Embedding information technology into the further education vocational education and training curriculum

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EMBEDDING

INFORMATION TECHNOLOGY

INTO THE FURTHER EDUCATION

VOCATIONAL EDUCATION AND TRAINING

CURRICULUM

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Collaborating Organisation: The Further Education Unit

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ABSTRACT

The purpose of this study was to develop a model of change which identified the forces that drive and restrain the embedding of information technology into Further Education vocational education and training courses for sixteen to nineteen year old students.

The analytical inductive approach used for the research had four components.

Firstly, the literature review examined the educational, media and theoretical contexts of the research.

Secondly, the fieldwork which aimed to identify the driving and restraining forces, comprised:

- a casing exercise undertaken at national, regional and local levels
- a census and surveys using data collected from two sources: Further Education vocational education and training courses in the Sheffield LEA area and the evaluation of the AI (Artificial Intelligence) applications to learning programme
- case studies: two longitudinal case studies, an implementation case study and three one shot case studies.

Thirdly, evaluation tools were developed to aid researchers evaluate governmental intervention into the embedding of advanced information technology into the Further Education vocational education and training curriculum.

Finally, four models of change were developed which identified and utilised the factors found to affect the embedding of information technology in Further Education vocational education and training courses. These models included:

- the Tricycle model which identifies three groups of people who may influence, positively or negatively, the change strategy
- the Factors Affecting the Introduction of Information Technology (FAIIT) model that outlines the factors, agencies, organisations and people which may influence the introduction of information technology into Further Education vocational education and training courses
- EMBED, a three staged model which highlights the driving and restraining forces influencing the introduction of information technology and advanced information technology into the Further Education vocational education and training curriculum
- the Durability model which focuses on the Further Education institution and provides a strategic framework to assist government and other funding agencies and departments embed information technology and advanced information technology into vocational education and training courses.

CHAPTER 1

INTRODUCTION

The purpose of this study was to develop a model of change which identified the forces that drive and restrain the embedding of information technology into Further Education vocational education and training courses for sixteen to nineteen year old students.

The reason for developing the model was to assist government and other funding agencies and departments to target funds more accurately on the critical success factors, for the embedding (sometimes called institutionalisation) of information technology and advanced information technology (AIT, more commonly called leading edge technology) into Further Education vocational education and training courses.

Aims and objectives of the study

The aim of this study, at the outset, was to develop a comprehensive model of change which outlined the forces that drive and restrain the embedding of information technology into the Further Education vocational education and training curriculum.

Another aim, which emerged as the study progressed, was to develop a set of evaluation tools that would enable researchers (and others) to better evaluate the impact of the curriculum change aimed at introducing AIT into Further Education vocational education and training.

The **specific objectives** of the study were to:

a. select an appropriate methodology which would allow sufficient valid and reliable data to be collected for the construction of a valid model of change
b. determine the amount of, type of and reasons why information technology was introduced into the curriculum areas studied

c. establish the critical factors which could influence the introduction and embedding of information technology into Further Education vocational education and training courses

d. evaluate relevant theories and models of curriculum and institutional change to establish their worth and implications for this study

e. evaluate the attitudes and perceptions of key stakeholders, to establish how these may affect the introduction and embedding of information technology into Further Education vocational education and training courses

f. assess the impact of governmental and other funding and/or intervention activities aimed at introducing information technology into Further Education vocational education and training courses

g. develop a comprehensive model of curriculum change for embedding information technology into the Further Education vocational education and training curriculum.

Reasons for conducting the study

There were three main reasons for conducting this study:

- lack of research on curriculum change in this context
- the importance of Further Education developments in information technology for the United Kingdom's (UK) future economic needs
- the need for effective strategies for change.

Lack of research on curriculum change in this context

A vast amount of research has been conducted in the United States and Canada on various aspects of curriculum and organisational change.

However, as Leigh (1988) states:

> *Missing from the mountainous pile of literature, whether academic or autobiographical are:*
> - *a rigorously tested model explaining how organisations work*
>
> and an indication of
> - *the levels of change, which are generally known to work.*
>
> Leigh (1988)

Most theories and models postulated thus far relate to compulsory education (see Figure 2, see page 26). The nature and diversity of Further Education and particularly the intricacies of Further Education vocational education and training make it a difficult area to access and thus, to study.

At the outset of this study little research in the UK had focused on those factors that could help facilitate the embedding of information technology and AIT into Further Education vocational education and training courses. In 1983 most of the research available on this subject came from:

- studies commissioned by the Further Education Unit (FEU)
- work completed by Further Education staff college (Coombe Lodge)
- studies funded by the Manpower Services Commission ([MSC] now the Department of Employment [DoE]), through its Further Education Branch and the New Training Technology (NTT) section (now the Learning Technology Unit [LTU]).

However, over the past decade many surveys have been conducted which have provided information about the factors affecting the introduction of information technology into Further Education vocational education and training courses. Unfortunately, none of these offer a comprehensive model or theory that can aid government in its deliberations about the parameters for funding which will facilitate the embedding of information technology and AIT into the Further Education vocational education and training curriculum.

As the reader will see from the literature review, the government have spent millions of pounds funding initiatives to facilitate the introduction of information technology into Further Education, notably through:

- the Department for Education's (DFE), formerly the Department of Education and Science's (DES), Education Support Grant (ESG), now under the Grants for Education Support and Training (GEST) scheme
- the DoE's Mutual Development Fund, previously the Non-Advanced Further Education (NAFE) central reserve.

However, little real evidence of the factors which have facilitated the successful embedding of information technology across Further Education vocational educational and training courses have emerged from this work.

The importance of Further Education developments in information technology for the UK's future economic needs

As Further Education institutions provide most technician and craft training, the way in which the Further Education vocational education and training curriculum incorporates information technology and AIT has implications for industry and for its students. For industry, the training and examinations provided must not only include use of the new technologies necessary for future economic growth and industrial production but be proactive in their introduction. For students, their training must enable them to see the relevance and necessity of such technologies as well as equipping them to respond to technological change.

One core concern highlighted by the second Butcher Report (1984), reiterating ALVEY (1982), was that the education and training infrastructure was not responding adequately to the changing demands of information technology. The report had several reservations about information technology shortages and technician education. One of the most important findings for this study was that the training provision for information technology from companies, the education system and private sources was inadequate.

This was due, according to Butcher (1984), to:

> *failure by industry to anticipate its future needs, a shortage of manpower undergoing training and problems of access to courses.*
>
> Butcher (1984)

To remedy this, the Butcher committee concluded that:

> *employers must co-operate more fully with the education and training system in order to ensure that their needs are met, and that they must anticipate these needs and articulate them clearly both to the workforce and to the providers of training* because *unless industry and commerce has the information technology-skilled workforce it requires, the UK will be unable to reverse its declining share, let alone maintain or increase its share of growing world markets.*
>
> Butcher (1984)

These reports and the Information Technology year (1982) prompted many government initiatives including the Microelectronics Education Programme (MEP) and the Microprocessors in Schools (MSS) for the school sector. Especially relevant to Further Education were the:

- ESG (now under GEST) funding activity J (1985) and V from 1986/1987
- DoE's (formerly the MSC) Work Related Further Education Mutual Development fund
- Department of Trade and Industry's (DTI) funding for information technology industrial skills updating and information technology based management information systems.

Unfortunately, over the period of this study, the literature review revealed that industry did not consider Further Education as the prime provider for courses in information technology.

The need for effective strategies for change

Instituting curriculum change in any part of the education system is not easy. This is especially so where the purchase of expensive equipment and the retraining of staff is necessary.

Most initiatives have been introduced without sound knowledge of the strategies which could ensure effective and efficient uptake. Within this study evaluation was found to be negligible and tools which could aid programme leaders to assess such initiatives were almost non-existent.

In April, 1984 (a), the FEU found a fragmented approach to the implementation of information technology in Further Education. Although this survey revealed some instances of good practice, these were dependent on lecturers using their own time to develop information technology materials.

Problems with the implementation of information technology have been raised in a series of studies conducted by the FEU and others throughout the period of the present study.

In 1990 the National Council for Educational Technology (NCET) conducted a survey to investigate the impact of information technology in the Further Education curriculum throughout England, Northern Ireland, Scotland and Wales. They found that the situation had not changed significantly since the 1983 study. One of the findings, that highlighted the need for the models developed in this study, was that:

> *the integration of information technology across the curriculum is still a relatively infrequent occurrence.*
>
> NCET (1991)

Surveys and studies, such as those conducted by the FEU and NCET, highlight issues and implications surrounding the introduction and embedding of information technology into Further Education vocational education and training courses. However, **no** study has yet developed a theory or model which enables funders to better focus their money in a way that will provide the most effective strategy for the embedding of information technology into Further Education vocational education and training courses across all curriculum areas.

The structure of the study

Figure 1 shows the structure of the study. It illustrates how the phases, components and outcomes of the investigation relate.

Study phases and components

Using an analytical inductive approach the study comprised two phases:

- an **exploratory phase,** which led to the development of two initial models of change which were used as *sensitising concepts* (that is, concepts which *suggest directions along which to look,* Blumer, 1954) for the subsequent phase
- a **development phase**, within which the evaluation tools and final models of change were developed.

Four interlinking components were included within the two phases of the study:

- the literature review
- the fieldwork
- the development of evaluation tools
- the development of four models of change.

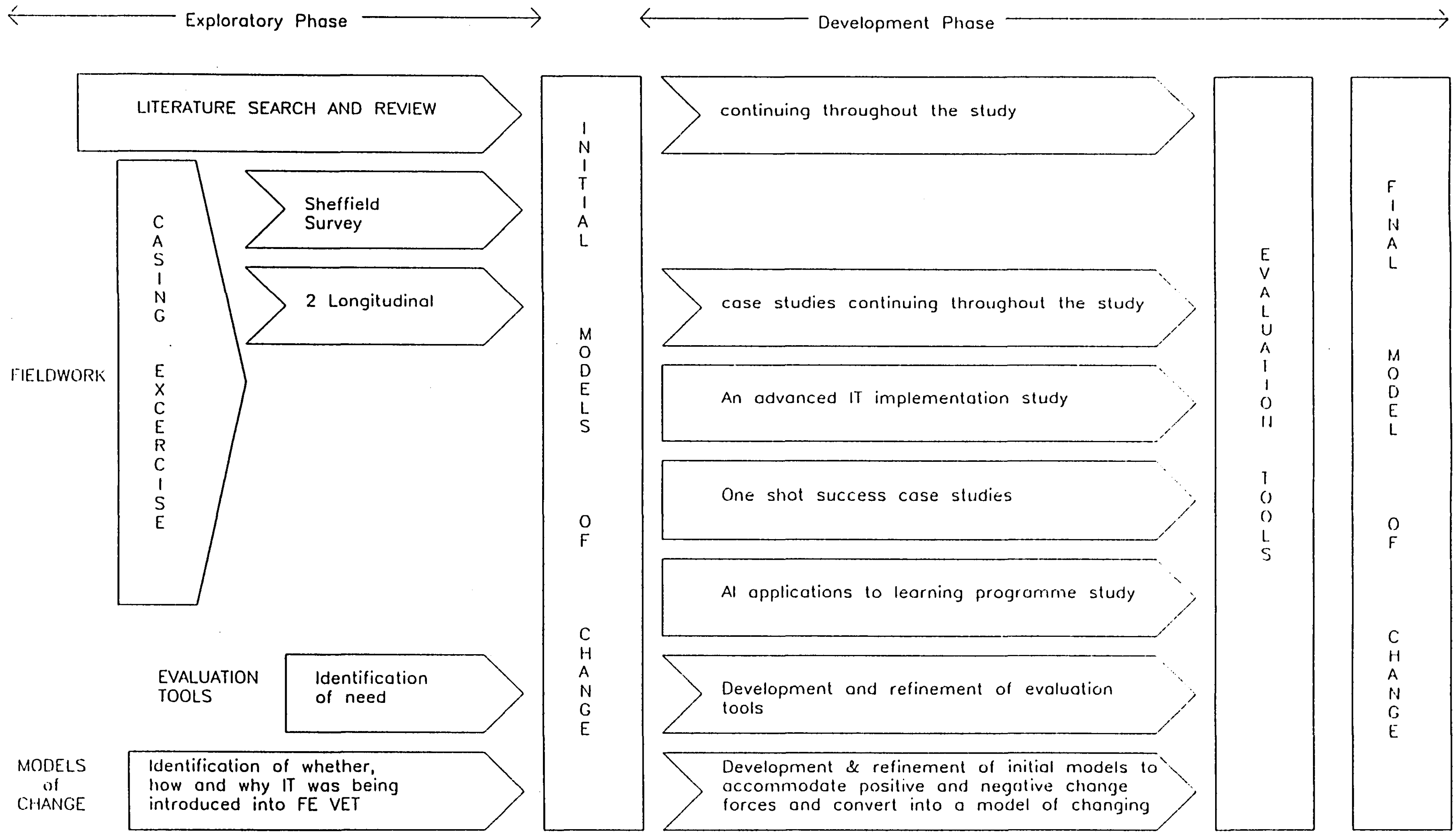
Some elements of the above components were exclusive to one phase, for example, the Sheffield study, however, all provided primary or secondary source data which was utilised when developing the evaluation tools and the models of change.

The exploratory phase

The exploratory phase comprised:

- the initial stages of the literature review
- a casing exercise at national, regional and local levels
- the Sheffield survey
- the identification and initial involvement of the two longitudinal case studies
- the identification of a need for evaluation tools and techniques
- the development of the two initial models of change.

FIGURE 1 **THE STRUCTURE OF THE STUDY**



This phase focused on the development of two models which highlighted whether, why and how information technology was being introduced into the Further Education vocational education and training curriculum.

Within the exploratory investigations, interviews with appropriate officials allowed national, regional and local government influence to be identified.

Following the casing exercise, a purposive sample of Further Education vocational education and training courses in Sheffield colleges were selected for the Sheffield survey. Observation, questionnaires and interviews were used with college principals, heads of departments, course leaders, lecturers and students from the sample courses. At all stages within this process secondary source data was collected and analysed.

Running concurrently with the Sheffield survey, two longitudinal case studies provided in-depth data for the study. Firstly, Castle (formerly Granville) College was selected as a case study because a bottom-up approach was being used by this college to facilitate the introduction of information technology and AIT into their vocational education and training courses. Secondly, Kingston-on-Thames College, was chosen. At Kingston a top-down approach was being used with the Principal firmly in control of the implementation model and design.

By the end of the exploratory work, a wider audience was needed to validate the Sheffield survey results and the initial case study data.

Another area of investigation highlighted from the initial work was the need for a framework which not only identified factors found to influence the introduction of information technology into the Further Education vocational education and training curriculum, but prioritised them in some way.

Finally, it became clear that little had been done to evaluate the effectiveness of government initiatives intended to accelerate the introduction and use of information technology and AIT in Further Education vocational education and training. Few tools and techniques were found that could aid a researcher in the collection, analysis and evaluation of data relating to the impact of information technology and AIT.

The development phase

Having identified a multiplicity of factors affecting whether, why and how information technology had been introduced into the Further Education vocational education and training, this phase of the study focused on:

- outlining the relative strengths of the forces found to drive and restrain the change process
- identifying those factors found to be necessary and/or sufficient (that is, the identification of the critical success factors) for a successful interventionist approach to the change adoption process.

An explanation of these influences and factors for government and other decision makers would allow them to concentrate their efforts and funding on those factors which are more likely to succeed when attempting to embed information technology and AIT into the Further Education vocational education and training curriculum. To make these processes and procedures more explicit a further model was required. The proposed model needed to provide a:

> *conceptual coat rack which will help both:*
> - *to simplify reality*
>
>   *and*
> - *to put some kind of order into our thinking.*
>
> Mercer (1985)

Although a larger national sample was needed to validate the Sheffield survey results and the initial case study data, resource constraints prohibited a survey similar to that carried out in Sheffield being undertaken in other LEA areas in the development phase. Therefore further case studies were used.

At the time, the author was asked to complete the field trials for the introduction and use of CUSTOM, an Expert System which had been developed at Castle College in a college catering environment. This provided an opportunity to explore and use a further fourteen sites, (ten being from the South Yorkshire and Humberside BTEC consortium and four from differing local authority areas across the country) to validate the implementation issues raised by the previous research.

Additional data was acquired from the investigation of another three Further Education colleges that had successfully implemented information technology / AIT into their vocational education and training courses. These colleges were used as one shot (that is, going out only once to the site) case study sites.

The research findings were also validated, and other issues raised, from the Further Education sector evaluation for the Artificial Intelligence (AI) applications to learning programme. This section of the research included the collection and analysis of data from a census and follow-up survey in Further Education colleges.

As a result, the development phase included seven elements:

- the continuation of the literature review
- the continuation of the two longitudinal case studies
- an implementation case study
- a set of one shot success case studies
- the utilisation of data collected from a census and follow-up survey for the evaluation of the Department of Employment's (DoE, formerly the Manpower Services Commission, MSC) Artificial Intelligence (AI) applications to learning programme aimed at developing and introducing intelligent computing into education and industry
- the development and refinement of evaluation tools and techniques
- the development of the final models of change.

The outcomes of the study

The principal outcomes from the study comprise four models of change. These were derived at differing stages of the study and progressively address the investigation's main aim.

The models include:

- the **Tricycle model** which identifies three groups of people who may influence, positively or negatively, the change strategy
- the **Factors Affecting the Introduction of Information Technology (FAIIT)** model that outlines the factors, agencies, organisations and people which may influence the introduction of information technology into Further Education vocational education and training courses
- **EMBED**, a three staged model of changing. This model utilises Lewin's (1958) force field analysis technique to document the driving and restraining forces that have influenced the introduction and embedding of information technology / AIT across the Further Education vocational education and training curriculum.
- the **Durability model** which focuses on the Further Education institution. This model incorporates those factors highlighted in EMBED and further indicates the critical success factors that are required for the institutionalisation or embedding of information technology and AIT across Further Education vocational education and training courses. This final model provides a strategic framework to assist government and other funding agencies and departments embed information technology and AIT into vocational education and training courses.

Another important, but subsidiary outcome from the study, comprised a set of evaluation tools to help individuals and organisations assess the success of government policies which focus on information technology and are aimed at facilitating change in Further Education. The evaluation tools (described in detail in Chapter 4) include:

- the taxonomy of variable determinants and analysis matrices
- the pyramid model
- the awareness index
- total growth of impact graphs
- cost effectiveness bars.

Personal history of the author

The personal history of the author had great bearing on the direction of this study both in the subject matter and the target audience under investigation.

The subject matter and target audience who form part of this study became a focal point of the author's life when she successfully completed the City and Guilds Further Education Teacher's Certificate in Speech, Drama and Communication. Interest in the psychological and curriculum theory and practice of education and training led her to complete her degree (principally in psychology but with some technology) through the Open University in December 1985. This degree, as well as reinforcing her interest in learning theory and practice, also introduced her to psychological and sociological methods of research. In the final two years of her degree the author also completed, in service, the Certificate of Education for Further Education teachers. A major study for the Certificate of Education was the development and introduction of work based modules for YT trainees across the vocational disciplines. One of these modules was in information technology and it was at this time that the author found how difficult it was to integrate this module across vocational areas.

Whilst studying for the degree the author was pursuing her teaching career. Firstly, the author worked part time teaching both adult and vocational education and training. Then she was appointed to a full time post, teaching General and Communication Studies across all vocational areas of a large tertiary college.

At this time, computers were being introduced into Further Education. However, the demand for such equipment by Computer Studies 'O' and 'A' level students and certain engineering and construction groups meant that access by general and communication studies lecturers and students was severely limited.

Also, having developed computer based modules for use with general and communication studies students, the author found that other members of staff did not have enough computer knowledge or skills to use them. Even with a tutor handbook, lack of confidence by lecturers inhibited the use of the packages and the workbooks in the classroom. At the end of the developmental period the author left the vicinity and her successor, having no real interest in the materials being embedded in the curriculum, did not pursue their use further.

In September 1985, the author moved to Sheffield and took up a two year research post at Sheffield Polytechnic. In this position the author, together with the research team, set up procedures to establish the amount and type of information technology contained in a sample of Further Education vocational education and training courses offered at South Yorkshire and Humberside colleges. Although using a different perspective, the data for the exploratory phase of this thesis was mainly collected within this research programme. From the research conducted within the Polytechnic research programme it became clear that, although the government was giving millions of pounds to fund initiatives that would facilitate the introduction of information technology into the Further Education vocational education and training curriculum, little was being done to evaluate its impact. During this study, an investigation of government funding led to the review of the Further Education Unit's (FEU) involvement in information technology in Further Education. From this the author was invited to participate in a joint FEU/MSC project being completed at Kingston-upon-Thames College. The project focused on the introduction of leading edge technology into Further Education.

