the issues in these areas are so important and pervasive, both locally and globally, that we ignore them at our peril.

This investigation springs forth from our involvement in the field of civil engineering education. It is nevertheless thought that the thrust of the investigation should be broadened to include all the other engineering disciplines and the related professions in order to expose the possibility of common needs which could lead to more broadly based 'solutions'. The other engineering disciplines and related professions being considered here are: electrical engineering, mechanical engineering, agricultural engineering, architecture, building management, quantity surveying, land surveying, town and regional planning, etc.

One component of this investigation will attempt to determine the views of the professional bodies on these issues. It was also felt that these bodies would be able to supply information on the existing environmental educational practices in their various professional disciplines. Hence I am approaching you as the Executive Officer of your professional organisation with the request that the enclosed questionnaire be completed so as to reflect the view of your profession. I am sure that you will agree that education in general, and education for the said professions in particular, must be responsive to the demands of the times. I hope therefore that I may count on your co-operation in this regard, for which, in anticipation, I sincerely thank you. Despite its bulky appearance the questionnaire only contains twelve questions. The completed questionnaire may be returned in the enclosed envelope at your earliest convenience. If requested I would be pleased to supply you with follow-up information in respect of this investigation.

Thank you once again for your assistance.

Yours sincerely

S.S.Long Pr.Eng.
HEAD OF DEPARTMENT

TECHNIKON-BASED ENVIRONMENTAL EDUCATION
aimed at the
ENGINEERING AND RELATED PROFESSIONS

INSTRUCTIONS:

° Please complete the questionnaire by placing ticks in the appropriate blocks or by responding in whatever other ways the questions may indicate.

° You are encouraged, where you feel it necessary, to qualify or elaborate on your answers in the spaces provided, or even by using additional sheets of paper. All types of responses, even those in the 'Not sure' categories will provide useful information for the purposes of this investigation.

° You may wish to peruse the whole questionnaire first in order to understand its general thrust.

Thank you.

---

1. Are the professionals in your discipline *adequately educated* in environmental matters?

Yes	No	Not sure

[adequately educated = thoroughly informed as to the impact of their professional activities on the environment in its broadest sense]

.....

.....

.....

(If your answer to this question is an unqualified 'yes', please move on to question 8.)

---

2. Could the inadequacies in the environmental education of the professionals in your discipline be addressed by means of:

(a) an optional, post-first qualification course* specialising in environmental matters? ☐

(b) amendments to the present curricula of the existing first qualification courses? ☐

(c) both of the above ☐

(d) any other (please specify). ☐

*post-graduate or post-diploma

.....

.....

.....

.....

---

3. Should the inadequacies in the environmental education of the professionals in your discipline be addressed in the areas of:

(a) knowledge about the natural ☐ and social ☐ environment?

(b) environmental concern, values and accountability? ☐

(c) ability to communicate and work in a team in an interdisciplinary manner? ☐

(d) any other (please specify). ☐

.....

.....

.....

.....

4. If a post-first qualification specialist environmental course is indicated in question 2, could your professional discipline be accommodated in the same course as the different engineering and other related disciplines?

Yes	No	Not sure

.....

.....

.....

5. Would the following statement be acceptable to your professional discipline, and if not, why not?

*Special environmental courses for engineers and those from related disciplines should be **holistic, interdisciplinary** and **issue-based** to enable such persons to appreciate the fundamental significance of the **relationship between man and his environment.***

[where: holism = a philosophical stance which places emphasis on the whole as opposed to the constituent parts.

interdisciplinary = an educational approach that seeks to break through the boundaries of subject disciplines to reinforce the principle of holism.

issue based = a characteristic of curriculums which emphasize issues rather than knowledge or techniques, e.g. pollution is an issue, but chemistry is not.]

☐ Acceptable ☐ Not acceptable ☐ Not sure

pto

8. Do you think it appropriate for practitioners in your professional discipline to act as environmental managers as opposed to say biological scientists?

Yes	No	Not sure

.....

.....

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9. Could you please supply information in regard to existing environmental education practices in your professional discipline.