Following this the author, together with the research team, were successful in a bid to evaluate the impact on Further and Higher Education of the MSC's (now DoE) three year AI applications to learning programme for which the author was appointed as the main researcher. Being contractually required to provide a validated methodology, and, in the absence of suitable tools and techniques, a priority for the evaluation study was the development of the methodology and the establishment suitable evaluation tools. These needs revived the author's interest in research methods and led her to produce the set of evaluation tools described in Chapter 4. The evaluation study provided the author with the necessary resources to census all Further Education institutions by self-completion postal questionnaire. It further necessitated close

contact with those Further Education institutions involved in the AI programme.
Finally, although the author only participated in the development of the questionnaire and sampling procedures, the results from the follow-up survey of Further Education institutions have been utilised in this study.
In the final years of the study the author has been running her own evaluation and research company. The work undertaken by the company has included the field testing of an expert system in customer complaints (CUSTOM) originally part of the AI programme. This study and a continued involvement with Kingston College of Further Education, have provided data for the final outcomes of this study. Also the evaluation tools have been used in other contexts.
The educational, work and personal experiences, as well as the author's interest in the psychological, methodological, technological and Further Education issues, have allowed her to investigate, develop, test and refine a new and significant model of change for embedding information technology / AIT into Further Education institutions.

Issues addressed

This study attempts to address some of the important issues raised both within the investigation and by others who have carried out research in this area. The data collected facilitated the development and refinement of a curriculum change model, EMBED, which synthesises the various forces found to enhance or inhibit the introduction, and more importantly, the embedding of information technology and AIT in Further Education vocational education and training courses.
It further provided a strategic model/framework to assist government and other funding agencies and bodies successfully embed information technology and AIT into Further Education establishments.
In addition, the evaluation tools and techniques created as part of the study will help others conduct more efficient and effective evaluations.

CHAPTER 2

REVIEW OF LITERATURE

The diversity of this research required a broad literature search and review which included study of the Curriculum Change Unit for Sheffield Hallam University's M.Sc. in Education.

There were three specific contexts it seemed most useful to review.

The educational context

The specific emphasis of the literature reviewed under the educational context was on the Further Education vocational education and training provision for sixteen to nineteen year old students. This part of the review was undertaken to complement the author's practical experience and knowledge and to provide an up-to-date insight into the Further Education environment, its institutions, courses and stakeholders. Such knowledge and understanding was necessary to ensure that any nuances of the system and its components which might impinge on the model emerging from the study could be accommodated. It was also essential that the resultant model reflected current practices and procedures which might affect its robustness and hence its future usefulness for those endeavouring to embed information technology into vocational education and training courses.

The media context

The second part of the literature review focused on the media context. The word media in this research was used as an all embracing term referring to information technology as a teaching/learning medium in its widest context, that is, as a teaching method, resource, basis for assignment, simulation and vocational application. This part of the review was carried out to identify factors affecting the embedding of the media, information technology, into the Further Education vocational education and training curriculum.

The media review covered:

- relevant milestones in the development of information technology
- studies conducted in Further Education vocational education and training courses
- initiatives aimed at bringing about change and using information technology in Further Education vocational education and training courses.

The theoretical context

The third context of the literature review was the theoretical context. This focused on relevant models, theories, processes, techniques, sources and strategies which might be used to bring about change. This part of the literature review also included a summary investigation of evaluation literature which was appropriate to, and facilitated the development of, the evaluation tools described in Chapter 4.

The educational context: Further Education vocational education and training courses

This part of the literature review aims to clarify, establish and describe the educational parameters of the study, thus:

- reviewing the educational system of England and Wales in order to define the level and scope of Further Education
- identifying the stakeholding audiences within a Further Education context
- highlighting the type of courses which exist within Further Education
- examining relevant changes in vocational education and training.

The level and scope of Further Education

The education system operating in England and Wales comprises school and post-school education or as the DES Welsh office (1985) described it, compulsory and post-compulsory education. The main type of institutions to be found within the public education sector are diagrammatically illustrated in Figure 2.

FIGURE 2

THE EDUCATION SYSTEM OF ENGLAND AND WALES

SCHOOL BASED COMPULSORY EDUCATION

Primary education
(normally 5 - 11 years, areas with middle schools may go up to 12 or 13)

Secondary education
11 (or 12/13) - 16 years

FURTHER EDUCATION
POST SCHOOL / POST COMPULSORY EDUCATION

(mainly up to 'A' level standard)
16 years +

6th form colleges + some 6th forms in schools	Colleges of FE / Tertiary colleges Colleges	Colleges of Art, Technology etc.
Usually 'O' & 'A' level academic subjects	Vocational & academic subjects	Vocational & academic subjects
	Adult education	Adult education
Adult/community education	Advanced education	Advanced education

HIGHER EDUCATION

(mainly post 'A' level standard)
usually 18 years +

Institutes of Further and Higher Education
(deal with both Further Education and HE courses)

Polytechnics (from 1992 the Polytechnics have become Universities)	Universities	Colleges of Art, Technology etc.	Institutes of Higher Education

Alongside the public education system there is a parallel private education sector.

Post-compulsory education starts at the age of sixteen. At this time an individual can continue at school until the age of eighteen or nineteen, go into employment (with or without education or training), take up a Youth Training place or go into full-time Further Education.

The DES Welsh Office (1985) and the HMI (1987) divide post-school education into two types:

- Non-advanced Further Education (NAFE) including education up to and including GCE 'A' level or equivalent
- Advanced Further Education (AFE) referring to education which leads to post 'A' level qualifications.

Bridging the two sectors are the colleges of Further and Higher Education which provide both NAFE and AFE courses.

Mainstream Higher Education in England and Wales provides AFE courses to students above the age of 18. From 1966 to 1992 four main types of institutions existed within the Higher Education sector:

- universities
- polytechnics, which became universities in 1992
- Institutes of Higher Education, some of which received university status in 1992
- vocationally focused colleges.

The Further Education provision

In a general sense, Further Education covers all post-school education. However, in England and Wales the term Further Education usually refers to post school non-university education which the DES Welsh Office (1985) considers to be highly developed and very diverse.

The Education Act 1988 and the Further Education Funding Council's (FEFC, 1992) Circular 92/01 defines Further Education as education which is suitable for those aged sixteen and over, which is not Higher Education and not provided at school.

The Rt. Hon Kenneth Baker MP (Secretary of State for Education and Science in 1989) in a speech to the Association of Colleges for Further and Higher Education (ACFHE) in February, 1989 said of Further Education:

> *Further Education is not just the bit between school and Higher Education. It is not just the Cinderella of the education service... Over 1,750,000 attend Further Education classes... taught by the equivalent of 63,000 lecturers.*
>
> Rt. Hon. Kenneth Baker (1989)

Section 120 (which replaced Section 41 of the 1944 Act) of the 1988 Education Reform Act defines Further Education, for the purposes of Local Education functions, as:

> a) *full-time and part-time education for persons over compulsory school age (including vocational, social, physical and recreational training)*
> b) *organised leisure-time occupation provided in connection with the provision of such education.*
>
> Education Reform Act (1988)

After the removal of polytechnics and other colleges of Further and Higher Education from LEA control in 1987, 400 Further Education colleges remained. Maclure (1989) stated that of the 1.8 million Further Education students, 93 per cent come within the categories of NAFE.

Thus, according to the FEFC's Circular (1992, 92/05), Further Education delivers academic and vocational subjects up to 'A' level standard (see Figure 2, page 26) through a wide range of institutions comprising:

- 245 general Further Education colleges
- 56 Tertiary colleges
- 118 sixth form colleges.

Although officially responsible only for courses up to A-level standard, many Further Education institutions offer post A-level work.

Over the time of this study there have been radical changes which have affected the Further Education provision both in terms of its operation and the nature of the qualifications being offered. For example, Maclure (1989) describes the implications of the Education Reform Act (1988) for Further Education. Formerly (under the 1944 Education Act) the Further Education provision had a three tier system of administration, central government that made national policy and, through government grants provided funds to Local Education Authorities (LEA) who administered the local education provision through the differing Further Education establishments.

Since the 1988 Reform Act, LEA Further Education colleges have been allowed the same financial delegation and self-government offered to schools. As the Further Education provision remains a statutory duty of local authorities, they are required to prepare a scheme for the Secretary of State's approval outlining how they intend to divide funds between their colleges. The local authority scheme has to incorporate provision for delegation of :

> *the management of any institution's budget share for any year to the governing body of the institution.*
>
> Education Reform Act (1988)

Delegation under the provision of the Act refers mainly to colleges with 200 or more full-time students. For these colleges, control over the budget has to be delegated to the college governors. However, the Act does extend delegation to colleges with less than 200 full-time students and to adult education centres where a local authority feels this course of action is appropriate.

Defining the stakeholders in Further Education

In any change programme, there will be different interest groups who can affect (detrimentally or beneficially) the introduction of the programme. The *stakeholders* (Legge, 1984) or *stakeholding audiences* (Stake, 1975) of the research programme therefore need to be identified. The stakeholders for this study are those who might affect, and be affected by, the structure, functioning and operation of Further Education.

Further Education stakeholders split into two groups:

- **external stakeholders**, who reside outside Further Education establishments but who may have a significant effect on the structure, functioning and operations of such establishments
- **internal stakeholders**, from within the Further Education establishment.

The Further Education Staff College (Coombe Lodge, 1975) describes Further Education's stakeholders as *external and internal participants* in an *education game* which is depicted as a football pitch. Figure 3 shows an updated version of the football pitch analogy. This figure takes account of the many government interventions into Further Education which have affected its functioning and operation, particularly in relation to the introduction of information technology. Weaver (1983), encases the stakeholders in a five storey mansion (see Figure 4. page 32) where the participants fall into three categories:

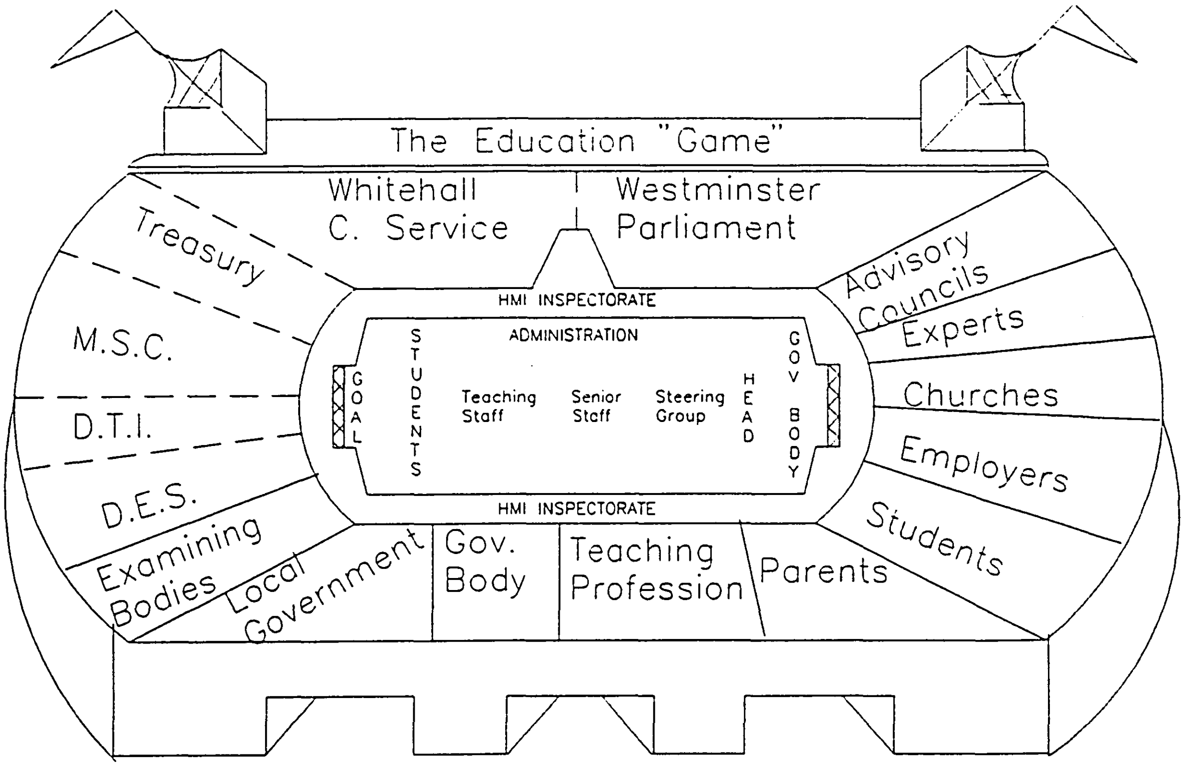
> *those who learn, those who teach and those who facilitate or control it.*
>
> Weaver (1983)

Although focusing on Higher Education, Weaver places the stakeholders in a five storey building, which has been represented as a diagram in this study (see Figure 4). Within the building, the residents on each storey function partly autonomously but are also dependent on those who are on the floors above and below, just as in the Further Education sector.

As one can see in Figure 4, the fifth storey is where the aims of education are fulfilled, that is, the point of personal contact and interaction between the teacher and learner. On the storey below the home of the discipline resides, that is, the department or school of the subject. Fifth floor activities are constrained by the departmental and institutional needs of the discipline.

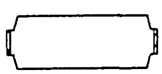
FIGURE 3

AN UPDATED VERSION OF THE FOOTBALL PITCH ANALOGY OF "THE EDUCATION GAME"

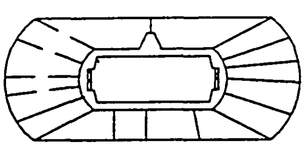


Source: "Participation, Accountability and Decision making at Institutional Level" Coombe Lodge (1975)

(An adaptation of the original 'game', 1987)



Individual Institution – including the internal participants



External participants who influence the functioning of the institution

FIGURE 4

WEAVER'S FIVE STOREYED BUILDING ANALOGY OF THE EDUCATIONAL ENTERPRISE FOR HIGHER EDUCATION

Fifth storey Personal transaction between the teacher and the learner
Fourth storey Home of the discipline
Third storey The institution
Second storey The LEA
First storey Central Government

On the central storey the institution resides. This again inhibits the freedom and affects the functioning of the residents on the floors above. Institutional pressures, allocation of resources, perceptions and interests of the institutional leaders, the complexities and dynamics of organisational operations all serve to influence fourth and fifth floor participants and operations.

The bottom two storeys contain the controllers of the education enterprise.

The second floor comprises the LEA, DES (now DFE) for locally managed colleges, and other controllers of the system such as the regional advisory councils. These authorities and agencies restrict the autonomy of individual institutions through their policies, resource allocations and other constraints they may place on the establishment. Recently, the introduction of local college management under the 1988 Education Reform Act and other movements have diminished the power of the residents on this storey. For example, the redirection of 25% of NAFE funding through the DoE and latterly through the newly established Training and Enterprise Councils (TEC) have limited the power of the LEA.

Finally, the bottom storey contains those residents with the ultimate power for the education enterprise, the political parties, Treasury, the Cabinet and the Queen.

As illustrated in Figures 3 and 4 many influential stakeholders exist both within, and outside, educational institutions.

Further Education's external stakeholders

The external stakeholders who have been instrumental to the introduction and embedding of information technology and AIT in Further Education can be categorised into two types:

- policy makers and administrators
- others who may affect the Further Education curriculum.

Policy makers and administrators

Policy makers and administrators outside Further Education institutions can be instrumental in making decisions that lead to initiatives which can facilitate the introduction and embedding of information technology and AIT in Further Education. Stakeholders in this category include:

- **government** who make policy about the structure, functioning and operation of the whole education system. For example, they set up committees, Butcher reporting in 1983 and Bide reporting in 1986, to report on the provision and direction of policies for information technology and AIT in Further Education
- administrators of the **European Social Fund (ESF)** which annually sets out areas for monetary bids from member States and their organisations. ESF funding includes an allocation for vocational education and training. Bids for this type of funding can be made at a national, local and/or college level
- policy makers and executives of **government departments** who provide and allocate funds for vocational education and training. For example, the former

DES through the ESG and the DoE through various vocational education and training initiatives have been instrumental in allocating funds for information technology in vocational education and training courses

- **LEA** elected members who make policy and establish priorities which allow bids to be made to other funding agencies, for example, the DES and the DoE. LEA officers and advisers (particularly those with a specific remit for information technology) are often responsible for the implementation of the funds acquired from the various government agencies and departments
- **other bodies and agencies through which information technology funds** can be acquired, for example, the Computer Society and the FEU. Such agencies, administer specific initiatives and projects relating to the introduction of information technology into the curriculum. This is often carried out at arms length, that is, where the initiative is managed and administered through some agency, body, organisation or department other than the initiator. Publications from the FEU show their specific interest in the introduction of information technology and AIT into the Further Education vocational education and training curriculum. They have also been responsible for co-ordinating and monitoring the courseware development under the ESG
- the Further Education institution's **governing body and others who are external** to the college but who might be significant players in the allocation of funding and resources for the introduction of information technology and/or AIT into the college's vocational education and training curriculum.

Others who may affect the Further Education curriculum

Others who have been found to affect the Further Education curriculum but who are external to the establishments in which the curriculum is delivered, include:

- **awarding and examining bodies,** for example, City and Guilds and BTEC, whose boards and staff can decide to incorporate (or not) information technology, with instructions for its operationalisation, into their syllabi

- **industrialists,** who can make demands on the content and structure of courses offered within Further Education establishments.

Further Education's internal stakeholders

Further Education's internal stakeholders split into three main groupings: the principalship, the lecturers and the students.

The principalship

The principalship in Further Education usually includes the principal, vice principal and assistant principals. In some colleges the principalship also includes heads of departments.

According to Gleeson and Mardle (1980) and Bush (1984) the importance of the principal to the internal functioning of the Further Education establishment lies in their role as a central focus for the network of information. Equally, Richman and Farmer (1974), Becher and Kogan (1980) and Hicks (1975) believe that the whole principalship team are significant to the functioning and response of the college to external and internal stakeholder needs.

The FEU (1984a) found the most important person for the introduction of information technology was the Vice Principal.

Contrary to the FEU's findings, the National Council for Educational Technology (NCET, 1991) found, in a survey conducted in 1990, that only one of the eighty five responding colleges had an information technology co-ordinator at Assistant Principal level (most ranged from lecturers to Heads of Departments). The effectiveness of the information technology co-ordinator, according to the NCET study, was dependent on management backing and the co-ordinator's involvement in the college information technology decision-making process. One of the conclusions of the NCET study was that there was considerable discrepancy between colleges in the power and effectiveness of information technology decision-making.

The lecturers

The lecturers are one of the most critical of the internal stakeholders. Ultimately the curriculum delivery mechanism, unless specified by examination and other syllabuses, is in their hands. Gleeson and Mardle (1980) noted the existence of two cultures in the staffing of Further Education colleges. They contrasted the **liberal/academic** approach of AFE and general studies lecturers with the **industry oriented** attitudes and perspectives of staff in vocational education and training departments. For most industry oriented staff their experience and main reference group lie in their industrial sector. These separate cultures, according to Morgan and Parkes (1976), are reinforced by an interdepartmental insularity which exists within many Further Education establishments.

This interdepartmental insularity is particularly important to the information technology provision at many Further Education colleges. NCET (1991) found that information technology has been, and still is, resourced and serviced by computer staff, thus making them one of the most important internal stakeholders for the embedding of information technology into vocational education and training courses. NCET asserts that these stakeholders are detrimental to the integration of information technology across vocational education and training. The NCET report states:

> *the concentration of all the computing skills in one section was a frequent phenomenon which obviously prevented integration occurring in many course areas.*
>
> NCET (1991)

From the 161 responses, received by NCET in the above study, other non-computing disciplines using information technology include:

Business Studies	(47 colleges)	Secretarial	(19 colleges)
Engineering	(34 colleges)	Science	(15 colleges)
Special needs	(27 colleges)	Art and Design	(14 colleges)
Mathematics	(26 colleges)	Construction	(13 colleges)
Hotel and Catering	(20 colleges)	Humanities	(10 colleges)

However, it is not clear from the report whether the information technology was taught by vocational or computing staff.