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10. Your professional discipline:

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11. Do you wish to receive further information about the results which may flow from this investigation?

Yes	No

12. Name of contact person and address of professional body:

.....

.....

.....

.....

.....

Please return to: The Head of Department: Civil Engineering
PE Technikon
Private Bag 6011
PORT ELIZABETH
6000

THANK YOU!

APPENDIX C2

SUMMARISED RESULTS FROM THE SURVEY DIRECTED AT THE LEARNED SOCIETIES

The summarised results of a questionnaire sent to learned societies of the planning professions (see § 3.4) are contained within following pages of this appendix.

KEY FOR THE TABLES IN THIS APPENDIX:

A	=	Architects
Ap	=	Atmospheric pollution
BM	=	Building managers
BR	=	Block release
Be	=	Built environment
CE	=	Civil engineers
CO	=	Consulting engineers
CT	=	Civil engineering technicians
Ec	=	Environmental economics
Em	=	Environmental management
Et	=	Environmental ethics
Ey	=	Ecology
FT	=	Full-time
MM	=	Mining & metallurgy
N	=	No
Np	=	Nuclear pollution
O	=	Other
PT	=	Part-time
QS	=	Quantity surveyors
Si	=	Social issues
SU	=	Land surveyors
Sw	=	Solid waste management
TP	=	Town & regional planners
U	=	Not sure
Wp	=	Water pollution
Y	=	Yes

QUES-L-S
19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Learned Societies

No	Q1			Q2				Q3					Q4			Q5			Q6										Q7				Q8			Q9			Q	Q
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	FT	PT	BR	O	Y	N	U	Y	N	U	1O	11
L1		1		1				1	1	1	1		1			1			3	2	8	10	1	4	5	6	7	9		1	1		1				1		CT	1
L2		1				1			1	1			1			1			9	8	5	10	2	4	7	6	3	1		1			1				1		A	1
L3	1																																1			1			TP	1
L4		1				1		1	1	1	1				1	1			5	3	6	10	1	2	8	4	7	9		1	1		1				1		CE	1
L5	1																																1	1		1			SU	1
L6		1				1		1	1	1	1		1			1			3	3	4	6	1	4	1	1	5	2	1	1	1	1	1				1		CO	1
L7		1				1	1	1		1	1	1	1			1			5	6	7	13	1	2	10	3	12	11	1		1	1	1				1		MM	1
L8		1				1				1	1		1			1			1	4	5	10	2	9	3	6	7	8		1					1		1		BM	1
L9		1				1					1		1					1					3	4		2	5	1			1			1			1		QS	1
No	2	7	0	1	0	6	1	4	4	6	6	1	6	0	1	6	0	1	6	6	6	6	7	7	6	7	7	7	2	5	5	2	7	2	1	2	7	0	9	9
%	22	78	0	11	0	67	11	44	44	67	67	11	67	0	11	67	0	11	43	43	58	98	16	41	57	40	66	59	22	56	56	22	78	22	11	22	78	0		100

APPENDIX D1

SURVEY DIRECTED AT THE ENVIRONMENTALISTS

Copies of the covering letter and questionnaire sent to the environmentalists (see § 3.5) are contained within following pages of this appendix.

Private Bag X6011 Privaatsak
Port Elizabeth
6000
tel: (041) 5043911
fax: 533644

12 June 1993

Dept.: CIVIL ENGINEERING

Ref./Verw.:

Addressed to:
Environmental specialists

Dear Sir

ENVIRONMENTAL EDUCATION AT TECHNIKONS

Through the Department of Civil Engineering at the PE Technikon an investigation is being launched into the need for **environmental education for members of the engineering and related professions.** This investigation is being done in view of accusations of environmental insensitivity that are sometimes being levelled against the said professions. The objective is the possible development of a special environmental course (or courses), and/or the amendment of our existing curricula in order to meet, as best we can, the perceived need.

Environmental education in the context of this investigation is construed in its widest context. It certainly involves the traditional emphasis on the natural environment, but it is suggested that issues of the broader environment also need to be addressed. This includes the social and cultural environments in both first and third world contexts. It is felt that some of the issues in these areas are so important and pervasive, both locally and globally, that we ignore them at our peril.