The students

Students, as recipients of the vocational education and training curriculum, comprise the final internal stakeholder for this study. The main age group for this research are 16-19 year olds, who, according to the Macfarlane Report (HMSO, 1981a), are also the main age group for vocational education and training courses.

The primary purpose of the education service for this age group is to provide a range of opportunities which meet the requirements of young people, parents and society at a cost that is nationally accepted.

According to the Macfarlane Report (HMSO, 1981a), this age group is diverse. Macfarlane identifies seven groups of clients in the 16 - 19 year old age group. These are divided into two categories based on their mode of attendance:

- those who leave full time education at 16
- those who stay on at school or college.

Students who leave full time education at the age of 16 fall into three categories. Those who:

1. enter employment and do not receive any structured education or training
2. enter employment and who have the opportunity for systematic education and/or training leading normally to an educational, vocational or professional qualification
3. leave school but who are without work or immediate prospects of work.

Government constraints on training providers, agencies and clients themselves have led to a downturn of individuals formerly found in 1 and 3 above. For example, this age group are now not allowed to draw benefits if they are not undertaking Youth Training. They must also receive as an essential part of their training, on-the-job vocational training leading to National Vocational Qualifications (NVQs).

Four further groups were identified for students continuing in full time education.

Those who:

4. wish to go on to Higher Education
5. are attending vocational education and training courses
6. are seeking to continue their general education
7. require remedial education.

The main client groups for this study are students in sub categories 2 and 5.

Further Education courses

In a survey into the NAFE provision in England and Wales, Her Majesty's Inspectorate (HMI, 1987), sampled thirty four colleges of varying sizes and found that a Further Education college typically offers:

> a) *pre-vocational courses such as the Certificate of Pre-vocational Education (CPVE)*
> b) *full-time and part-time vocational courses*
> c) *full-time and part-time general education courses leading to GCE O (now GCSE) and A-level*
> d) *'mixed economy' courses involving a combination of a vocational course and general education elements such as GCE O (now GCSE) and A-levels*
> e) *adult education, including recreational and other non-vocational courses, offered mainly during the evening*
> f) *mainly part-time, off-the-job education and training within the YTS*
> g) *fee-earning courses commissioned by employers and agencies such as the MSC (now the DoE)*
> h) *short courses (often for local industry) covering a wide variety of subjects and skills*
> i) *AFE courses mainly by part-time day and evening study.*
>
> HMI (1987)

From the survey four curricular traditions were identified:

1. the academic provision, catering for students wishing to study subjects leading to A-level qualifications [identified in (c) and partly (d) above]

2. the vocational provision [that is, Further Education vocational education and training] which includes CPVE, City and Guilds, BTEC, NVQs and other recognised vocational courses leading to qualifications of up to 'A' level equivalence [identified in (a), (b), (f), (g), (h) and partly (d) above]
3. Adult Education as identified in (e) above but including community education programmes which may also be connected with the school and 6th Form provision
4. AFE, which comprises post A-level work such as the City and Guilds Further Education Teacher's Certificate, Higher BTEC and Higher National Diploma work, pre-HE diplomas and part time degree work.

The main focus of this study, Further Education vocational education and training courses, is identified in (2) and (b). These, as specified above, lead to vocational qualifications which have recently been subject to review and restructuring by the DoE and the National Council for Vocational Qualifications (NCVQ).

The changing face of vocational education and training

The DoE's Programme for Action for the New Training Initiative (HMSO, 1981b) in endorsing the MSC's consultative document — A New Training Initiative (May, 1980) — set out its objectives and a ten point plan of action for achieving the objectives.

The first two objectives of the New Training Initiative have had a profound effect vocational education and training provision of 16 - 19 year olds. They state that the future of industrial training should be:

> *(i) to develop skill training including apprenticeship in such a way as to enable young people entering at different ages and with different educational attainments to acquire agreed standards of skill appropriate to the jobs available and to provide them with a basis for progress through further learning*

(ii) to move towards a position where all young people under the age of eighteen have the opportunity either of continuing in full-time education or of entering a period of planned work experience combined with work related training and education.

HMSO, Cmnd 8455 (1981b)

The main points for action relating to the student population covered in this study are:

(iii) increased incentives for employers to provide better training for young people in jobs
(v) setting a target date for recognised standards for all the main craft, technician and professional skills to replace time-serving and age restricted apprenticeships
(vii) more opportunities for vocationally relevant courses for those staying on in full-time education
(viii) closer co-ordination of training and vocational education provision nationally and at a local level.

HMSO, Cmnd 8455 (1981b)

Within the White Paper (HMSO, 1981b) the DoE listed several areas of concern which required action. Three had a particular relevance to this study.

Firstly, although new technology offered the UK a chance of becoming more productive and creating new jobs and services, it needed to produce a *better educated, better trained and more adaptable workforce* in order to take advantage of technological advances.

The second concern related to the acquisition of traditional craft apprenticeships and technician skills. Prior to the White Paper (HMSO, 1981b), these skills would have been acquired through day release at Further Education establishments but, at the time of writing, opportunities were felt to be declining and inadequate because of the lack of co-ordination between the college and work.

Finally, the responsibility for training was in need of review as, at that time, the DoE considered it to be *muddled* (HMSO, 1981b).

In conclusion, the White Paper (HMSO, 1981b) postulated the need for:

> *clearer goals, better means of delivery, a fairer allocation of financial responsibilities and, above all, a will to work together and get on with it.*
>
> HMSO, Cmnd 8455 (1981b)

The White Paper (HMSO, 1981b) focused on the training provision for young people and announced the replacement of the Youth Opportunities Programme with the New Youth Training Scheme (YTS). It also postulated the need for more general vocationally-oriented courses and a pre-vocational examination.

Although not the primary concern of this study, colleges of Further Education and their maintaining authorities have had an important role to play in YTS. The importance of YTS for this study has been in the ensuing governmental initiatives which have had a profound effect on the functioning and operation of Further Education colleges.

The DoE, in the Programme for Action (HMSO, 1981b), did not believe it could predict the composition and future needs of a skilled workforce. However, the DoE did predict the need for a higher proportion of technician level occupations. Allied to this it cited technological change as one of the important reasons for change within industry and commerce.

The Programme for Action introduced the idea of occupational standards rather than training as the key to the future of the UK. However, in order to operationalise this concept, a system needed to be developed which could embody the wide range of recognised standards of achievement. This endorsed the then MSC's commitment to make available by 1985, relevant standards of competence (rather than time serving) with associated courses and certificates for all significant skilled occupations.

In the Training for Jobs White Paper (HMSO, Cmnd 9135, 1984), the government reinforced the need for the definition of standards of performance and a certification system which could apply to both academic and vocational courses in schools and colleges and which would link with other training standards and qualifications.

The wider aim of the White Paper was:

> *to open up access to training and to jobs through a coherent system of training standards and certificates of competence, covering achievement in vocational education and training both initially and throughout life.*

HMSO, Cmnd 9135 (1984)

There was concern that the public sector needed to be more responsive to employment needs and have a greater incentive to provide cost effective courses more closely reflecting the needs of the customer. This led the government to give the MSC new responsibilities which would enable it:

> *to purchase a more significant proportion of work-related NAFE provided by local authorities.*

HMSO, Cmnd 9135 (1984)

The work-related NAFE (WRNAFE) referred to in this paper included technical and vocational NAFE, now called vocational education and training.

In 1984 the expenditure for NAFE in England and Wales totalled about £1.8 billion, £800 million of which funded the work-related educational provision. The MSC at that time spent approximately £90 million as a direct and indirect customer of NAFE courses or services. This expenditure increased to £155 million in 1985/86 and £200 million in 1986-87 accounting for about 25% of the total NAFE provision which had previously been administered by LEAs. The 1984 White Paper specified that this funding should be used for NAFE vocational education and training initiatives and courses which related to labour market needs. The priorities itemised all had implications for the introduction and use of information technology. They included:

- newly emerging skills (e.g. electronics and robotics)
- occupations where traditional programmes no longer matched modern commercial and industrial needs (e.g. some parts of business studies)
- staff development for relevant and up-to-date work needs.

The Education and Training for Young People White Paper (HMSO, Cmnd 9482, 1985) documented the progress of the various initiatives. Some of these, although relating to vocational education and training, were not the primary focus of this study, and hence, have not been covered in detail in this literature review. They included:

- YTS (now Youth Training, YT)
- the Certificate of Pre-vocational education (CPVE), providing courses of general education with a strong vocational bias for young people who choose to stay on in full time education for one year after compulsory education
- the Technical and Vocational Education Initiative (TVEI), aimed at stimulating the provision of technical and vocational education for 14 -18 year olds in a way that would widen and enrich the curriculum and prepare young people better for the world of work.

Important to this study, the White Paper (HMSO, 1985) reiterated the concern for the UK to create a highly skilled and innovative workforce able to meet the needs of existing and new technologies. In addition to the proposals which extended TVEI and YTS, the White Paper gave a definite commitment to review vocational qualifications because the existing qualifications system was believed to be too complex.

The positive attributes of the system outlined in the White Paper (HMSO, 1985) were:

- its credibility and acceptance by employers
- its stability
- the diversity of its courses.

The system's weakness, as postulated by the White Paper, lay in its emphasis on certification based on the testing of skills and knowledge that have been obtained over a strictly defined period of time and which are neither comprehensive nor coherent. Thus it was proposed that the qualification system should be changed to a market-oriented system that could better respond to the needs of young people and adults.

This would allow for:

- *individual achievement certified by one body or part of the system to be recognised by other parties of parts of the system*
- *the testing of skills and competence as well as knowledge and understanding*
- *recognition of learning achieved outside formal education and training situations*
- *flexible patterns of attendance and learning.*

HMSO, Cmnd 9482 (1985)

To develop this system, the government invited the MSC to form a working group of employers, employees, examining bodies and local authorities to carry out a review of the structure of vocational qualifications in England and Wales, reporting to the Government by the end of September 1985. In conducting the review, the White Paper instructed the working group to develop a system that would:

- be relevant to individual needs
- be comprehensible and easily accessible to users
- recognise competence as well as knowledge and skill
- provide opportunities for progression
- allow certification of education, training and work experience.

Alongside these criteria the working group were to account for the views of the:

employer, customer, the provider (particularly the college) and the student.

HMSO, Cmnd 9482 (1985)

The interim and final reports from the review (MSC/DES, 1985 and MSC/DES, 1986) proposed a framework of vocational qualifications which adhered to the criteria set out in the White Paper, as well as providing what they considered at the time to be a cost effective solution to the qualification problem. The government endorsed the recommendations in a subsequent White Paper (White Paper Working Together - Education and Training, HMSO, Cmnd 9823, July 1986).

The working party proposed that the existing structure for qualifications should be rationalised and modularised with the qualifications being re-classified and re-linked. The ensuing framework was to have a limited number of levels and degrees of vocational specificity and would accommodate the newly structured qualifications. At this stage, the proposed framework was to span levels I to IV and include qualifications up to Higher National awards.

The vocational qualifications within the new system would be called National Vocational Qualifications (NVQs) and were to:

- incorporate the assessment of skills, knowledge and understanding
- assess both the ability to use the skills and apply the knowledge and understanding
- provide cumulative credit based on a minimum group of competences required for the issue of an award
- be transferable as partial assessment of competence in other occupational areas.

Under the review, the working party highlighted the need for a national council to implement, or secure action to implement, a system of vocational qualifications that would achieve the objectives set out above. There was no intention by the working group that the newly established council should be an examining or validating body nor should it have statutory powers. However, it could exert influence to facilitate the achievement of its objectives through those with statutory powers .

In accordance with the recommendations made by the working group, the government established the National Council for Vocational Qualifications (NCVQ) in 1986 to:

> *hallmark qualifications which meet the needs of employment within a new structure which everyone could use and understand - the NCVQ Framework.*
>
> DoE/NCVQ (1991)

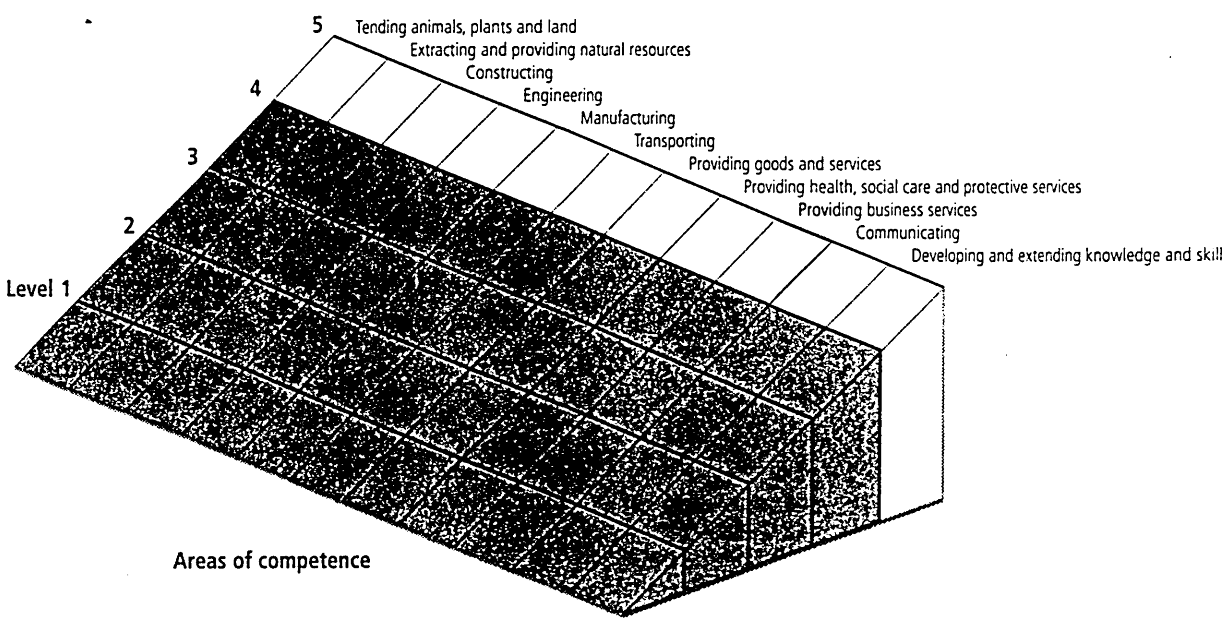
The government agreed to pump prime the NCVQ for up to five years, after which it would be funded through government grants and levies on certificating bodies for the use of the NCVQ seal of approval.

Since its inception the NCVQ has:

- developed policy for the vocational qualification system as a whole
- negotiated with others to achieve its stated objectives
- accredited bodies that are approved to offer awards within the new framework
- discharged the responsibility for quality assurance through its accreditation function.

The present NVQ framework (NCVQ, March 1993) is shown in Figure 5.

FIGURE 5 THE NVQ FRAMEWORK



NCVQ (March, 1993)

The framework now operates at five levels (see Table 1) and is based on areas of competence. The NCVQ say that this framework shows how qualifications relate to each other and how people can progress through the system. Each NVQ is given a level and a title which places it within the NVQ framework. The primary purpose of the framework is to facilitate transfer of learning.

The competences are developed by an analysis of functional work roles. They are intended to provide the initial organisational structure for competence based qualifications but are still undergoing refinements.

The NVQ levels shown in Figure 5 and Table 1 provide a general guide rather than being prescriptive. Basically, the changes in level as one moves up the system (that is, from 1 to 5) indicate the degree of complexity, personal autonomy and responsibility required an individual to be deemed competent.

In 1991 Jessop set the NVQ framework within an educational context. Figure 6 (see page 49) illustrates Jessop's ideas about the links between school and academic qualifications and NVQs. He cites BTEC National qualifications as being *roughly equivalent with NVQ level III*.

In 1990, the Confederation of British Industry (CBI, 1989) with the NCVQ specified the equivalence of NVQ level III with two 'A' levels. However, Jessop (1991) highlights his concern that, as the two types of qualifications have different aims, there can be no objective basis for drawing such equivalence.

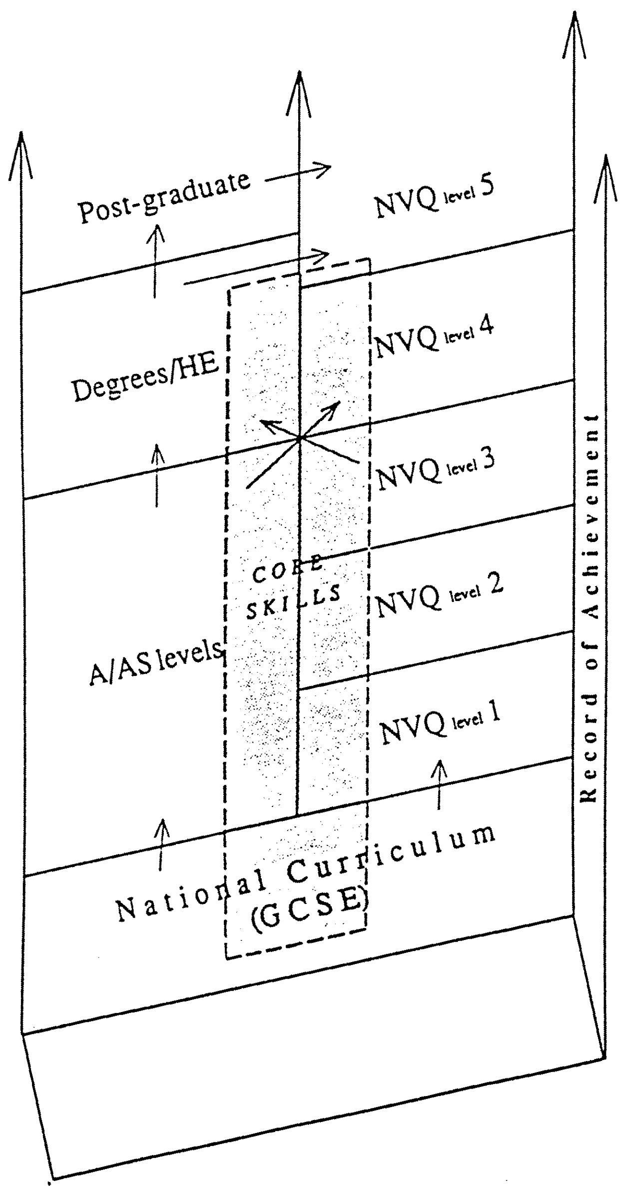
The NVQs developed as part of NVQ framework are employer led and based on units and elements of competence and performance criteria derived from an analysis of job functions rather than from education and training programmes (Jessop, 1990). The focus of these employer-led standards is that they are defined by outcomes which Jessop (1991) believes provide access to learning and assessment not possible within a qualification system based on syllabi and programmes.

TABLE 1 LEVELS WITHIN THE NVQ FRAMEWORK

Level 1	competence in the performance of a range of varied work activities, most of which will be routine and predictable
Level 2	competence in a significant range of varied work activities, performed in a variety of contexts. Some of the activities are complex or non-routine, and there is some individual responsibility or autonomy. Collaboration with others, perhaps through membership of a work group or team, may often be a requirement
Level 3	competence in a broad range of varied work activities performed in a variety of contexts and most of which are complex and non-routine. There is considerable responsibility and autonomy, and control or guidance of others is often required
Level 4	competence in a broad range of complex, technical or professional work activities performed in a wide variety of contexts and with a substantial degree of autonomy. Responsibility for the work of others and the allocation of resources is often present
Level 5	competence which involves the application of a significant range of fundamental principles and complex techniques across a wide and often unpredictable variety of contexts. Very substantial personal autonomy and often significant responsibility for the work of others and for the allocation of substantial resources feature strongly, as do personal accountabilities for analysis and diagnosis, design, planning, execution and evaluation. NCVQ (1993)

FIGURE 6

A FRAMEWORK FOR EDUCATION AND TRAINING



Jessop (1991)

The emerging NVQ model of vocational education and training (see Figure 7) postulated by Jessop (1990 and 1991) is considered appropriate to meet the needs of vocational education and training in the 1990s and beyond.

As illustrated in Figure 7, there are two strands to the model. The strand on the left summarises the procedures through which a student goes to achieve an NVQ. These include a system of initial assessment and guidance which leads to the assessment (and where appropriate) the accreditation of prior learning (that is, certain units and elements of competence might be accredited without further tuition through the production of relevant evidence of prior learning and experience). From the assessment, an Action Plan specific to an individual's needs will be developed. This will be operationalised through a series of learning opportunities which will lead to the NVQ or units towards the NVQ being certificated and/or awarded.

The strand on the right contains the NCVQ elements which are seen to be critical to the accumulation of credits and to the development of an integrated framework for vocational education and training. Firstly there is the NCVQ database which has been publicly available since April 1990. The database contains detailed information on all NVQs, including:

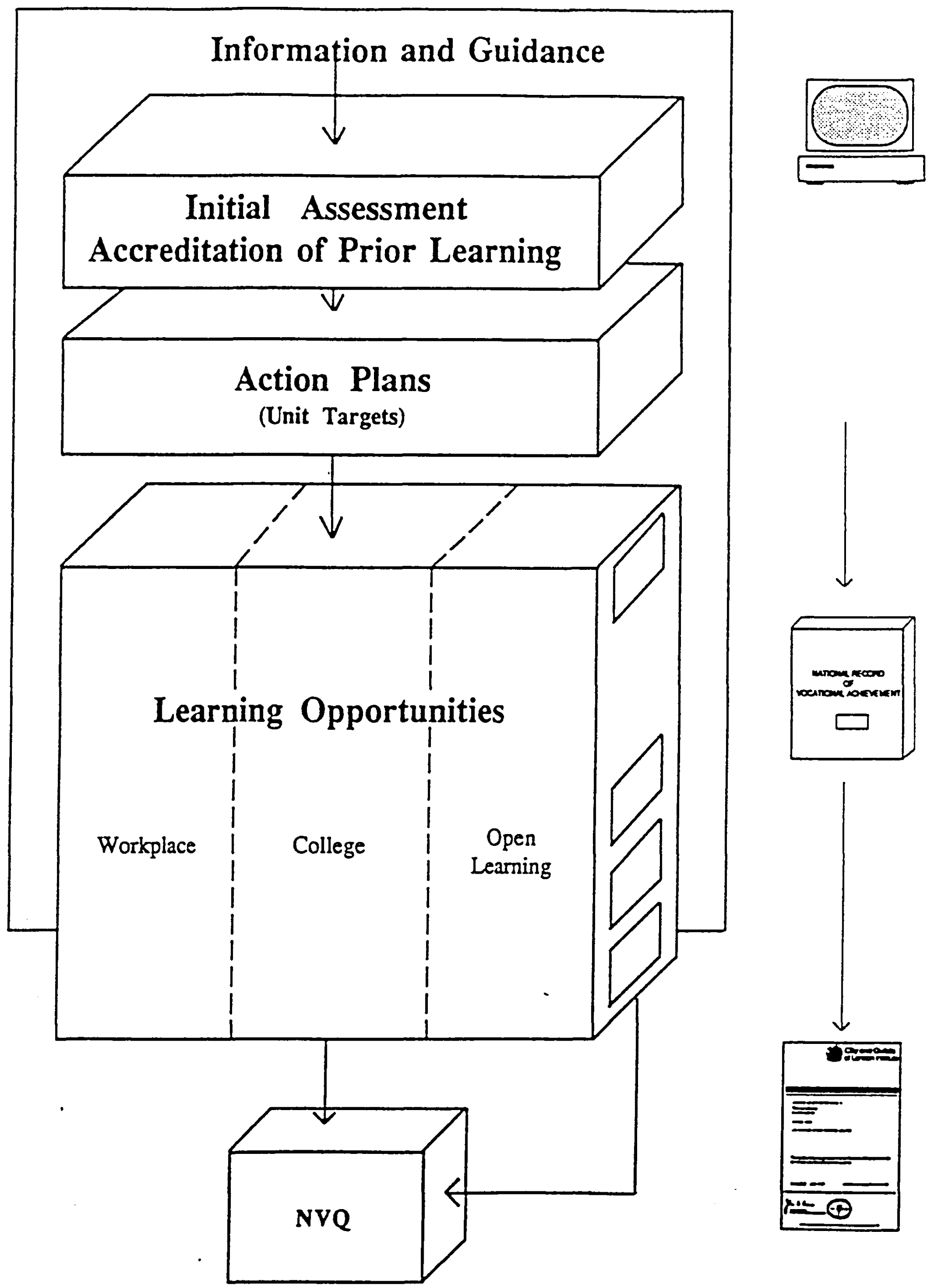
- units and their elements of competence and performance criteria
- assessment methods and awarding body.

Secondly, there is the National Record of Vocational Achievement (NROVA) which is available to all students studying within the NVQ framework. The NROVA contains the personal record of achievement of an individual as they progress upwards through the framework or, horizontally, by the accumulation of credits into other programmes and occupational areas.

Finally, there is the award itself. The NCVQ accredits the qualification and provides quality assurance but is not an awarding or validating body. The awards are the responsibility of the awarding body selected as part of the employment led development process.

FIGURE 7

THE EMERGING MODEL OF EDUCATION AND TRAINING



Jessop (1991)

Obviously, the introduction of the NVQ framework and the move towards employer-led outcome related qualifications (containing the elements in Figure 7) has implications for Further Education. The change from the time-related syllabus-oriented vocational education and training courses, according to Boffy (1990) will require a fundamental shift in attitudes and perceptions.

Jessop (1991) agrees that the outcome-based model will have a profound effect on Further Education and other institutions providing vocational education and training. He considers that the vital changes required for lecturers relate to their role in the learning process. Previously the role of the lecturer focused on providing training and teaching. The shift to the NVQ model requires that lecturers and trainers **facilitate learning** rather than controlling the process.

In examining the components of Figure 7, Jessop indicates some new roles required by the lecturer. For example, the skills to provide:

- objective information and guidance at the outset
- initial assessment of prior learning including the establishment, documentation and presentation of prior learning and experience
- assessment of achievement through the collection of evidence where the primary focus is on the assessment of a competent performance whilst at work
- the provision of learning experiences which are most appropriate and efficient to the individual learner

The most radical change postulated by Jessop (1991) is institutional. This includes the move from a course-based provision with scheduled classes that have fixed term dates for a given number of students to an individualised learning approach which, in theory, can vary considerably for each person completing the NVQ.

The NVQ framework and model, when completed and extended to the higher levels will significantly affect the functioning and operation of Further Education vocational education and training, its establishments and the people that deliver such education and training.

This study focuses on courses that, if they had been studied today would have been operating at NVQ levels 1, 2 and 3. However, at the time the fieldwork was completed most of courses studied were still working within the traditional vocational education and training qualifications system.

2. The media context: Information Technology and AIT

This part of the literature review concerns itself with the nature and relevance of media being studied, that is, information technology and AIT. It further examines the implications of introducing these media into NAFE vocational education and training courses. It covers:

- the development of information technology
- definitions, particularly in relation to information technology and AIT in Further Education
- initiatives aimed at bringing about change and using information technology in Further Education

The historical perspective

Table 2 shows the computer generations and educational milestones which have had a major impact on the introduction and use of information technology in Further Education vocational education and training courses since the 1940s.
Although other educational initiatives have been introduced which have had a direct relevance to schools, for example the microelectronics programme (MEP), these have not been included in the table because they were mainly concerned with schools, and have not had a substantial impact on the Further Education sector.
Table 2 has been constructed principally from Evans (1982); Cotterell and Ennals (1985) and Cotterell, Ennals and Briggs (1988). As one can see the main educational milestones with relevance to Further Education have taken place over the past decade.

Since the 1940s, the progress in computer technology, information science and programming techniques alongside the advances in micro-electronics and telecommunications have, according to Bradbeer (1983), allowed the three elements to be brought together resulting in rapid advances in the technology.

TABLE 2

FIVE GENERATIONS OF COMPUTER TECHNOLOGY

Time	Computer Generation	Technology milestones indicating the beginning of the generation	Main milestones for FE VET
1940s	1st Vacuum values	Computer able to store programs within its own processor	
1952/ 1964	2nd Transistors	Invention of the transistor - reduction in the size of the computer	
1964/ 1971	3rd Silicon chip	Discovery of integrated circuits	
1971/ 1980	4th Large scale integrated circuits (LSIC)	Advances in micro electronics allowed for the expansion in power provided by LSIC	
1980s to date	5th Intelligent computing	Very large scale integrated circuit allowed for computers that could emulate human experience, knowledge and communication (often referred to as Artificial Intelligence [AI]). This advance allowed computers to symbolise knowledge rather than process data.	1982 IT year and ALVEY 1984 Butcher report 1984 FEU Framework for Action 1984 DES ESG funding for IT 1985 Policy framework for NAFE central reserve 1986 Bide report

Hubbard (1981), differentiates between **old** technology, which requires mechanical devices to function, and **new** technology, which uses electronic means to drive the application.

This study focuses on **new** information technology which combines the three technologies: computing, microelectronics and telecommunications.

Figure 8 highlights the functions of new information technology according to Hawkridge (1983).

FIGURE 8

THE FUNCTIONS OF NEW INFORMATION TECHNOLOGY (HAWKRIDGE'S MODEL)

MAKING INFORMATION
- creating
- collecting
- selecting
- transforming

↗↙ SENDING/ RECEIVING ↖↘ SENDING/ RECEIVING

↗↙ ↖↘

DISPLAYING INFORMATION ←→ SENDING/ RECEIVING ←→ STORING INFORMATION

Hawkridge (1983) believes that new information technology has three distinct characteristics:

- it can deliver information accurately and speedily because of increased capacity, flexibility and efficiency
- it has the ability to search and select information from large complex stores of data and the facility to present this data in different modes
- it allows information to be sent, received, stored and displayed in its most effective and efficient forms.

However, Hawkridge (1983) raises five problems he believes exist in relation to the use of new information technology in education.

1. the insufficiency of high quality hardware technology
2. the concern that the use of information technology in a learning context will lead to an over-dependence on mediated learning (learning through media) rather than enactive learning (learning through direct experience). This, according to Olson and Bruner (1974), could be detrimental to a child's education. Papert (1980) refutes this reservation. He believes that the computer's power to stimulate and present material in thousands of forms, covering a myriad of functions, means that educational users will acquire a sense of mastery over the technology
3. the teachers' unwillingness or inability to change roles when new information technology is introduced. By this, Hawkridge (1983) refers to the need for teachers to change their role, by putting the learner in control and becoming themselves a technician, selector of courseware, individualiser of instruction, manager, scheduler and adviser
4. the development of an educational elitism creating inequality of opportunity in educational achievement
5. the worry that new information technology might lead to an erosion of the public education system. Two groups of critics suggest this:
    - those critics who believe that new information technology will be too expensive for the public education system, therefore better equipped private educational institutions will emerge to provide parallel functions
    - those who believe that new information technology will be so cheap that the opportunities for general and vocational training without face-to-face contact will increase, making the public education system redundant.

Stonier (1983) describes the state of educational software at the time as comprising *two stages of rubbish*:

- unimaginative well-programmed drill and practice
- imaginative badly programmed software.

However, Stonier (1983) thinks that a third stage will emerge; the development of good educationally valid computer programs.

AIT

Cotterall and Ennals (FEU, 1985) describe how the introduction of fifth generation computers (see Table 2, see page 54), often called AIT, would bring about generic changes in design philosophy and in the field of applications. However, in order to maximise the potential of fifth generation computing there was a need for:

- the basic mechanisms for inference, association and learning in hardware to be understood to ensure that they became the core functions of fifth generation computers
- AI software which was able to utilise the above functions
- the advantages of AI research achievements and developments in natural human machine interfaces to be illustrated
- support systems to help software development to be provided.

The advances offered by fifth generation computing would solve the mediated learning problem postulated by Hawkridge (1983), as well as leading to the development of *good* educational programs, of the type specified by Stonier (1983).

The ALVEY committee

In response to the Japanese's fifth generation projects, the Minister of Information Technology, Kenneth Baker set up a committee, chaired by John Alvey. Its purpose was to meet international competition and contribute towards international co-operation, for example, by cultivating information itself as a new resource. The ALVEY committee reported in 1982.

The recommendations made by the ALVEY committee resulted in a £350 million national programme of research and development which commenced in March 1983, under the direction of the ALVEY Directorate. The ALVEY Directorate focused initially on the **enabling technologies** which included:

- man-machine interface ([MMI] now called Human-computer interface [HCI])
- Intelligent Knowledge Based Systems (IKBS)
- software engineering
- very large scale integration (VLSI).

A further initiative in 1984, concerned itself with user problems rather than their solutions.

The FEU in its IT Bulletin (June, 1987a) outlines the implications of each of ALVEY's enabling technologies for Further Education:

- **HCI** refers to the interface between the user and the computer. This is an important element of AIT, especially with expert systems. Developers of such systems devote much time to produce efficient user interfaces which account for the physical and mental characteristics of the user. The FEU highlight three aspects of HCI:
  - the direct interface between the user and the machine
  - understanding the computer language
  - the impact of the technology on the user and organisation.
- **IKBSs** (including expert systems) concern themselves with knowledge rather than data. They make use of inference and the understanding of language. The purpose of an expert system is to represent human expertise in a particular area of knowledge so that the computer can perform functions in a similar manner to those performed by a human, that is, expert systems endeavour to emulate the functioning of an expert.
- **Software engineering** comprises the application of engineering principles to the production of software

- **VLSI** form the basis of the hardware that supports AIT, that is, the many thousands of switches contained on a single chip enable an extensive range of information and material to be processed.

The FEU believe that Further Education establishments should be able to contribute to the development of skills required to use the equipment and techniques associated with AIT.

Table 3 outlines the implications of the above enabling technologies for Further Education. In the present study, the main emphasis has been on the introduction and embedding of IKBS, in the form of expert systems into the Further Education vocational education and training curriculum.

Concerns raised by ALVEY Directorate (1982) about the need to increase the number of first degree places in information technology skills led to the formation of the Information Technology Skills Shortages Committee. Under John Butcher MP Parliamentary Under Secretary for State for Industry, the committee sought to:

- establish employer demands for information technology at professional and technician levels
- ascertain how far the education and training systems were likely to meet employer demands
- determine the actions required to meet any shortfall
- improve messages from the employment sectors involved in information technology.

The Butcher Report (1984) contains three reports, the first concerns itself mainly with the needs of graduate information technology skills. However, the second report is much more relevant to this study because it addresses technician level skills.

Butcher had difficulty in defining a technician, especially in relation to new technology. There were two main reasons for this:

- information technology would bring about major structural changes in employment transforming jobs which had been traditionally at a technician level
- new types of jobs would be created by the emerging technology.

TABLE 3

THE IMPLICATION OF ALVEY'S ENABLING TECHNOLOGIES FOR FURTHER EDUCATION

HCI needs	IKBS (especially Expert Systems)	Software Engineering	VLSI
Courses and HCI to be integrated into the existing curricula	Building of an expert system as a learning tool	Any course dealing with software design should incorporate software engineering principles	Used with any course dealing with microelectronics
To be considered when information technology is being used as a teaching medium	Use of a complete expert system to impart expertise on a particular subject	The principles of software engineering should lead to greater reliability and allow further development of computer based training (CBT)	
To be addressed and monitored when management and administration are introduced and used	Application of expert systems in college management and administration systems		

Butcher and the committee (1984) highlighted four important information technology skills required for the target audience of this study, that is, employees below the graduate level. They were:

- a solid grounding in electronic engineering, computer science or both
- a less detailed understanding of information technology but concern with its application in some other non-information technology areas
- sufficient familiarity with information technology to enable technicians to carry out changing tasks
- the ability to capture data, transfer it and analyse it to achieve efficient process control.

Another core concern of the Butcher committee (1984) was that the education and training infrastructure would not be able to respond to, nor satisfy, the increased demands for technology related occupational skills created by the rapid changes in information technology. The committee believed that:

> *unless industry and commerce has the IT skilled workforce it requires, the UK will be unable to reverse its declining share, let alone maintain or increase its share of growing world markets.*
>
> Butcher (1984)

Butcher's second report (1984) outlined the factors which, at that time were thought to lead to technician level skill shortages. It also highlighted the reasons for their continuance.

The factors leading to technician level information technology skill deficiencies, as cited by Butcher (1984), were:

- the routes by which one could become a technician, that is, school leavers entering employment through employer-based or college-based training
- the inadequacy of the training provision through BTEC, City and Guilds and RSA, in company and offered by private training providers
- lack of access to relevant information technology courses

- the unsuitability of Further and Higher Education courses to meet the needs of employers.

The reasons for the skills shortages continuing, as cited by Butcher (1984) were:

- the lack of updating in technology skills
- limited training budgets
- cut backs made due to recession
- decline in the total workforce
- reduction in traditional apprenticeships
- the reluctance to recruit at the age of 18 because of the wage rates.

According to Butcher, the solution to these deficiencies lay partially in the Further Education provision. In order to resolve the deficiencies the committee reported that Further and Higher Education institutions needed to:

- be more actively involved with local industry and commerce
- improve the relevance of courses to the needs of industry
- improve access for those who would wish to update skills and retrain by changing entry requirements, the timing and type of courses offered.

However, Butcher (1984) believed that the existing training and education structure was capable of *meeting the challenge*. Therefore the report recommended that:

> ..... *the Government, through its current actions in the Further Education and training fields, should emphasise the need for greater level of IT skills in the workforce and the importance of updating/retraining in this context.*
> ..... *attention should be drawn to the training provision currently available, and to sponsored schemes to encourage its use.*
> ..... *particular attention should be given from the school stage onwards to encouraging girls to pursue careers in IT.*
>
> Butcher (1984)

The Butcher recommendations had an important effect on the funding of information technology initiatives for Further Education vocational education and training.

ALVEY's (1982) and Butcher's (1984) conclusions that there *was much to be done to improve the exploitation of existing technology*, prompted the establishment of the IT 86 committee in February 1986.

The IT86 committee

The IT86 committee was chaired by Sir Austin Bide. Its members comprised information technology suppliers, users and academia. The then Minister of Information Technology and Industry gave the committee nine months to compile a report which would assess the needs of information technology in the UK and make recommendations for further action.

The ensuing report set out a Plan for Concerted Action (Bide, 1986) which proposed the following actions and approaches:

i. an integrated national/European approach
ii. co-ordinated action involving both users and suppliers
iii. government involvement, including financial support for specified projects
iv. a major thrust to create awareness of IT and show its potential
v. a substantial education and training programme
vi. opportunities for our best academics to work on research programmes which have an effective route to exploitation
vii. maintenance of the collaborative culture established by the ALVEY programme.

The relevance of the above actions to this study reside in (iii), (iv) and (v). The IT86 committee believed that effective training should be made available and promoted for both managers and practitioners. To facilitate this the committee recommended three interlinking strands to the plan of action:

- a programme to stimulate exploitation of research in information technology
- a collaborative research effort to support information technology markets
- the development of information technology skills and awareness.

In support of the final action point, IBM estimated in 1983 that, for every 50 technically naive end users, one information technology specialist was required. Further to this the National Computing Centre (NCC) estimated that there would be 400,000 such end users by 1987, creating the need for 8,000 skilled support staff. To meet this need, Bide recommended an expansion of the Butcher committee (1984) measures for providing specialists with appropriate skills to fill the gap.

IKBS and Further Education

The fifth generation of computing technology, because of its ability to process knowledge, provides great potential for education generally but particularly within the Further Education context (Cotterell, Ennals and Briggs, 1988). Cotterell et al's specific interest in IKBS lay in the development and use of expert systems as they believe that expert systems will have a profound impact on Further Education, particularly in the vocational areas. They also postulate several implications for the use of expert systems technology by Further Education lecturers. These include the use of expert systems to:

- create new resources and courses
- enhance existing courses
- provide new approaches for staff development.

Cotterell et al (1988) consider that Further Education vocational lecturers with industrial experience will have most to gain from the development and use of expert systems technology. Indeed, they believe that Further Education establishments could offer the bridge between education and industry of the type sought by ALVEY. Ennals and Cotterell (1985) cite a critical element for the successful embedding of information technology across the Further Education curriculum as staff development. To succeed, they believe that sufficient time needs to be allocated for on-going staff development activities which:

- accommodate the differing perceptions of staff
- take account of staff reactions to computers

- apply to the member of staff's:
  - subject area
  - organisational and management tasks.

If effective, the staff development will:

- ensure positive transfer of learning
- encourage positive reactions to computers
- facilitate the use of computers in the classroom.