This investigation springs forth from our involvement in the field of civil engineering education. It is nevertheless thought that the thrust of the investigation should be broadened to include all the other engineering disciplines and the related professions in order to expose the possibility of common needs which could lead to more broadly based 'solutions'. The other engineering disciplines and related professions being considered here are: electrical engineering, mechanical engineering, agricultural engineering, architecture, building management, quantity surveying, land surveying, town and regional planning, etc.

A questionnaire similar to the one enclosed is being sent to a sample of practitioners in the in the above mentioned professional fields. However it has also been thought prudent to approach a number of environmental specialists in order to build an 'informed outsider's point of view' on the issues that we are raising with the said professions. Hence we are approaching you as an environmental specialist, trusting that you will be kind enough to spare a few minutes of your time to fill in the enclosed questionnaire, returning it in the enclosed envelope at your earliest convenience. Despite its somewhat bulky appearance the questionnaire only contains ten questions. I am hoping that you will agree that the issues being raised are very important from an environmental point of view, and hence will be willing to give of your valuable time to participate in this information gathering exercise. Thank you very much for your co-operation. Although you are requested to supply your name and address you may, if you wish, treat the questionnaire anonymously. The content of each questionnaire will in any event only be used in a anonymous manner. Respondents' names and addresses are merely to be used for control purposes, and in those instances where respondents have requested follow-up information.

Thank you once again for your assistance.

Yours sincerely

S.S.Long Pr.Eng.
HEAD OF DEPARTMENT

TECHNIKON-BASED ENVIRONMENTAL EDUCATION
aimed at the
ENGINEERING AND RELATED PROFESSIONS

INSTRUCTIONS:

° Please complete the questionnaire by placing ticks in the appropriate blocks or by responding in whatever other ways the questions may indicate.

° You are encouraged, where you feel it necessary, to qualify or elaborate on your answers in the spaces provided, or even by using additional sheets of paper. All types of responses, even those in the 'Not sure' categories will provide useful information for the purposes of this investigation.

° You may wish to peruse the whole questionnaire first in order to understand its general thrust.

Thank you.

---

1. Do you think that engineers and related professionals are *adequately educated* in environmental matters?

Yes	No	Not sure

[adequately educated = thoroughly informed as to the impact of their professional activities on the environment in its broadest sense]

.....

.....

.....

(If your answer to this question is an unqualified 'yes', please move on to question 7.)

---

2. Do you think that the inadequacies in the environmental education of those in the engineering and the related professions could be addressed by means of:

(a) an optional, post-first qualification course* specialising in environmental matters? ☐

(b) amendments to the present curricula of the existing first qualification courses? ☐

(c) both of the above ☐

(d) any other (please specify). ☐

*post-graduate or post-diploma

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3. Do you think that the inadequacies in the environmental education of those in the engineering and the related professions should be addressed in the areas of:

(a) knowledge about the natural ☐ and social ☐ environment?

(b) environmental concern, values and accountability? ☐

(c) ability to communicate and work in a team in an interdisciplinary manner? ☐

(d) any other (please specify). ☐

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4. If a post-first qualification specialist environmental course is indicated in question 2 do you think that the different engineering and related disciplines could all be accommodated in the same course?

Yes	No	Not sure

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.....

5. Is the following statement acceptable to you, and if not, why not?

*Special environmental courses for engineers and those from related disciplines should be **holistic, interdisciplinary** and **issue-based** to enable such persons to appreciate the fundamental significance of the **relationship between man and his environment.***

[where: holism = a philosophical stance which places emphasis on the whole as opposed to the constituent parts.

interdisciplinary = an educational approach that seeks to break through the boundaries of subject disciplines to reinforce the principle of holism.

issue based = a characteristic of curriculums which emphasize issues rather than knowledge or techniques, e.g. pollution is an issue, but chemistry is not.]