In addition, for AIT, staff development activities should ensure familiarity with:

- the concepts of knowledge and information including procedural and declarative thinking
- information handling
- wordprocessing
- expert systems at an introductory level
- the social implications of expert systems technology.

Ennals and Cotterell (1985) argue that policy initiatives in Further Education should be formulated at Ministerial level. Specifically, they believe that each college should establish an independent information technology unit. To be successful this unit will need to involve representatives from every department to ensure that it is:

> *not identified with mathematics, science, or even computing.*
>
> Ennals and Cotterell (1985)

The unit will provide technology transfer and staff development activities. Two of the main outcomes from the unit should be the provision of:

- core courses for students
- introductory courses for lecturers.

Once developed, these courses can be used to facilitate the development of modules for use across a range of college courses. All of these initiatives should incorporate applications of AIT.

Key technologies

In 1988 the Engineering Council together with the Further Education Unit (FEU) introduced the concept of *key technologies*. This term relates specifically to engineering and science but is considered to be crucial to international competitiveness. Key technologies have been defined as:

> *newly emerging topics in science and engineering which are likely to have a major evolutionary effect on an existing product or process or may lead to a revolutionary product or process.*
>
> FEU/ Engineering Council (1988)

Key technologies, as described by the FEU/Engineering Council (1988) are important to three types of people:

- those in industry and commerce, who need to respond to the changing market demands
- individuals who need to keep up-to-date through continuing education and training
- those who provide vocational education and training courses.

The type of students referred to by the FEU/Engineering Council include:

- students working directly with science and technology
- those who may be affected by the wider application of the key technologies.

The latter, according to the FEU/Engineering Council (1988), need a curriculum which will foster positive attitudes towards the key technologies and an understanding of their effects on society and the economy.

Although industry-led, the key technologies, as indicated above are considered by the FEU and the Engineering Council (1988) to be important to the educational process especially in the curriculum content of relevant Further Education vocational education and training courses. The FEU and Engineering Council state that colleges need to have an annual review of their technology-based curricula to ensure that content and teaching methods can be updated to keep abreast of the key technologies.

Figure 9 shows a spiral curriculum model devised by FEU/Engineering Council. The model spans the whole of the education provision linking the needs of the key technologies with economic awareness. At the Further Education level the focus is on engineering applications.

Aspects of information technology in Further Education

As indicated in the previous sections a variety of definitions have been used to describe the differing types of technology. Alongside these, numerous definitions of the term information technology itself exist.

From a survey into the use of information technology in Further Education conducted for the FEU in 1983, the FEU (1984) concluded that the proliferation of definitions caused confusion and led to the use of different definitions in Further Education institutions. The FEU (1984) found that the absence of an acceptable definition often delayed policy-making about information technology which, in turn, prohibited its embedding across the college curriculum.

The most comprehensive and applicable definition of information technology at the outset of this study was the FEU's working definition. It stated that information technology was:

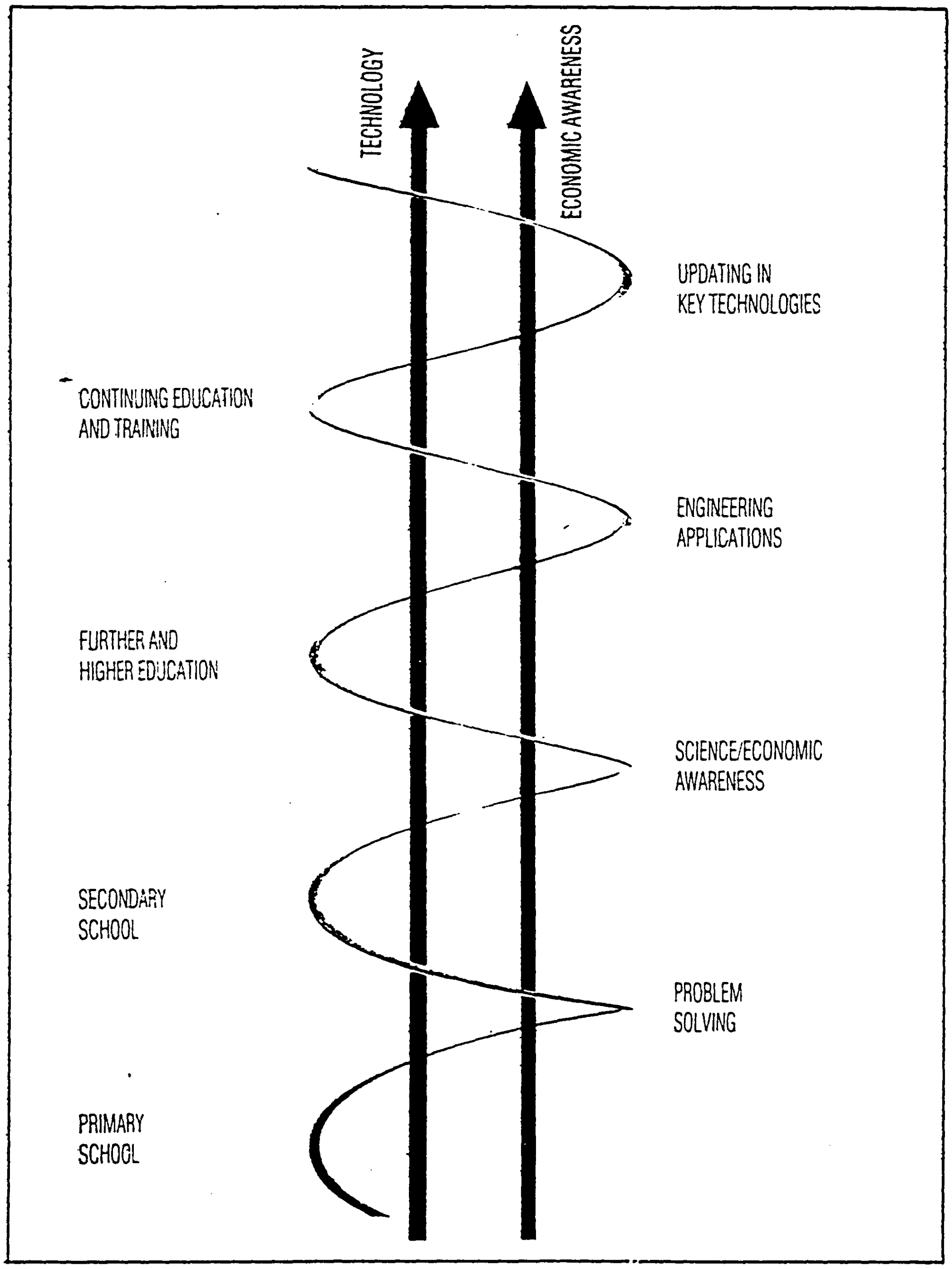
> *the acquisition, production, transformation, storage and transmission of data by electronic means in forms such as vocal, pictorial, textual or numeric, such as to facilitate the interaction between men and between men and machines. Information technology also includes the applications and implications (social, economic and cultural) of these processes.*
>
> FEU (1984b)

The key factors associated with the above definition which would facilitate the introduction of information technology into the Further Education curricula, were, according to the FEU (1984b):

- use and storage of *data*
- relationships between the *people* and the *machines*
- systems *applications* and their *implications.*

FIGURE 9

THE SPIRAL CURRICULUM FOR THE KEY TECHNOLOGIES



FEU/Engineering Council (1988)

The conclusions from the FEU's survey (1984a) split into four main sections:

1. **Policy**

   Findings relating to the development and implementation of information technology policy revealed:

   - the need for a clearer definition of information technology to eliminate confusion and promote the speedy development and adoption of information technology policies
   - a wide variation in the development and content of information technology policies
   - that financial constraints prohibited colleges adopting long-term policies for information technology.

2. **Provision**

   The information technology provision across the colleges surveyed showed that:

   - the inclusion of information technology in mainstream Further Education curricula was slow and uneven
   - the focus of information technology was in engineering, science, business and office studies whereas most of the other departments had little or no awareness of what was required in this area
   - the development of software was mainly reliant on enthusiastic staff
   - there was an ineffective co-ordination of software development activities
   - there was a need for purpose built computer accommodation
   - the wish of most colleges was to own and use microcomputers and their applications rather than mainframe computers.

3. **External support**

   The findings regarding external support revealed:

   - that the links with schools in support of information technology for teachers was tenuous
   - significant variations in LEA support and control
   - that some colleges had benefited from government funding.

4. Staffing

Finally, the findings about staffing showed:

- a diversity of staffing for information technology across college departments
- that staff development for information technology varied between colleges.

The FEU's contribution

The FEU has been very important in providing information and strategies to aid the introduction and embedding of information technology and AIT in Further Education vocational education and training courses. Following their Framework for Action on information technology (1984b) the FEU has procured and provided funding for many information technology and AIT projects in the Further Education sector.

The FEU's Framework for Action

The Framework for Action policy statement (1984b) identifies three areas where information technology might impinge on Further Education. They are:

a. **curriculum provision,** that is, the type of courses Further Education could provide across the curriculum and how information technology could be embedded into these courses, whether existing or new

b. **education technology**, that is, how information technology could affect the learning process. It has been asserted by the FEU that information technology and, especially AIT, would increase the autonomy of the student, giving the student more choices about the time, place and content of their learning

c. **organisation and management.**

Additionally, the statement emphasises the importance of supporting those staff concerned with introducing information technology through **staff development and software support.** The FEU policy statement pledges support and encouragement for the widespread application of these four areas of activity.

FEU projects

To comply with their policy statement (1984b), the FEU funded and/or supported a series of projects both alone, and in conjunction with other government agencies through:

- the MSC's Work Related NAFE Mutual Development Fund (initially the NAFE Central Reserve)
- Department of Trade and Industry (DTI) initiatives
- the DES (now DFE) ESG information technology provision.

Before commencing any projects the FEU specified that the information technology activity should be analysed in terms of:

> *data, and the associated processes, people, machines, applications and implications.*
>
> FEU (1984c)

Projects sponsored by the FEU focused on:

- the **use of new technologies**, for example, robotics generally, robotic arms, computer numerically controlled (CNC) machines
- the **curriculum provision**, for example, the design of courses in microelectronics, a series of four computer literacy units, a computer assisted package providing guidance for profiling, an evaluation of the requirements for the support of information technology, retraining in information technology and support systems for information technology
- **staff development** in the use of microcomputers and in AIT
- **staff awareness**, including a staff awareness package for Computer Aided Design (CAD)/Computer Aided Manufacture (CAM) and a publication which illustrated the use of CAD in Further Education
- **testing and control,** for example, in advanced condition monitoring by acoustic methods of non-destructive testing and strategies for operator quality control using computer based manufacturing systems.

The outcomes of many of the projects sponsored by the FEU have been promoted by conferences and publications. The following were found to be relevant to this study:

1. The four **computer literacy units** developed by Lloyd, Taylor and West (1984 (a), (b), (c) and (d)). The series comprised:
   - a general guide aimed at those providing computer literacy courses and lecturers who are looking for support
   - twenty eight teaching modules and support materials for computer literacy. These can be used to generate twenty eight hours of tuition
   - twelve modules for those wishing to develop further skills and knowledge of computing
   - seventeen further modules relating to the application of computing in industry, commerce etc.
2. The FEU **staff development pack** which included:
   - seven curriculum exemplars
   - a comprehensive model for the implementation of a staff development programme at college and regional level.

   Several of the difficulties raised by this project were because many of the institutions:

   had not identified a policy or strategy for the introduction of information technology.

   FEU (1985a)

   Specific problems which hindered the progress and embedding of information technology across the Further Education curriculum included:

   - computer facilities being dedicated to computer studies staff and locked away when not being used by these staff
   - tutors defining computer literacy as programming in BASIC
   - the lack of up-to-date computer facilities and shortage of disks for development

- the perception of some vocational departments as 'non-users' by senior college staff
- the lack of management interest and encouragement
- the unwillingness of senior staff to allow time for staff development
- the lack of support staff.

3. A project involving the FEU and the Professional, Industrial and Commercial Updating (PICKUP) initiative (1986).

   (The PICKUP initiative was introduced by the DES to stimulate the updating role of education and the part colleges can play in meeting the needs of business for post-experience education and training).

   This joint project aimed to **identify the changing requirements of local organisations which result from the introduction of new technologies.**

   The conclusions drawn from the survey showed that:

   - new technology was being introduced into organisations in a *modest and ad hoc* way
   - the organisations surveyed intended to increase their investment in new technology without employing more staff
   - most companies carried out their own investigations before purchasing new technology
   - only a few companies knew about government grants for new technology
   - very few companies considered colleges a source of advice
   - colleges were not considered by companies for training staff in the new technology areas.

4. A DTI project (FEU/DTI, 1987) aimed at **demonstrating the ways in which Further Education institutions could better provide retraining in the types of information technology required by industry.** This project used the FEU's network of experimental colleges to demonstrate how each could improve their information technology training for local industry. Ten colleges and one LEA were involved in the network. They provided different forms of

support, including a fully equipped bus, courses, CAD/CAM training, robotics, management information services and a learning centre.

The outcomes and recommendations from this project highlighted the need for colleges to:

- carry out market research on the information technology needs of industry
- improve the image of the college in this area
- collaborate with employers to establish their needs
- develop better staff attitudes to:
  - market research
  - collaborating with employers
  - meeting employers' training needs
- provide staff development in marketing
- update and extend the information technology skills and knowledge of staff
- develop costing and pricing policies for industrial training programmes.

5. An FEU/MSC (WRNAFE) project conducted in 1987, **aimed to raise the awareness of the education and training system to the potential of information technology**. The project further sought to:
   - explore how new technology related to Further Education vocational education and training courses
   - enhance the basic curriculum process,
   - determine whether the FEU curriculum model could accommodate information technology based activities.

   The project had two stages and used the matrix shown in Figure 10 (FEU, 1988) to indicate how well the five types of information technology systems, shown across the top of the horizontal axis, interact with the processes of the FEU's curriculum development model, shown down the left on the vertical

FIGURE 10

INTERACTION WITH THE FEU CURRICULUM MODEL COMPONENTS AND INFORMATION TECHNOLOGY SYSTEMS

	INFORMATION TECHNOLOGY SYSTEMS				
PROCESSES OF CURRICULUM DEVELOPMENT	Information Networks	Information Centres	Computer -Assisted Learning	Information Processing	Image Processing
Values and Needs					
Design					
Implementation					
Evaluation and review					

FEU (1988)

axis. The model itself is described in detail in the Curriculum Change section of this Chapter.

Originally support featured on the vertical axis (FEU, 1987a) but it was removed because it was found to be central to the whole matrix (FEU, 1988).

The main outcome from this study was that information technology was widely used in teaching and administration tasks and for updating course material.

From the study, the FEU highlighted the following information technology problems in Further Education establishments:

- the inadequacy of software and hardware
- the lack of staff development for the effective and efficient use of computer equipment
- the reluctance of some departments to make use of information technology, partly because there was no compulsion for computers to be used in their curriculum area and partly because staff said that they did not have time to retrain.

Three consistent problems were raised by the FEU projects:

- employers have a negative image of Further Education institutions
- employers do not perceive Further Education establishments as a viable competitor for the provision of training to fulfil their information technology retraining needs
- the technology in Further Education is inadequate for the needs of industry and commerce.

These confirmed the findings and concerns raised by the Butcher Report (1984).

Training for Jobs

In 1984 the Training for Jobs White Paper (Cmnd 9135), gave the then MSC new responsibilities to ensure that work related NAFE (WRNAFE) became as responsive as possible to labour market needs.

It also set up a policy group, chaired by Sir Roy Harding, comprising the MSC and the Local Authority Association (LAA). In May 1985, this group developed a general framework for the focus and distribution of WRNAFE funds from 1986/1987.
The recommendations included a proposal that each LEA should provide a three year development plan for its WRNAFE provision. This plan was to form the basis of an agreement between the LEA and local MSC officers. After the policy group report had been submitted in 1985, an implementation group was established to help and advise the MSC on the administration of the funds through LEAs.
An important part of this initiative for the introduction and embedding of information technology lay in the administration of the Mutual Development Fund's central reserve. This, although being held by the MSC, continued to be administered through area and regional offices. Funding the initiative in this way allowed for central control to ensure that colleges responded better to employer needs.
The policy makers perceived Further Education vocational education and training to need:

- research and development projects, aimed at improving WRNAFE 's responsiveness in information technology. The projects in this section were designed to:
  - extend the application of information technology which supported curriculum development
  - involve the research and development of teaching methods
  - research the needs of local industry
  - address the updating needs of staff delivering new technology training
- assistance for projects aimed at meeting nationally identified needs, locally
- contingency support to enable LEAs to respond to sudden changes in the scale or character of local training needs for certain non-local authority provisions.

At the outset priority was given to the research and development projects.

This funding is now administered directly through the local Training and Enterprise Councils (TEC), with an amount administered by the DoE for National Development Fund (NDF) projects. One funding activity under the NDF includes the use of new technology.

The Education Support Grant (ESG)

The ESG provided a second source of funding which has significantly influenced the introduction and use of information technology in Further Education.

This grant, administered through the DES, was established under the Education (Grants and Awards) Act 1984. It empowered the Secretary of State for Wales to pay grants to LEAs in England and Wales for areas which had:

> *an important contribution to make in promoting continuing improvements in the education service and in assisting LEAs to respond to changing demands.*
>
> DES (1984a)

The 1984 Education Act gave the Secretary of State power to support activities to:

- *help LEAs to respond swiftly to new demands on the education service*
- *promote qualitative changes and improvements in standards of provision in areas of particular importance*
- *encourage LEAs to redeploy their expenditure at the margin in accordance with objectives of particular national importance.*

DES, 208/84 (1984b)

Eleven activities were funded under the ESG in the financial year 1985/1986. The total expenditure for this year was not to exceed £30 million. This, when supported at 70%, was expected to give a total expenditure for the DES of £21 million.

The activity of particular importance to this study was funding activity J (funding activity V from 1986/1987) which provided money for information technology in NAFE. The proposed length of support for the activity was five years, with reduced funding available during the final years of the ESG.

The aim of this funding activity was to extend the use and awareness of information technology in NAFE courses. In order to achieve this aim the ESG assisted LEAs in providing:

- courses for vocational students which reflect the increasing use of information technology in the workplace
- sufficient knowledge and skills for teachers, in vocational areas not normally associated with computers, to enable them to take account of work related information technology in their teaching.

Applications for ESG funding could be made for all or any of the three items specified under this activity, that is, hardware, staff development and courseware development, and were to be made through the LEAs for any or all of the colleges within their LEA area (DES, 6/84, 1984c). Part of the staff development provision included the establishment of twelve to fifteen colleges to act as regional centres for staff development and training. These centres were to be created in:

> *colleges which have particular strengths in information technology.*
>
> DES, 6/84 (1984c)

Circular 5/86 (DES, 1986) describes the ESG provision for 1987/1988. It outlines another area of funding of specific importance to this study, that is, support for Centres of Expertise. Kingston College, one of the study's longitudinal case studies, became the Centre of Expertise for expert systems. At the time of writing the DES envisaged that:

> *expertise in developing courseware is likely to be thinly spread.*
>
> DES, 6/84 (1984c)

Therefore, a small number of authorities were funded, through the ESG, to provide staff development for courseware. A copy of the courseware developed under this initiative was to be lodged with the FEU.

In order to secure ESG funding, the LEA had to submit a plan which outlined how the funding and provision for hardware, staff and courseware development would be allocated throughout the LEA's colleges. The funding, although given yearly, included some indicative expenditure (money for which the DES was morally committed) for subsequent years of the LEA's plan.

The information technology in NAFE funding activity accounted for:

- £10 million of the ESG programme for 1985/1986 (this included £1.5 million each for staff and courseware development) DES, 6/84 (1984c)
- £9 million of the ESG programme for 1986/1987. This included:
  - £5 million new expenditure for hardware
  - £2.5 million for staff development of which approximately £1 million will be allocated for the continued support of staff development centres
  - £1.5 million for courseware development, most of this was indicative expenditure DES, 5/85 (1985)
- £8 million of the ESG programme for 1987/1988, comprising:
  - £4 million new expenditure for hardware
  - £2.2 million for staff development, comprising £0.4 million new expenditure and £1.8 million indicative expenditure
  - £1.8 million for courseware development, comprising £0.4 million new and £1.4 million indicative expenditure DES, 5/86 (1986a)
- £4.7 million of the ESG programme for 1988/1989, comprising 4.5 million indicative funding plus £0.2 million new funding allocated for staff and courseware development DES (July 1987a)
- £4.6 million of the ESG programme for 1989/1990, comprising 4.4 million indicative funding plus £0.2 million new funding allocated for staff and courseware development. DES (July, 1988)

Bids made under DES circular 5/86 had to indicate spending for staff and courseware development for 1988/1989 and 1989/1990. Funding for hardware ceased at the end of 1987/1988.