☐ Acceptable ☐ Not acceptable ☐ Not sure

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6. The adjacent list of topics may form part of the environmental curriculum aimed at members of the engineering and related professions. You may wish to add a few more. Number all the topics in order of importance as you see it, with 1 being most important, 2 the second most important, etc.

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Topic	Rank
Solid waste management	
Water pollution	
Atmospheric pollution	
Nuclear pollution	
Environmental management	
Social issues	
Environmental ethics	
Environmental economics	
Ecology	
The built environment	

7. Do you think it appropriate for engineers or others from related professions to act as environmental managers as opposed to say biological scientists?

Yes	No	Not sure

.....

.....

.....

.....

8. What is your environmental specialisation?

.....

9. Do you wish to receive further information about the results which may flow from this investigation?

Yes	No

10. Your name and address:

.....

.....

.....

.....

.....

Please return to: The Head of Department: Civil Engineering
PE Technikon
Private Bag 6011
PORT ELIZABETH
6000

THANK YOU!

APPENDIX D2

SUMMARISED RESULTS FOR THE SURVEY DIRECTED AT THE ENVIRONMENTALISTS

Summarised results obtained from the questionnaires sent to the environmentalists (see § 3.5) are contained within following pages of this appendix.

KEY FOR THE TABLES IN THIS APPENDIX:

Ap	=	Atmospheric pollution
BR	=	Block release
Be	=	Built environment
Ec	=	Environmental economics
Em	=	Environmental management
Et	=	Environmental ethics
Ey	=	Ecology
FT	=	Full-time
N	=	No
Np	=	Nuclear pollution
O	=	Other
PT	=	Part-time
Si	=	Social issues
Sw	=	Solid waste management
U	=	Not sure
Wp	=	Water pollution
Y	=	Yes

QUES-ENV

19/11

ENVIRONMENTAL QUESTIONNAIRE ANALYSIS

Environmentalists

No	Q1			Q2				Q3					Q4			Q5			Q6									Q7			Q8	Q9	
	Y	N	U	a	b	c	d	a1	a2	b	c	d	Y	N	U	Y	N	U	Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	Y	N	U		Y	N
1		1			1			1	1		1				1	1			6	4	5	10	1	3	7	8	2	9	1			E	1	
2		1		1				1		1			1			1			4	2	3	9	1	8	5	7	6	10	1			E	1	
3			1	1	1			1	1	1	1			1			1		5	4	6	7	1	9	10	3	8	11	1			E	1	
4		1			1			1	1	1						1			6	6	6	6	2	5	1	3	2	4	1			E	1	
5		1				1	1	1	1	1	1	1		1		1	1		6	6	6	6	6	3	3	3	1	6	1			E	1	
6		1				1		1	1	1	1		1			1			8	6	9	10	1	5	4	3	2	7		1		E	1	
7		1	1		1			1	1	1	1	1		1		1			8	6	7	10	11	3	1	5	4	9	1			E	1	
8		1			1			1	1	1	1	1				1			7	8	9	10	2	3	1	4	5	6		1	1	E	1	
9		1				1				1			1			1				4	5		7	6					1			E	1	
10		1				1	1	1	1	1	1	1	1			1			10	9	11	12	5	3	8	4	7	6	1			E	1	
11		1			1			1	1	1	1	1	1	1		1	1		3	3	3	3	2	4	6	5	4	4	1			E	1	
12		1				1		1	1	1	1			1		1			5	4	8	9	7	3	6	1	2	10		1		E	1	
13		1			1			1	1	1	1				1	1			7	8	9	10	3	2	1	6	5	4	1			E	1	
14		1			1			1	1	1			1			1														1		E	1	
15		1			1						1					1			2	2	2		1	6	9	5	8	7		1		E	1	
16		1		1				1	1	1	1		1			1			7	8	9	10	1	3	2	4	6	5	1			E	1	
17		1				1		1	1	1	1		1			1			3	4	5	6	9	2	10	7	1	8		1		E	1	
18		1		1	1									1		1			3	2	4	5	1	10	6	7	8	9		1		E	1	
19		1				1				1					1	1			7	4	9	10	3	2	1	8	5	6	1			E	1	
20		1				1		1		1			1			1			5	5	5	5	2	3	3	5	1	4		1		E	1	
21		1				1		1	1	1	1		1			1				5	6				1	7		8		1		E	1	
22			1			1		1	1	1	1		1			1			7	8	2	4	6	3	5	9	1	10	1			E	1	
23			1			1		1	1	1	1		1			1			4	4	4	4	3	1	2	2	1	3	1			E	1	
24		1				1	1	1	1	1	1		1			1														1		E	1	
No	0	21	4	4	10	12	3	20	18	21	17	5	13	6	3	23	3	0	20	22	22	19	21	21	21	21	20	21	14	10	1	24	24	0
%	0	88	17	17	42	50	13	83	75	88	71	21	54	25	13	96	13	0	57	51	60	77	36	41	44	50	40	70	58	42	4		100	0