The FEU was asked by the DES (1985) to:

- co-ordinate and monitor the courseware development
- discuss questions relating to courseware production and dissemination including copyright.

By 1991/1992 the ESG had been integrated with the LEA Training Grants Scheme (LEATGS) under a unified scheme, the Grants for Education Support and Training (GEST) scheme.

The LEATGS started in April 1987 (HMI, 1989a and 1991). At the outset this scheme was seen as a new way of funding in-service education and training (INSET). The support offered was for National Priority Areas (NPA) and Local Priority Areas (LPA).

The Further Education sector, because of the major part it plays in the training of technician and craft level students for those key occupational areas requiring information technology skills (HMI, 1989b), attracted funding as an NPA, for the:

> *training of Further Education lecturers in the teaching of information technology and the integration of information technology across the curriculum.*
>
> HMI (1991)

The objective of this funding activity was that:

> *lecturers in all subjects should be able to use information technology authoritatively and confidently in their teaching.*
>
> DES (Circulars 6/86,1986b; 7/87, 1987b; 5/88, 1988b and 20/89, 1989)

It included funding for training:

- to teach awareness of information technology
- to enable lecturers to embed information technology into their teaching in computer-based and computer-managed learning

which was supported at 65%. This funding continued for a year (supported at 60%) under GEST.

GEST was established as a unified programme following a scrutiny of the two grants (ESG and LEATGS) in 1989 (Glickman and Dale, 1990; DES 1990a and DES 1990b) by the Prime Minister's Efficiency Unit. The rationale for GEST was to:

- improve the co-ordination between the ESG and the LEATGS
- reduce the administration.

However, it was agreed that both ESG and LEATGS would continue to be paid separately, whilst co-ordination of administration would be sought wherever possible. The ESG, LEATGS and GEST have provided an investment of approximately £50 million by central government in an endeavour to introduce and embed information technology into the Further Education curriculum.

The direction of information technology in Further Education

In assessing the need to understand computers in order to use them, Neuwirth (1986) proposes three ways in which computers can be useful in the educational process. These reflect the thoughts of the FEU.

- learning with computers, for example, data processing, spreadsheets and text processors.
- learning through computers, for example, computer simulation and computers when used as a medium to teach about an industrial process
- learning about computers. The scope of this can range from general computer literacy (e.g. for YTS trainees) to an in-depth study of the internal workings of a computer (for Electronic Engineering students).

In many Further Education vocational education and training courses, all three can be essential for positive transfer of learning, for example, in the teaching of Computer Aided Design (CAD).

Similarly, Gwyn (1986), supported by van Weert, outlines four classes of AIT that they call **new technologies of information** or **new information technology (NIT)**.

The four classes include:

- learning about information technology
- learning with the aid of information technology, that is, using the technology as a teaching aid
- learning by the means of information technology, that is, for example using a computer assisted learning (CAL) or computer based training (CBT) package
- information technology as an aid to management.

HMI survey

HMI, in a survey of NAFE (HMI, 1987) found the use of information technology, although adding an extra dimension to teaching, to be disappointing.

At this time, the use of information technology in NAFE was found to:

- have no central focus for the development of specialist computer options across other non-computer departments
- have no clearly articulated policy for the use of computers as a teaching aid
- be inadequately planned, often leading to the installation of incompatible hardware and acquisition of an inadequate range of software
- be used, in many cases, only as an adjunct rather than as an aid to learning.

The same study (HMSO, 1987) identified insufficient funding as one of the main reasons for the inadequate provision of hardware and software in NAFE. Although benefiting from ESG funding, HMI proposed that inadequate funding inhibited the introduction of highly powered professional workstations in the Further Education curriculum.

Colleges linking themselves with industry, through which they had been able to procure equipment and funding, were cited as instances of good practice in the HMI survey.

Defining information technology in Further Education

Davis, Cade and Good (1988) conducted a study which examined the issues and problems of information technology in teaching and learning. They agreed with the findings of the FEU survey (1984a) that the use of differing definitions of information technology in Further Education created a problem. The complexity of definitions, according to Davis et al (1988), indicate the breadth of information technology in terms of its numerous uses and the skills required by users and developers. Although regarding the FEU definition as the most comprehensive, Davis et al, found that this definition omitted some important aspects of information technology such as graphics (on-screen design of buildings, cars etc.) and interactive programs (programs linked to video for facilitating subject learning).

Davis et al (1988) in defining information technology, differentiate between:

- **aspects of technology** (IT), that is, those occupations which use information technology as technology, for example, engineering, electronics and computer science
- **information management** (IM), sometimes called information systems management, where information technology is subservient to its applications, that is, users do not see themselves as using information technology but only use the equipment to help them perform efficiently.

Davis et al believe that a clear distinction needs to be made between IT and IM. They confirm Ennals and Cotterell's (1985) stance that information technology and, more importantly, AIT, needs to be integrated across the Further Education curriculum as an underlying principle of teaching and learning. In addition, both Davis et al (1988) and Ennals and Cotterell (1985) believe that, for information technology to be successful in Further Education, it needs to be introduced across the whole curriculum and administered through a separate information technology department or centre. The primary focus of this information technology department or centre would be to change the traditional association between IT, IM and male dominated technical subjects.

In the Davis et al (1988) study, several important practices were found to lead to the embedding of information technology in Further Education. They include:

- a central college policy to provide a framework for action to prevent ad hoc implementation
- a staff development strategy for all levels of staff in every department
- the development of close links with employers to enable the needs of industry to be addressed in the college curriculum provision
- the development of links with schools to market information technology and information management
- increased marketing/promotion to reach under-represented groups.

The need for research

The Education and Human Development Committee of the Economic and Social Research Council (which replaced the Social Science Research council in 1984) agreed that information technology and education should be one of its priority areas. Funding under this provision included research:

- on the development and adaptation of the curriculum to equip people, including those of school age, to deal with intelligent machines
- on the effect that intelligent machines, which aim to help teaching within the existing curriculum, might have on education
- which will prepare students for the changes that are likely to occur on the arrival of such machines.

To this end, the Information Technology in Education Research (InTER) Programme was established. This programme supports a substantive research programme. The brief for the co-ordinator, as laid out in the Internal Working Paper InTER/A/89 (Lewis, 1989), included the need to:

- formulate research guidelines
- stimulate relevant research
- identify the requirements for information technology in education
- review, evaluate and disseminate recent and current activity in the field of information technology and education
- establish and maintain a database for use by cognitive scientists, educational research practitioners and policy makers.

Core skills

In 1989 (HMI, 1989b), the then Secretary of State for Education John McGregor wrote to the National Curriculum Council (NCC) and Schools Examinations and Assessment Council (SEAC). He instructed the NCC and the SEAC to examine the issue of developing information technology as part of the core curriculum for 16-19 year old 'A' level and vocational students.

The resulting framework (NCC, March, 1990) includes six core skills relating to information technology. It highlights the need for students using information technology to have the ability to:

- *use computers and electronic equipment to process and communicate information*
- *use computer simulations to develop an understanding of real and theoretical situations*

and to

- *use word processors, databases, spreadsheets and other software, as well as electronic communication systems such as electronic mail and teletext.*

NCC (March, 1990)

Kenneth Baker (ACFHE speech, 1989) believes that *familiarity with technology* and *systems* are crucial to any core curriculum developed for vocational education and training students.

When referring to the needs of the core curriculum and the future international demands on Further Education, Maclure (1991) postulates that:

> *our hand will be forced by the rest of the Western world which expects to have a literate, numerate, information technology competent workforce.*
>
> Maclure (1991)

Morgan (1990) believes that the world is in the early stages of a global economy and information technology revolution which will provide the employment context for education. According to Morgan, two mega-trends exist which are relevant when assessing the implications of technology in education. Firstly, the change from an industrial to an information society will add new subjects to the curriculum and provide technology as a base subject for all students. This will, so Morgan believes, create a divide between *high tech* (for example, electronics, biotechnology, robotics and computer studies) and *high touch* subjects (for example, media studies, community and child care, leisure studies, tourism and textile design). High tech subjects will create cultural homogenisation and individual isolation unless they interface with the high touch subjects.

The second mega-trend postulated by Morgan (1990) is the move from a national to a global economy, where fewer goods will be required for world markets. This will create economic integration and perhaps production sharing between countries which will lead to the need for the education process to provide a majority (rather than a minority, as in the industrial revolution) of individuals who:

> *possess individual autonomy, communication skills, self confidence, creativity, self reliance, self help, initiative, inventiveness, self starting and enterprise.*
>
> Morgan (1990)

The development of such skills and abilities are considered to be important to the future education process. Although relating specifically to the Technical Vocational and Education Initiative (TVEI) and focusing on the pupil perspective, the role implications cited by Morgan have a generic applicability across all educational contexts where technological change is required.

Table 4 shows the role changes for the teacher and pupil which will be necessary to accommodate new technologies.

TABLE 4

TECHNOLOGICAL CHANGE :
ROLE IMPLICATIONS FOR TEACHERS AND PUPILS

People	Changes from:	Changes to:
Teachers	Teacher/instructor Knowledge as a means Subject centred identity Control by adult status Teacher evaluates	Tutor/counsellor/facilitator Knowledge as means and ends Methods/relationships centred Control by negotiation Teacher and pupil evaluate
Pupils	Passive receiver Recipient of time management Episodic accountability for personal progress Pupil status	Active explorer, user, applier Responsible for personal time management Frequently accountable for personal progress Student status - participates in planning

NCET survey

In 1990, the NCET (1991) undertook a survey to investigate and report on the impact of information technology in the Further Education curriculum throughout England, Northern Ireland, Scotland and Wales. The survey focused on curriculum, resources and staff development. It gauged the effect of the termination of the network of staff development centres for information technology which had been financed by the ESG and Work-Related Further Education Development Fund (WRFEDF).

The main findings from this survey are similar to those found seven years earlier by the FEU (1984a). They can be grouped, as with the FEU study (1984a) into four areas:

- policy
- provision
- staff development
- external support.

The NCET (1991) findings have been summarised (see Table 5) to show the progress which has occurred since the FEU (1984a) survey and to identify those problems which still exist.

As shown in this and the previous section, there is a proliferation of literature about Further Education and information technology. However, most of the information technology literature highlights problem areas and makes recommendations about **what** should be done without giving a firm lead about **how** it should be done. There are only a few notable exceptions, for example, from the FEU (1984a), Ennals and Cotterell (1985) and Davis et al (1988).

The government has played a major part in the expansion of information technology across the Further Education curriculum. However, if one analyses the NCET study, it is clear that the initiatives and funding have had little real impact on facilitating the embedding of information technology across all vocational education and training courses. Many problems identified at the beginning of this research still exist (see Table 5) and this highlights the need for the type of model which has been developed from this study to be reviewed and utilised when policy is being formulated. There is also a need to collate the outcomes from studies such as those that have been documented in this part of the literature review so that a more focused approach can be used for future governmental funding and initiatives in this area.

TABLE 5 PROGRESS ON INFORMATION TECHNOLOGY

(cited by NCET, 1991 since FEU survey, 1984a)

Progress since FEU (1984a)	Problems since FEU (1984a)
Policy	
Institutional policies for IT being widespread	Lack of policy (linked with the assumption that IT should be in technical departments)
Many policies including the right of access to IT facilities and experience for staff and students	IT decision making in a transitional state
Centralised IT budgets and decision making enabling rational decisions about purchases	Departmental concerns mitigating against standardisation and larger purchases
Some colleges using IT as a method of enhancing their image in the local community	The effectiveness of IT co-ordination depending on the amount and type of management backing
Some instances of good practice for the embedding of IT being found	Embedding of IT still relatively infrequent
	The need for more strategic planning, staff development and improved software availability for cross-curricular embedding
Provision	
IT co-ordinators now present in over 50% of the colleges	Major problems for access occurring where computers are in specialist departments
IT committees present in some colleges.	Some colleges unaware that IT is likely to become a core skill for 16-19 year olds
Over 50% of the colleges offering specific IT or computer courses	Colleges that have flexible access centres for IT, being unaware how IT can support flexible learning
Perceptible trends towards networking and using industry being found	Colleges, having marketed IT courses, finding it difficult to keep equipment up-to-date
	Management information systems for administration slow and difficult to install
	Some college libraries still untouched by IT
	Lack of specially developed educational software
Staff Development	
Most colleges providing some sort of IT staff development	Staff development being the most neglected part of IT
	Lack of funding for staff development
	Insufficient technical support
External support	
Some colleges are particularly successful in securing grants from government and industry/commerce for the purchase of hardware	

3. The theoretical context

The theoretical context for this study has two interlinking components. Firstly, there is a review of theories, models and strategies which can be used to aid the change process. The second component in this context involves a summary review of evaluation literature relating to the assessment of governmental intervention.

The change literature reviewed in this thesis has been selective due to the immense amount of literature available on the subject. Thus, this section focuses on change theories, methods, tools and techniques at the organisational level. As stated in the introduction, there is relatively little theoretical literature relating to curriculum change in the Further Education vocational education and training context, particularly in relation to information technology. Therefore, this part of the literature, although having an educational bias, does include other theories and models which have implications for the research undertaken as part of this study.

This component of the literature review, is sectioned as precisely as possible. However, because of the interdependence of the issues discussed, the sections are not mutually exclusive and items contained within them could often have been included in more than one section.

Change and innovation

Many writers on change have attempted to differentiate between change and innovation. If these are different it could be particularly important for this study because it deals with both:

- information technology which might be a well-established tool in some colleges, in others partially and in still others a little or not at all
- AIT which by its very nature is new and could be considered innovation.

Different notions of innovation

Zaltman (1973) distinguishes three different uses of the term **innovation**. They include instances where innovation:

- is seen as being synonymous with invention but does not necessarily involve an organisation adopting the innovation
- refers to the idea, practice or material that has been invented being introduced without being adopted
- is used to describe the process where existing innovation becomes an integral part of an adopter's cognitive state and behavioural repertoire. Thus, a person can adopt the innovation without having been inventive.

The Organisation for Economic Co-operation and Development (OECD, 1973) define innovation as:

> *a deliberate attempt to improve practice in relation to certain desired objectives.*
>
> OECD (1973)

According to Becker and Whisler (1967), innovation is something new in relation to the technological environment across a set of similar organisations:

> *the first or early use of an idea by one of a set of organisations with similar goals.*
>
> Becker and Whisler (1967)

Implicit in this definition is the idea that an innovation that is well established across a set of similar organisations and new to a particular organisation is *change behaviour* rather than *innovation*.

Daft, writing with Becker (1978), agreed with the above, seeing the conflicting definitions of innovation as subsets of organisational change which are related to change behaviours.

The change behaviours indicated by Daft and Becker (1978) include set(s) or subset(s) of behaviour(s) which are:

- different from those currently being used within a particular organisation
- new to a group of organisations sharing the same technology and goals as the organisation undergoing change.

The former is considered change and the latter innovation by Daft and Becker.

Aitken and Hage (1971), believe innovation to be organisation specific. The essential element of innovation is the newness of the idea or behaviour to the adopting organisation.

Havelock (1982) agrees but relates innovation to people rather than organisations. An implicit assumption by Havelock is that the innovation will benefit the people being changed. Havelock (1982) differentiates between innovation and change, defining change as:

> *any significant alteration in the status quo ..... this will mean an alteration which is intended to benefit the people involved*

and innovation as:

> *any change which represents something new to the people being changed.*
>
> Havelock (1982)

Dalin (1978) uses innovation and change interchangeably, linking innovation with the improvement in:

> *practice in relation to certain desired objectives.*
>
> Dalin (1978)

Mercer (1985) agrees with Dalin but, when differentiating between innovation and change, believes that innovation operates on a smaller scale whereas change is:

> *all embracing and subsumes innovation.*
>
> Mercer (1985)

Gerstein (1987) distinguishes between technology and innovation and cites Drucker who considers innovation to be related to the entrepreneur. Innovation, according to Drucker is the:

> *specific tool of entrepreneurs, the means by which they exploit change.*
>
> Gerstein (1987)

Gerstein believes that innovation is a *social process* emerging from a number of sources, one of which might be technology, but all of which relate to the needs and values of the customer. Technological innovations differ. They are, according to Gerstein, not related to the customer and serve only technology's purposes.

Change and changing

Fullan (1982), writing about the meaning of educational change, maintains that change has two components. These relate to the implicit or explicit theory of:

- education, which addresses the nature of the change - *what the change is*
- change, which examines the *process being followed to implement change.*

By 1985, Fullan considered that research on educational change needed:

> *to go beyond theories of change (what factors explain change) to theories of changing (how change occurs and how to use this new knowledge).*
>
> Fullan (1985)

According to Fullan, a theory of changing is one which:

> *concerns itself with how to influence, manage and otherwise alter those factors known to affect outcomes.*
>
> Fullan (1986a)

Also Fullan (1986a) believes that change is related to the learning process which is linked with both individuals and the organisation.

First and second order changes

Cuban (1988) differentiates between first and second order changes.

First order changes are those that improve efficiency and effectiveness without destroying the organisational structure and features, or altering the roles of the adopters. This type of change is more likely to succeed.

Second order changes are those that reform the whole organisation. Many of these fail because they cannot be, or have to be adapted to be accommodated into the existing system. The changes required to accommodate the new strategy, process or technique into the existing structure can lead to failure of the whole change activity if not successfully implemented.

Radical and evolutionary change

Becher and Kogan (1980) identify two types of change:

- **radical change** that focuses primarily on values and secondarily on forms of organisation or patterns of activity
- **evolutionary change** which is associated with maintaining a continuity of values in one direction whilst introducing significant discontinuity in another.

The FEU, when examining the consequences of introducing the Technician Education Council (TEC) into Further Education, differentiated between radical and evolutionary change (FEU, 1981 and 1982). The introduction of TEC qualifications was radical change, according to the FEU.

Change in the curriculum

Although the FEU do not define innovation they believe change to be an integral part of *curriculum development* which:

> *denotes bringing about change in both programmes and methods of teaching and learning.*
>
> FEU (1981)

Vincent and Vincent (1985) write specifically about information technology in Further Education. They use the term curriculum change to include both:

> *innovation (which implies a complete break from what has gone before) and development (which is a modification of what has gone before).*
>
> Vincent and Vincent (1985)

Bolam (1986) uses change and innovation in a different way from the definitions outlined above. Change is used as a generic term referring to unplanned and planned developments requiring management. Innovation is used to cover planned or deliberate intervention aimed at improving education. These definitions relate to a description by Bolam of the national scene and its implications for school improvement.

It is clear from the definitions offered by the various authors that innovation has different meanings. However, all relate to the change process and primarily focus on the:

- invention itself, that is, the product, process or service
- individual, in terms of the innovator or the fact that something is new to another individual
- organisation, in terms of the newness of a procedure, tool or product, to a specific organisation or (dependent on the author) across organisations or the way the innovation is introduced
- difference between large and small scale changes.

Models of Change

Mercer (1985), reviewing the factors and theories that bring about change, believes that models are frameworks for thinking with. He postulates that models are:

> *conceptual coatracks which help both to simplify reality and to put some kind of order into our thinking.*
>
> Mercer (1985)

Thus, models help give meaning to a set of disparate events and phenomena. Some models help the user sort out ideas about change dealing with analytical skills and others focus on practical skills. Models, according to Mercer, can be:

- **value-free**, because they provide only a framework or scaffolding for the phenomena
- **value-laden**, because they predetermine how our perceptions of the world are constructed

and they can be:

- **specific,** in that they relate to a specific situation
- **general,** in that they take a global view and have little practical application in concrete situations.

Leigh (1988) believes that models are tools for making sense of the change process. They provide:

> *a mind set for thinking about something clearly.*
>
> Leigh (1988)

However, they are often unacceptable because they are perceived as:

- not accurately reflecting the real world
- incomplete and as such can encourage narrow thinking
- seldom offering detailed, validated guidance for action.

Taking account of his reservations, Leigh believes that, although an immense amount of academic and autobiographical literature about change exists there is still a need for:

- a general model which has been rigorously tested and which explains how organisations work
- a model which shows a set of validated levers of change which are generally known to work.