APPENDIX E

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT SOUTH AFRICAN UNIVERSITIES

The results of a survey aimed at establishing the extent of environmental education available to engineers at South African universities is contained within this appendix.

KEY FOR THE TABLES IN THIS APPENDIX:

Ap	=	Atmospheric pollution
BR	=	Block release
Be	=	Built environment
Ce	=	Civil engineering
ES	=	Engineering & Science
Ec	=	Environmental economics
Ee	=	Environmental engineering
Em	=	Environmental management
Es	=	Environmental science
Et	=	Environmental ethics
Ey	=	Ecology
FT	=	Full-time
Md	=	Multi-disciplinary
Np	=	Nuclear pollution
PT	=	Part-time
Rp	=	Research project
Si	=	Social issues
Sw	=	Solid waste management
We	=	Water engineering
Wp	=	Water pollution

SAU-UG
19/11

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT SA UNIVERSITIES
Undergraduate Level

Inst No	Optional/ Compulsory	Level (year)	Orientation	Weighting (%)
U1	O	4	Environmental Management	1.4
U2	C	4	Environmental Management	2.8
U3	C	4	Environmental Management	2.1
U4	C	3	Project Planning	0.8
U5	C	4	Project Planning	1.6
U6	C	4	Environmental Engineering	1.7

U7: Being developed — Average: 1.7
U8: Not being offered

SAU-PG
19/11

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT SA UNIVERSITIES
Post-graduate Level

Inst No	Dura-tion (yrs)	Programme Format			Entry Discipline			Main thrust of P/G programme					Op-tions	Coursework topics & research project weighting (%)									
		FT	PT	BR	Ce	ES	Md	Ce	We	Ee	Em	Es		Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	Rp
U1	1.0	1			1			1						6	1			3	2			1	1	40
U2	1.0	1				1			1					6	17	5		8						50
U3	1.5	1					1				1			6	6	6		10	10	10	5	10	5	33
U4	2.0	1	1			1				1		1	1	6	13	13		3			3	3		12
U5	2.0	1		1	1				1						8			4				4		25
U6	2.0		1		1					1				8	14	6		8	4				8	8
No	6	5	2	1	3	2	1	1	2	2	1	1	1	5	6	4	0	6	3	1	2	4	3	6
%	1.6	63	25	13	50	33	17	14	29	29	14	14	17	6	10	8	0	6	5	10	4	5	5	28

U7: Being developed
U8: Not sufficient information

APPENDIX F

ENVIRONMENTAL PROGRAMMES AT SOUTH AFRICAN TECHNIKONS

According to EPPIC (1993: 24-27) the following environmental programmes are being offered at South African technikons.

1. National Diploma in Environmental Health
2. National Higher Diploma in Environmental Health
3. Diploma in Environmental Health
4. Diploma in Horticulture
5. National Diploma in Chemical Engineering
6. Masters Diploma in Civil Engineering
7. National Diploma in Nature Conservation
8. National Diploma in Parks and Recreation Management
9. National Certificates in Pollution Control
10. Certificate in Mine Environmental Control
11. National Diploma in Water Care

ooooOOOOoooo

APPENDIX G

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT OVERSEAS UNIVERSITIES

The results of survey aimed at establishing the nature of environmental education that is available to engineers at overseas universities is contained within this appendix.