Getting from here to there

The very simplest change framework, postulated by Leigh (1988) is illustrated in Figure 11. This framework underpins all change strategies, whatever they may be.

FIGURE 11

THE BASIS OF ALL CHANGE

How to get from

HERE $\longleftrightarrow$ THERE ?

to

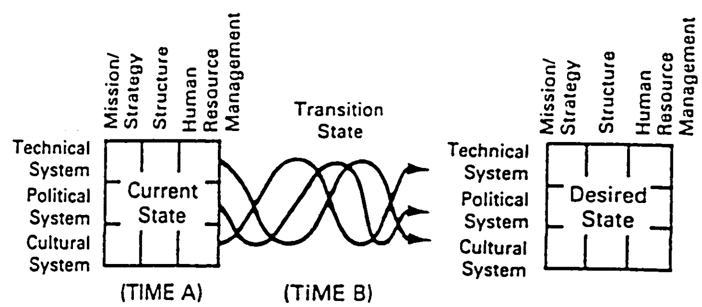
An expansion of this framework is Tichey's strategic change model (see Figure 12) which is described by Leigh (1988) According to Leigh, Tichey's models of change illustrates the stages that need to be managed in order to achieve lasting change. The three stages are:

- the **current state**, the state operating at present, that is, the HERE
- the **transition state**, where changes are made which allow the desired state to be achieved
- the **desired state**, the state to be achieved, that is, the THERE.

Tichey (in Leigh, 1988) believes that every organisation has a technical, political and cultural system which needs to be accounted for in any change process. He illustrates these three sub systems as strands of what he calls a stategic rope (see Figure 13). In order to bring about strategic change managers need to unravel the strands, work on them and then rewind them so that permanent change can be implemented. To secure effective change it is essential that the strands are continually integrated.

FIGURE 12

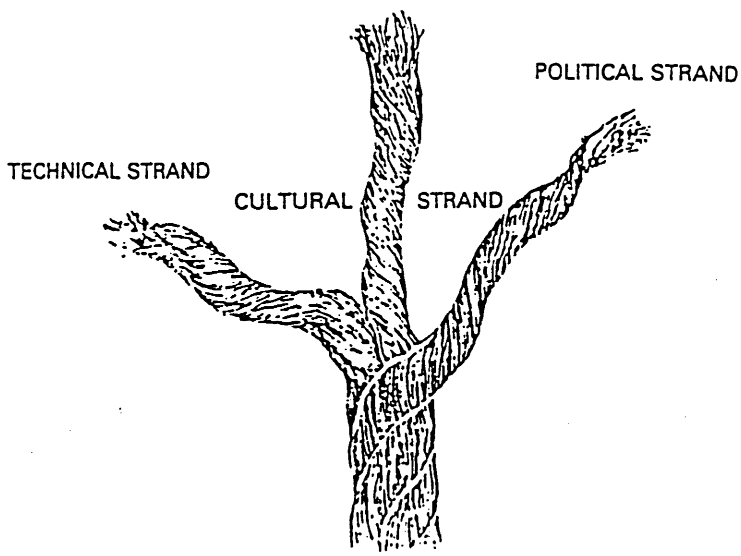
THE STRATEGIC CHANGE MODEL



Tichey (reproduced in Leigh,1988)

FIGURE 13

STRANDS OF THE STRATEGIC ROPE



Tichey (reproduced in Leigh,1988)

Models of organisational change

Leigh (1988) believes that, although models of the change process exist, there is no universal model or framework of organisational change. According to Leigh (1988) three important ways of viewing organisations have influenced management thinking this century. They are:

- the **traditional/classical model** which deals, in the main, with mass production organisations. Within this model, organisations are seen as machines with layers of management. The authority of the individuals within such organisations matches their responsibility. This model is now considered to be too rigid to reflect what happens in real organisations
- the **human relations model** which relates to organisations with democratic leadership and flat hierarchies that rely on team development to function. They are seen to be living organisms with mutually connected and interdependent parts. The authority in this type of model flows from the bottom upwards, not from the top downwards. Groups within the organisation have as much influence as the manager
- the **systems model** which adopts a computer systems approach that examines inputs, processes and outputs. Within this model the organisation is treated like a giant computer or system where everything is related to everything else. The underpinning for management is that in order to handle change effectively one needs to understand the system as a whole before unravelling the parts to see how they fit together. This model emphasises openness of relationships, need for rationality, team work and cohesive groups, and interdependence. This model has had a significant effect on how managers handle change but is now losing favour because practice has shown that being able to master the interdependence of an enormous, tightly linked organisation is beyond the skills of most managers, even with the most sophisticated analytical tools.

The model described by Leigh (1988) as emerging from the above takes the view of the organisation as a *loosely-coupled system.* This loosely-coupled model demands the converse of the systems model from managers. Instead of examining the system from a macro perspective, managers are expected to understand the whole of the organisation by examining its differing parts. Within this type of model, change and turbulence are accepted by the organisation which is bound together by shared values, sentiments and symbols. The focus of this model is on the individual as opposed to the group. Change in this model is a developmental process where growth and direction are the main issues and everyone is a change agent. Management's role is to manage the organisation's culture and values and to develop an overall vision which will inspire and direct the sub-systems of the organisation.

Legge (1984), discussing how to evaluate planned organisational change, outlines two models of change: normative and descriptive.

- **Normative models** prescribe the kind of change strategy that should be used to achieve the desired future state. When examining normative models one has to consider three aspects of changing:

  planning; strategies of change and desired outcomes and effectiveness.

  (Legge, 1984)

  These three aspects cover vast areas of research and involve many types of models. Legge (1984) summaries three:

  – **the rational comprehensive** model which assumes that the best decisions are made rationally through decision-makers:

    - making clear their values and expressing them as a consistent set of goals and objectives
    - examining the alternatives that might facilitate the achievement of the goals and objectives
    - assessing the utility and predicting the consequences of the adopting the alternatives

- selecting the most appropriate action for the achievement of the goals and objectives.

- **the disjointed incrementalism model**, which according to Braybrooke and Lindbolm (1963), provides a descriptive account of how planners and managers *actually* make decisions. It also identifies a normative/prescriptive framework for how they ought to proceed. Within this model decision makers do not evaluate the alternatives for the maximisation of the objectives, they make *successive limited comparisons* and a series of *disjointed* and *incremental* decisions which allow them to *muddle through.* Each decision leads to marginal improvements of the existing state of affairs rather than providing a comprehensive strategy which is designed to achieve precise objectives. The emphasis of this type of approach is on gaining the support and agreement of the most powerful interested parties for the alternative that they prefer. Braybrooke and Lindbolm (1963) believe that this way is the best way for complex decision making in our pluralistic world.
- **the mixed-scanning model,** proposed by Etzioni (1973) resides between the two normative models described above. The model is prescriptive about how the information is collected. Firstly, fundamental decisions are made by *scanning* at an *all-encompassing level.* This process involves examining the alternatives open to the organisation at an overall level and in terms of its values and goals. At this stage the specific details are omitted. Following the overall scanning, incremental decisions can be facilitated and scanning at *a highly detailed level* can then take place. Etzioni believes that this two staged scanning should be completed in a series of iterative steps which reflect the real world procedures adopted *in large variety of fields.*

- **Descriptive models of change** focus on what actually happens when change is being planned, how change occurs, how the change is implemented and how the outcomes are assessed.

The organisational development (OD) model

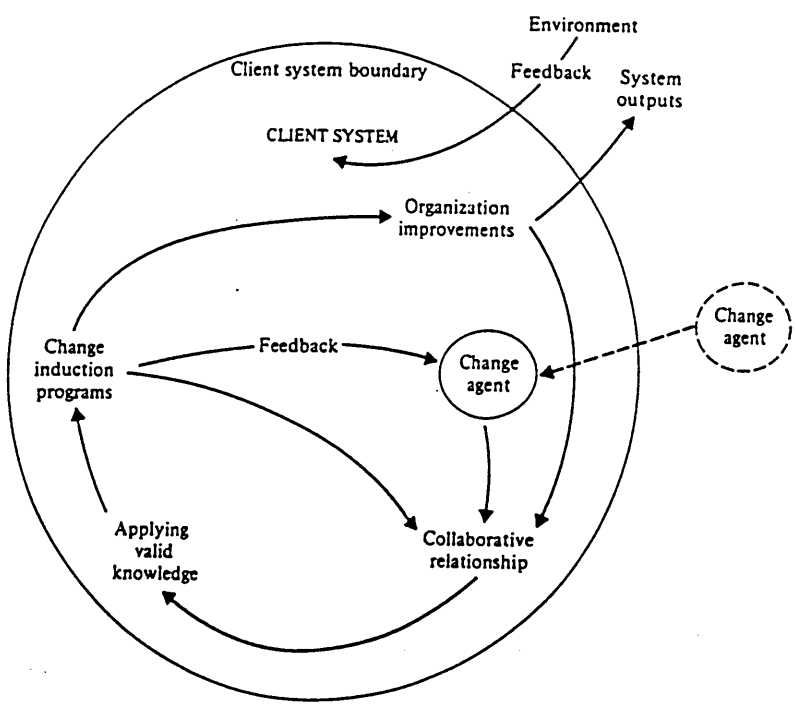
Organisational development is maybe one of the most well known methodological models for bringing about organisational change. Bennis (1969), defines this new and emerging approach as:

> *a response to change, a complex educational strategy intended to change the beliefs, attitudes, values and structures of organisations so that they can better adapt to new technologies, markets and challenges, and the dizzying rate of change itself*
>
> Bennis (1969)

According to Bennis (1969), OD has seven basic characteristics most of which have been captured by Peter (Bennis and Peter, 1967) in the model shown in Figure 14.

FIGURE 14

BASIC ELEMENTS INVOLVED IN OD



Bennis and Peter (1967)

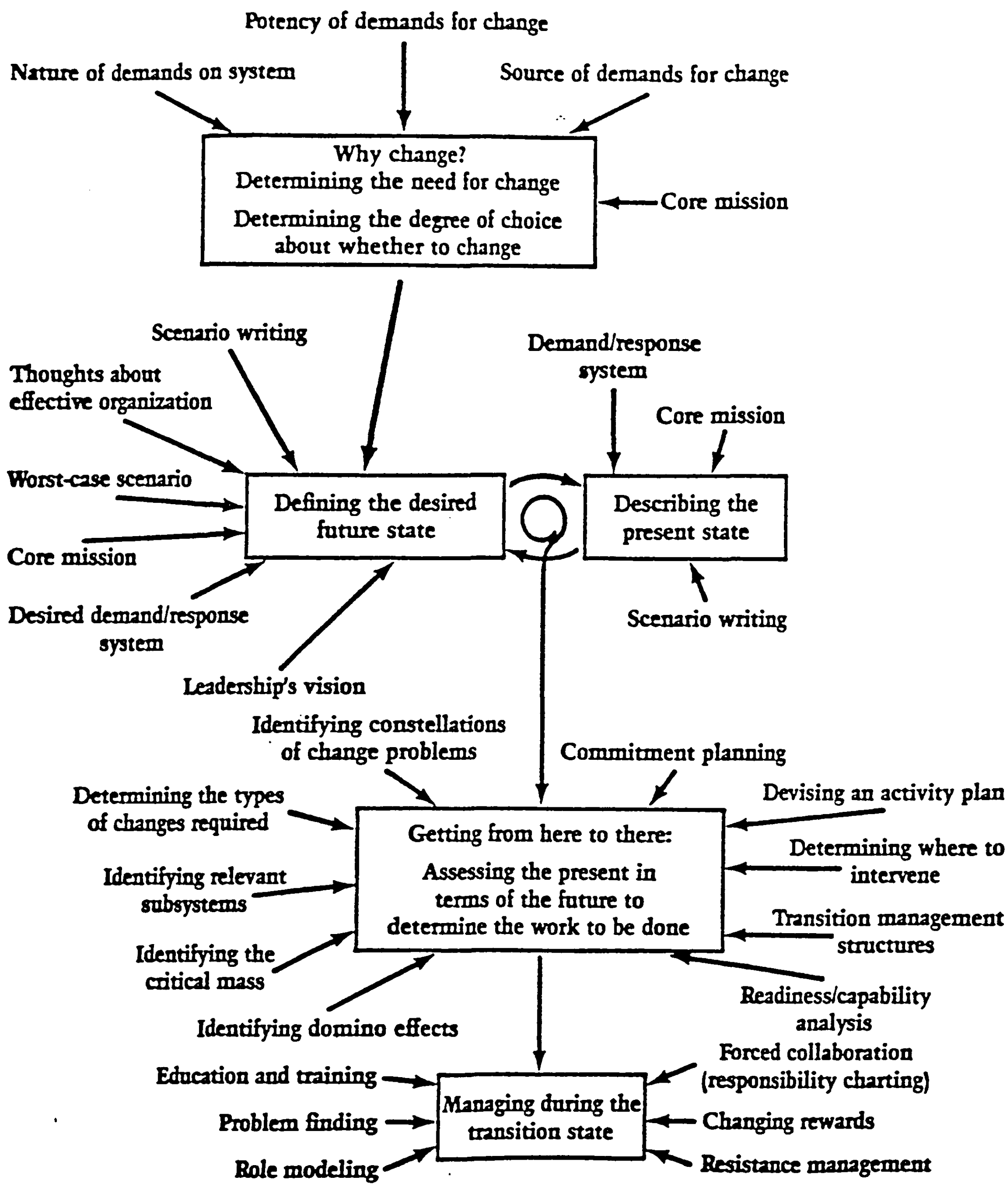
The basic characteristics, textually described by Bennis (1969), comprise:

- a specifically developed educational strategy to aid planned organisational change. The strategy almost always concentrates on the values, attitudes, relations and organisational climate (the people variable) as an entry point
- an educational strategy which emphasises and builds upon experienced behaviour to facilitate planning and action
- the linkage of the changes sought with present organisational demands
- the use of external change agents
- collaboration between the change agent and the client system
- change agents who share a social philosophy, that is, a set of shared values about the world and human organisations which shape their strategies, determine their intervention and govern their responses to clients' systems
- the development of normative goals based on the social philosophy of the change agent. These include: the improvement in interpersonal competence; shift in values where human factors and feelings are legitimised; an increased understanding between and within working groups; development of more effective *team management*; development of better methods of *conflict resolution* and the development of organic rather than mechanistic systems.

Beckhard and Harris (1987) following an organisational development perspective agree with the three states proposed by Tichey (in Leigh 1988), however they name them present, transition and future states. In a much more complex diagram, Beckhard and Harris highlight the differing states alongside the various issues and needs that are likely to impinge upon them. Within this model decision making needs to be made at each point in the change process (see Figure 15).

FIGURE 15

THE OD CHANGE MANAGEMENT PROCESS



Beckhard and Harris (1987)

Action research

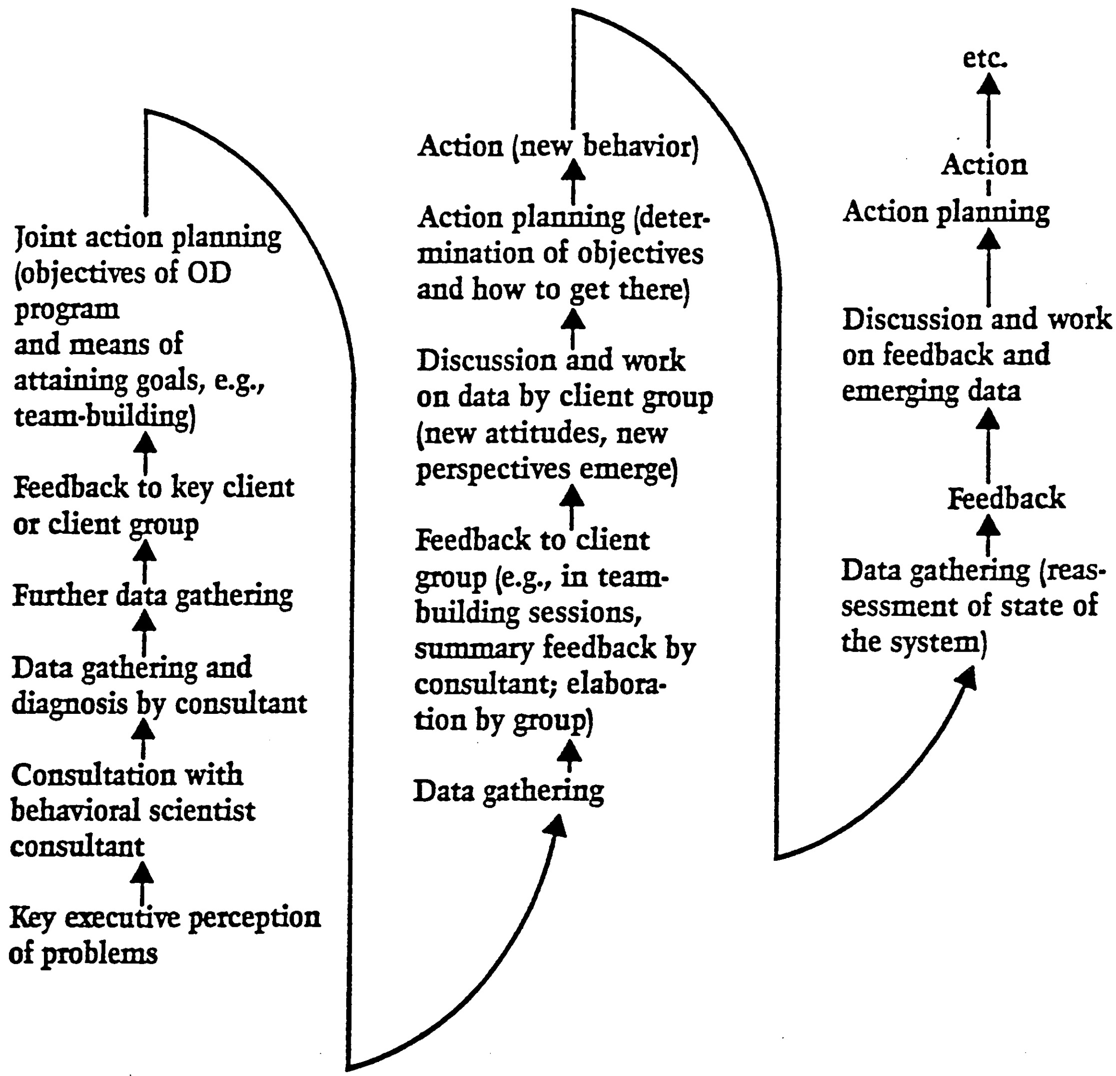
Nearly two decades after Bennis's publication, Burke (1987) reviews the development of OD and describing its methodological model as *action research.* This type of research was first conceptualised by Kurt Lewin (1958), one of the founders of the OD movement. It involves a process of evaluation and feedback thought to be critical in determining the direction and intensity of social change efforts and has four components:

- **problem orientation** which is designed to explore, clarify and identify the factors contributing to problems within an organisation. Action research provides data which can contribute to an organisation's ability to take action on the critical problems and to create a climate in which organisational learning can take place which will lead to the permanent resolution of the problem
- **involvement of the client system.** An essential component of action research which emphasises the ability of the organisation to engage in the processes which will facilitate the solution of the initial problem(s)
- **problem-solving and data gathering as a continuous process.** This is another important aspect of OD which assumes that the action research processes will become embedded into the organisation. Once embedded, procedures will be established that will enable the organisation's processes to be continually examined. These procedures will provide solutions before problems become crises
- **feedback of results,** which need to be quickly, efficiently and actively fed into the organisation so that they can become part of the action learning process.

Burke (1987) cites the processes of action research as outlined by French (1969). These have been illustrated in Figure 16. As one can see action research involves a continuous sequence of research ⇔ feedback ⇔ action. He specifies four components: diagnosis, feedback, discussion and action, which overlap but fall short of Lewin's description of action research.

FIGURE 16

ACTION RESEARCH MODEL FOR OD



French (1969)

Burke believes that for organisational change to be considered OD it needs to:

- respond to a client need
- involve the client system in planning and implementation
- lead to a change in the organisation's culture, that is:

the pattern of norms or the standards of rules of conduct to which the members of an organisation conform.

Burke (1987)

OD, according to Burke (1987), involves a *total system approach* directed at the organisation's sociotechnical system, that is, the technology and the social subsystem of the organisation.