KEY FOR THE TABLES IN THIS APPENDIX:

Ag	=	Agriculture
Ap	=	Atmospheric pollution
BR	=	Block release
Be	=	Built environment
Ce	=	Civil engineering
Co	=	Conservation
De	=	Development
ES	=	Engineering & Science
Ec	=	Environmental economics
Ee	=	Environmental engineering
Eh	=	Environmental health
Em	=	Environmental management
En	=	Energy
Es	=	Environmental science
Et	=	Environmental ethics
Ey	=	Ecology
FT	=	Full-time
La	=	Law & legislation
Md	=	Multi-disciplinary
No	=	Noise
Np	=	Nuclear pollution
PT	=	Part-time
Re	=	Natural resources
Rp	=	Research project
Si	=	Social issues
Sw	=	Solid waste management
We	=	Water engineering
Wp	=	Water pollution

OSU-UG
19/11

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT OVERSEAS UNIVERSITIES

Under-graduate Programmes

Inst No	Dura-tion (yr)	Programme Format			Main thrust of instructional programme								Opt-ions	Coursework topics & Research project weighting (%)																	
		FT	PT	BR	Ce	We	Ee	Em	Es	Co	En	Re		Sw	Wp	Ap	Np	Em	Si	Et	Ec	Ey	Be	Re	En	De	Ag	No	La	Eh	Rp
A1	4	1					1							2	4	1	1	2	2	1		2		2					2		4
A2	4	1										1			3			3			3			3					3		3
A4	4						1		1				2																		
A5	4	1					1		1				2																		
A6	4	1	1				1							2	2	2	1	4	4	1	1	2		2					2		5
A7	4	1				1								1	1			1	2			3		2							3
A8	4	1					1							1	6	1	1	4	2		2	6		1					2		4
A9	4	1					1							1	5	3	1	4		1	1	3							1		3
G1	2.5	1							1					5	5	5				5	5							2	5	2	5
UK1	3	1			1									2	2	2	1	7	1			2	1						1		
UK2	4	1			1									2	4	4		2					2							4	4
UK4	3	1					1							8	7	3	1	8				2			3			3			4
US1	4	1					1							3	5	4		1		1				1					1		2
US10	4	1			1										20			2	10	2	2								2		12
US11	4	1												1	3	1															
US13	4	1			1									1	3	1		1	1										1		
US14	4	1			1									2	4	2															
US15	4	1			1									3	3	1															
US4	4	1			1										3									2							
US7	4	1					1							2	4	2			2												
US8	4	1					1							2	4	2	2														
US9	4	1			1									1	3	1															
No	22	21	1	0	8	1	10	0	3	0	0	1	2	17	20	16	7	12	8	6	6	7	2	7	1	0	0	2	10	2	11
%	3.8	95	5	0	35	4	43	0	13	0	0	4	9	2	5	2	1	3	3	2	2	3	2	2	3	0	0	3	2	3	4

OSU-PGS
27/11

ENVIRONMENTAL EDUCATION FOR ENGINEERS AT OVERSEAS UNIVERSITIES
Post-graduate Programmes

Inst No	Dura tion (yr)	Programm Format			PG Entry Discipline			Main thrust of instructional programme							Opt- ions	Coursework topics & Research project weighting (%)																
		FT	PT	BR	Ce	ES	Md	We	Ee	E	Es	Co	En	Re		Sw	Wp	A	Np	Em	Si	Et	Ec	Ey	Be	Re	En	De	Ag	No	La	Eh	Rp
A1	1	1	1		1						1					12	12	2		10				5							10		30
A3	1	1	1		1						1					7	13	11		14						7					13	7	33
A7	1.5	1	1			1			1		1				2	8	8	8	1	2	1			3						4	2	2	40
B1	2	1				1					1					11	12	4	2	2			2	9					1	1	1	6	20
C1	1	1	1		1	1			1						2	8	16	8		8				8		16							30
C1	1	1	1		1	1				1						2	2	2	2	12	8	4	8			8		8			8		30
G1	2.5	1				1					1				4	5	14	5		5	5		5			2					5		25
N1	1.5	1				1		1			1				2	3	7	4	1	8				11		8	1				1	1	33
N2	1.5	1									1	1		1	4	4	4	4	1	10	4		4	4		4					2		33
UK3	1	1					1						1			2	2	4	3	4	5	2	10	4		4	10				6		33
UK3	1	1					1					1				4	4	6	1	6	5	2	4	13		7		3	3				33
UK3	1	1					1	1							5	2	15	4	1	6	5	2	5	4				3	5				33
UK3	1	1					1				1					8	8	11	6	4	5	2	4	4						3			33
UK3	1	1					1			1						6	6	8	1	10	8	2	4	4							4		33
No	14	14	5	0	4	6	5	2	2	2	8	2	1	1	6	14	14	14	10	14	9	6	9	11	0	8	2	3	3	3	10	4	14
%	1.3	74	26	0	27	40	33	11	11	11	44	11	6	6	42.9	5.9	9	6	2	7	5	2	5	6	0	7	6	5	3	3	5	4	31
US1	2	1	1		1	1			1							30	30	5		5													20
US1	1							1			1				2																		
US1	1.5	1			1				1		1				2	8	24	8		8				8									20
US1	1	1	1		1			1								30	40																20
US2	2	1				1			1		1				2	5	20	20	5	5				5									20
US3	1	1				1			1		1				2	10	20	5		4			4										20
US4	2	1	1		1			1								25	30				10		15			10							20
US5	1				1			1	1						2	20	20						10			10							20
US6	1				1			1						1	2	10	30			5				10		20							20
US7	1	1			1				1		1				2	20	20	20	10														20
US8	1.5	1				1		1	1							20	20	10	10														20
No	11	8	3	0	7	4	0	6	7	0	5	0	0	1	7	10	10	6	3	5	1	0	3	3	0	3	0	0	0	0	0	0	10
%	1.4	73	27	0	64	36	0	32	37	0	26	0	0	5	63.6	18	25	11	8	5	10	0	10	8	0	13	0	0	0	0	0	0	20
No	25	22	8	0	11	10	5	8	9	2	13	2	1	2	13	24	24	20	13	19	10	6	12	14	0	11	2	3	3	3	10	4	24
%	2.2	73	27	0	42	38	19	22	24	5	35	5	3	5	52	11	16	7	3	7	6	2	6	7	0	9	6	5	3	3	5	4	27

APPENDIX H

NATIONAL DIPLOMA IN CIVIL ENGINEERING AT THE PORT ELIZABETH TECHNIKON

Curriculum

The National Diploma is a **3-year** qualification of which two years are spent at the Technikon and one year in industry undergoing experiential training.

YEAR 1 (Technikon attendance)

PART S1 (Duration: 1 Sem.)		PART S2 (Duration: 1 Semester)	
Mathematics IA	WIC110	Mathematics IIB	WIC220
Surveying I	CSU111	Surv.(Civil) II	CSU221
Drawing I	CDR111	Drawing II	CDR221
Appl. Mechanics I	CAM111	Theory of Str.II	CTS221
Construction IA	CCO111	Construction IB	CCO121
Computer Skills I	CCP111	Comm. Skills IA	CCM121
		Man.(Civil) I	CMC121

YEAR 2 (Experiential Training)

CIVIL ENGINEERING PRACTICE CEP201, consisting of the following two semester modules:
Civil Engineering Practice IIA CEP211
Civil Engineering Practice IIB CEP221

YEAR 3 (Technikon Attendance)

PART S3 (Duration: 1 Semester)		PART S4 (Duration: 1 Semester)	
Management (Civil)	CMC231	Documentation III	CDO341
Transportation Eng II	CTE231	Transportation Eng III	CTE341
Geotechnical Eng II	CGE231	Geotechnical Eng III	CGE341
Struct. Design IIIA	CSD331	Struct. Design IIIB	CSD341
Struct. Analysis II	CSA231	Struct. Analysis III	CSA341
Water Engineering II	CWE231	Water Engineering III	CWE341

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