Figure 17, illustrates three OD models distinguished by Burke (1987). All stem from, and link to, Lewin's three staged model, on the left of the figure and which includes:

- **unfreezing**, changing the present level and type of behaviour in the organisation
- **movement**, taking action to change the social system
- **refreezing**, establishing new behaviours which will be durable over time.

The middle column of Figure 17 outlines the **action research** approach.

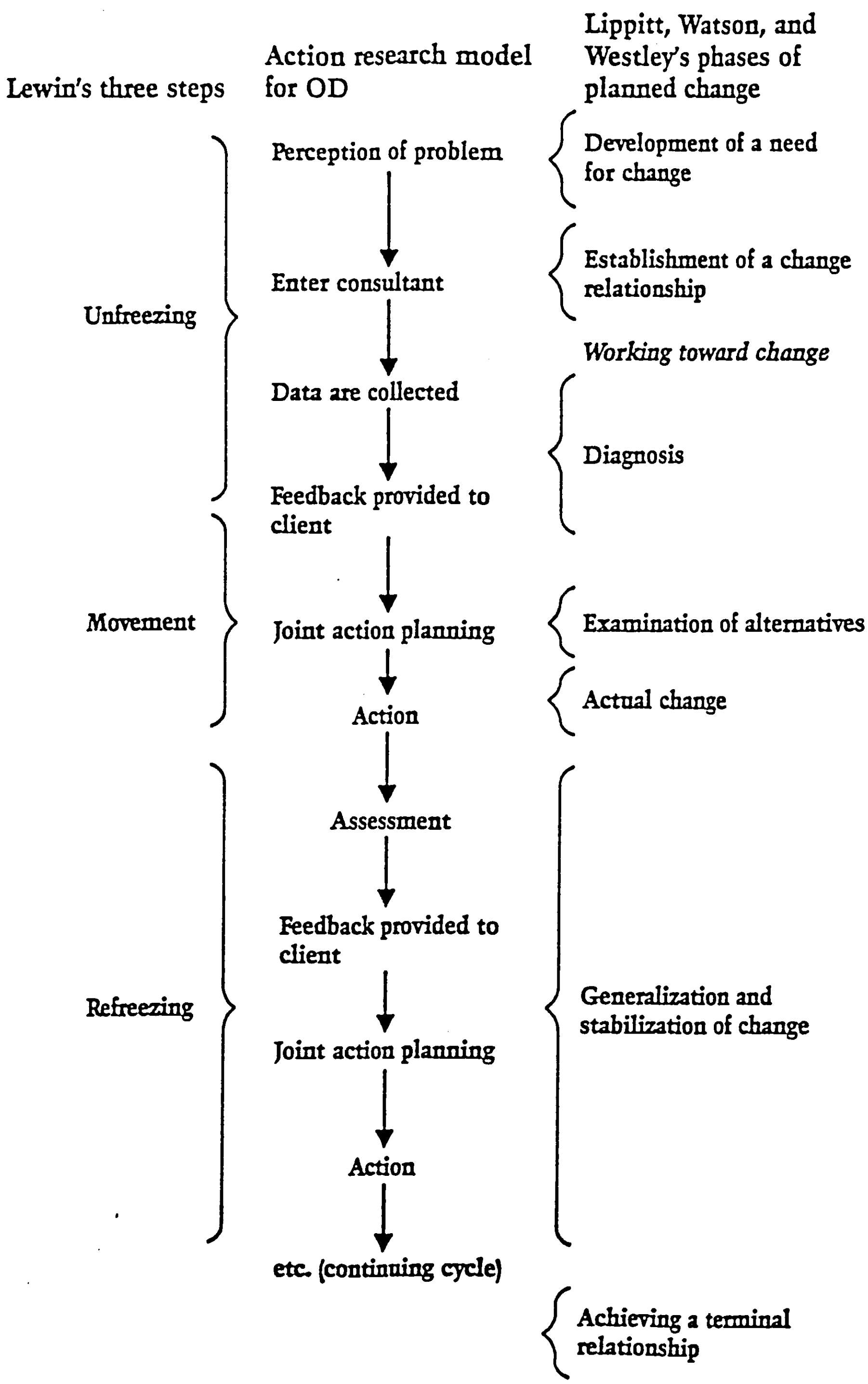
The final model, illustrated down the right of Figure 17 highlights Lippett, Watson and Westley's (1958) five phases for planned change. These phases have been illustrated as seven items because *working towards change* has been split into diagnosis, examination of alternatives and actual change.

From the three models shown in Figure 17, Burke (1987) postulates a *generic model* of change comprising the:

- appointment of an external **consultant**
- **information** (about the nature of the system and the need for change) being **gathered and fed back** for appropriate action by the client system
- **collaboration** taking place between consultant and client system
- **implementation** of the planned change by the client system with the help of the consultant
- **institutionalisation** (or embedding) of the change.

FIGURE 17

COMPARISON OF THE THREE OD MODELS OF CHANGE



Burke (1987)

Gerstein (1987), another author working in OD, considers the implications of technology and organisational change. To this end, Gerstein (1987) provides a conceptual model which describes the role of information systems operationally and strategically. He cites three important *connections* which need to be considered when attempting to bring about technology-related change in organisations. These include:

- the effect of information technology on the operational and strategic aspects of the enterprise
- the connection between information technology, its impact on the organisation and its people
- the connection between information technology and its relations with organisational and human factors.

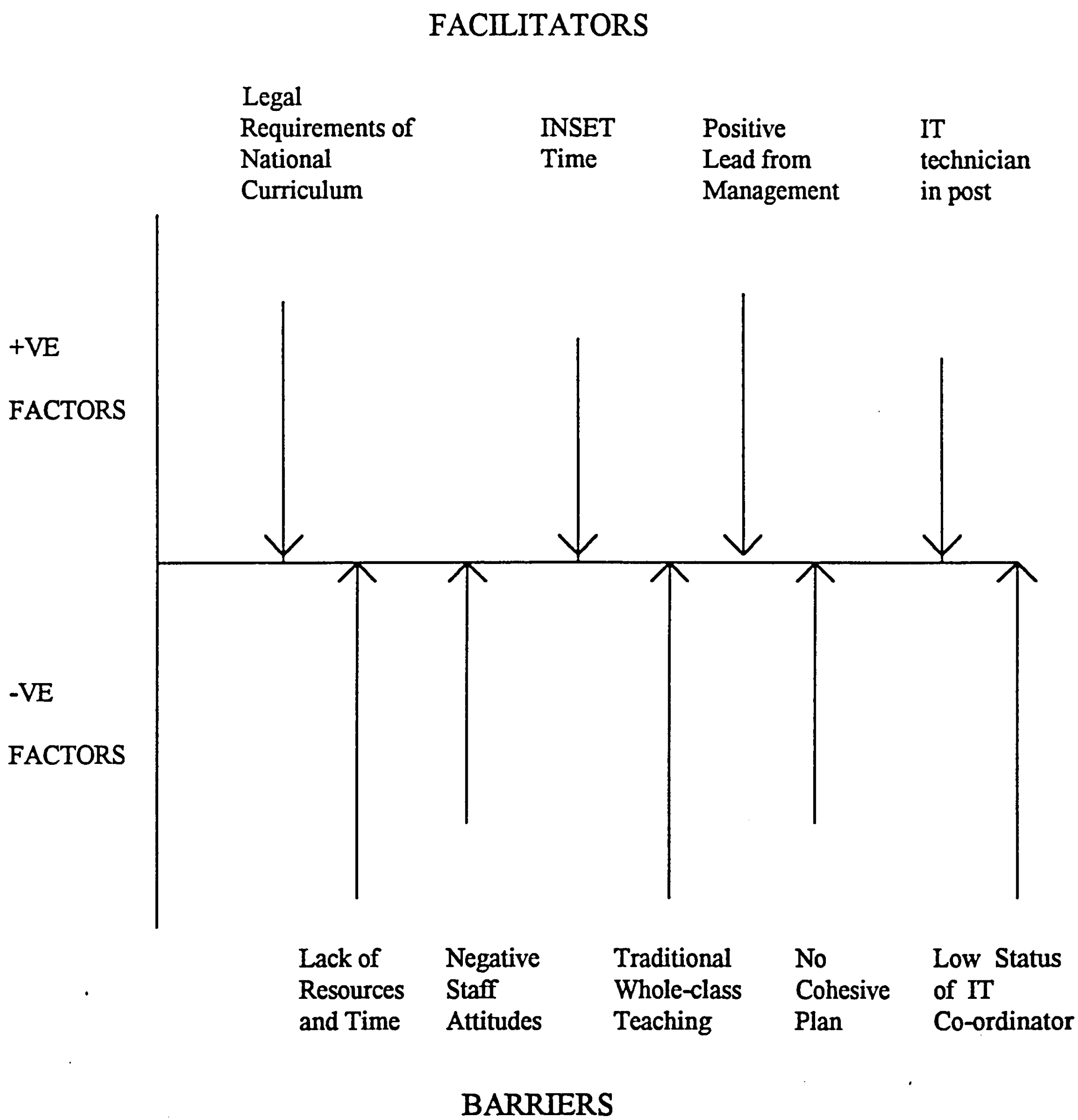
Force-field analysis

Alongside the three staged programme for organisational change, Lewin (1947) borrowed the idea of *force* from physics but developed it as a psychological construct which establishes force as a perceptual concept linked with an individual's environment (or field). Such forces can intrinsically influence an individual in respect of their motivation to take an action. Interacting with the intrinsic motivation of the individual is extrinsic motivation which in Lewin's terms, relates to the perceived capacity of another's influence. For example, a lecturer might wish to use information technology for their own fulfilment, as with the computer enthusiast. However, those in power (perceptually and in reality) might exert pressure on lecturers who do not wish to complete any information technology training. Any change is a dynamic process where sets of driving and restraining forces create a state of *quasi stationary equilibrium* (see Figure 29, page 150). In order to bring about change an analysis of the different driving and restraining forces needs to be undertaken so that the driving forces can be increased and the restraining forces decreased. This type of analysis has been called **force-field analysis**.

An illustration of the outcomes of a force-field analysis applied to the implementation of a whole school policy is shown in Figure 18. It was conducted by Steadman et al (1991) and included in an information technology policy paper for the DoE.

FIGURE 18

POLICY AIM: TO IMPLEMENT A WHOLE SCHOOL POLICY IN IT



In this kind of diagram the length of the line representing each force roughly corresponds with its perceived strength.

Steadman et al (1991)

The force-field process has been cited by many authors including Elliott-Kemp (1982); Dyer (1984); Mercer (1985); Burke (1987); Huczyncki (1987) and Leigh (1988). Dyer (1984) believes that force-field analysis is synonymous with action research and can be linked with Dyer's general problem-solving model which assumes that change represents a problem that needs to be solved. Dyer's model has seven steps:

- identification of the problem
- gathering the data
- analysing the data
- reformulating the problem
- planning the action
- taking the action
- evaluating the action.

Critical success factors

In line with Lewin's facilitating forces, Rockart with Bullen (1986) refined the concept of Critical Success Factors (CSFs). CSFs are those things that have to go right in order for an organisation to succeed in bringing about change. There are two types of CSFs

- **necessary CSFs**, that is, factors that are critical for an organisation to achieve its mission
- **sufficient CSFs**, that is, those factors that are important to an organisation achieving its mission.

When listing CSFs it is important to ensure that only factors that can be allocated under the two headings above are included.

The CSFs approach, when applied to information technology, involves the identification of industry-level CSFs and their linkage with an appropriate form of information technology that can help achieve or alter a particular CSF. In doing this, the organisation can see the strategic applications for information technology.

From a review of a variety of research studies investigating the process of technological innovation, Twiss (1986) identifies several CSFs for successful technological innovation. They are:

- a market orientation
- relationship with the company objectives
- effective evaluation techniques
- good project management
- creativity
- an innovative environment
- a highly motivated project champion or technological entrepreneur.

The final CSF identified by Twiss (1986) suggests that a formal management system alone is not sufficient to bring about successful technological innovation. To substantiate this, Twiss cites a study conducted by the National Research Council of Canada in 1969, who found that from ninety five projects:

> *all of the successful ones had at least one able and dedicated leader pushing them. No project was successful without such a person behind it.*
>
> Twiss (1986)

Twiss (1986) also cites a study conducted by Languish et al (1972). From a study of eighty four innovations that had been granted the Queen's Awards for technological innovation in 1966 and 1967 Languish et al identified seven CSFs:

- an outstanding person in authority
- another outstanding person
- the clear identification of a need
- the realisation of the potential usefulness of the discovery
- good co-operation
- the availability of resources
- help from government sources.

Six factors that delay innovation, that is, restraining forces, were also identified:

- some other technology not sufficiently developed
- no market or need
- potential not recognised by management
- shortage of resources
- poor co-operation or communication.

Twiss (1986) further highlights a study conducted by Freeman et al under project SAPPHO. Within the investigation Freeman et al studied twenty nine pairs of more and less successful innovations. The study concluded that successful innovators:

- have a better understanding of user needs
- pay more attention to marketing
- perform development work more efficiently but not necessarily more quickly
- make more effective use of outside technology and advice although undertaking more of the work in-house
- are managed by more senior personnel with greater authority.

Decision making models of change

One model of organisational change which highlights the need for clarity of policy and purpose is the **garbage-can view of action and choice** (Cohen, March and Olsen, 1972), or, as Legge (1984) calls it, the **garbage can model**. Cohen et al's examples are mainly taken from studies of educational organisations which show that decision-making situations, instead of being concerned with making decisions that are instrumental to change, become a garbage can into which problems and solutions are dumpėd. This creates a situation where individual and group interests are only partially understood and actioned. Viewing the situation from a dramaturgical approach, actors are seen to walk in and out of decision processes, solutions are generated without reference to problems, and outcomes are not a direct consequence of the process.

There are four key concepts to the garbage can model:

- problems
- solutions
- participants
- choice opportunity.

All of these impinge on the decisions made by the actors in the garbage can. Equally, within the garbage can, several independent streams exist, the patterns of which can have a substantial effect on the process and outcomes of the decision making and hence any change action or movement.

Conversely, Quinn (1980) views change from a rationalist perspective, called **logical incrementalism**. This model involves a jointly analytical and political process where strategic change is seen as a cautious step-by-step evolutionary process in which:

> *managers consciously and proactively move forward incrementally.*
>
> Quinn (1980)

To operationalise the model managers need to:

- improve the quality of strategic decisions and information used to support corporate decision-making at a strategic level
- create an infrastructure which will:
  - allow for effective implementation
  - accommodate the needs of the organisation's subsystems
  - respond to organisational uncertainty, resistance and political pressure.

Curriculum change models

As the focus of this study is on bringing about change in the curriculum, this part of the literature review describes models directly related to curriculum change.

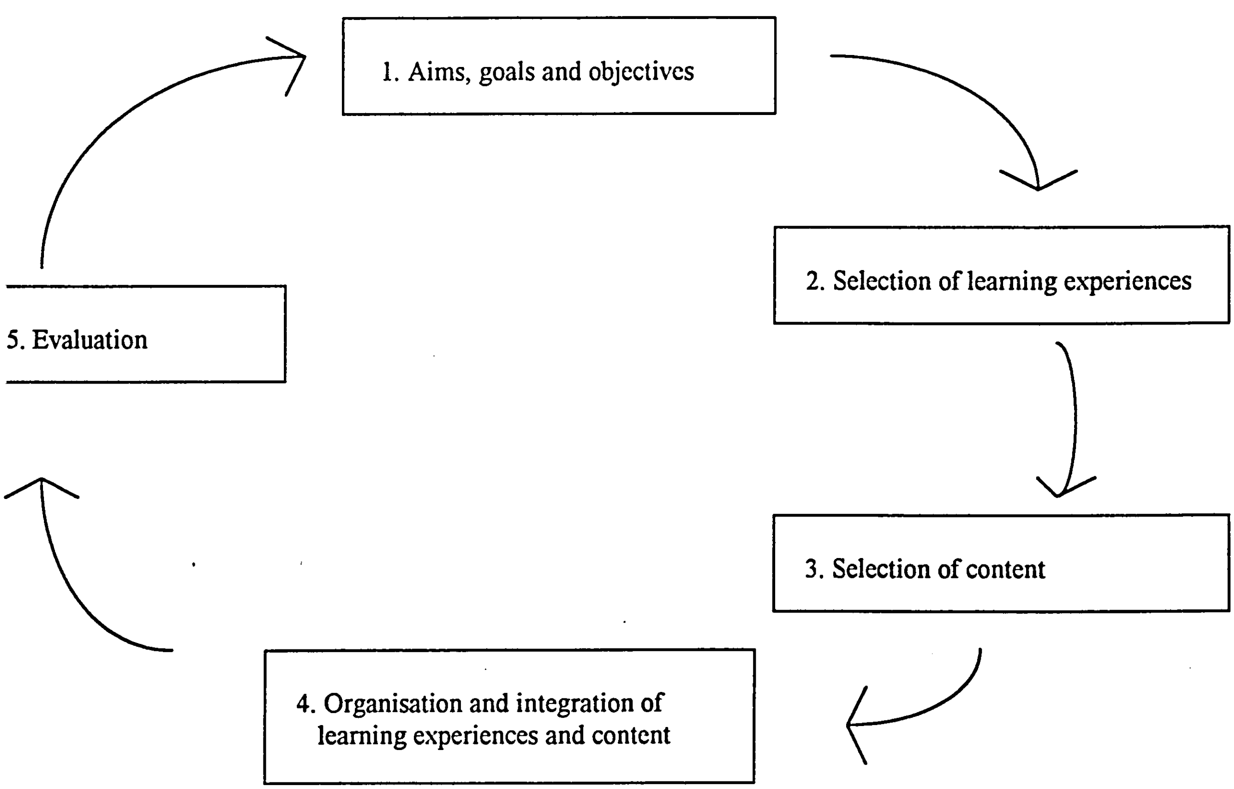
The objectives model

A model that has had a significant effect on curriculum development, especially in Further Education is the rational cyclic model of curriculum development. It is based on a continuous feedback loop process (Tyler, 1949) and is often referred to as the objectives model, especially in evaluation.

Its significance in Further Education has been in the design and development of curriculum for vocational education and training examination courses such as Business and Technician Education Council (BTEC), City and Guilds and the regional examination councils. The model is shown in Figure 19. It illustrates the aims ⇔ objectives ⇔ planning ⇔ implementation ⇔ evaluation cycle.

FIGURE 19

TYLER'S MODEL FOR CURRICULUM DEVELOPMENT: THE OBJECTIVES MODEL



Tyler (1949)

The FEU model

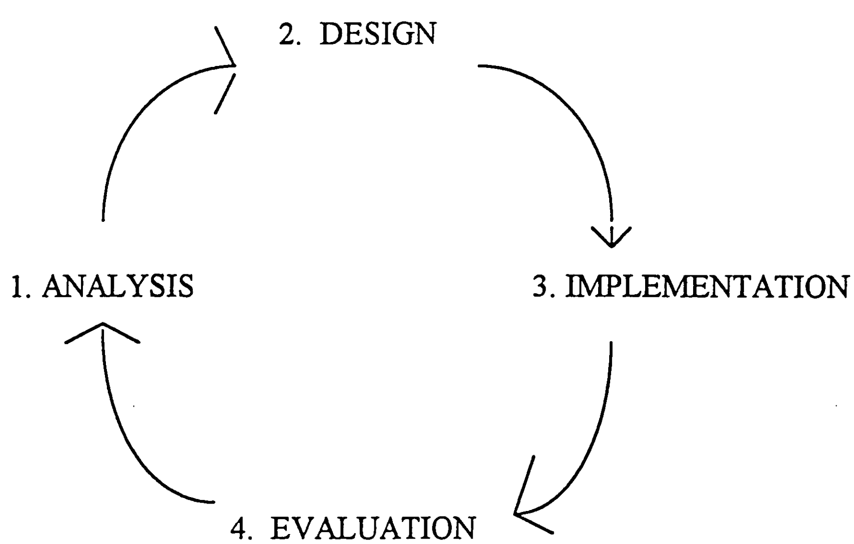
According to the FEU, development is synonymous with change. Thus, a curriculum development model must highlight the important aspects of the curriculum change process.

In 1981, whilst studying curriculum change in relationship to the development and introduction of Technician Education Council (TEC now part of BTEC) examinations into the Further Education curriculum, the FEU proposed a simple model of curriculum development. This model reflects Tyler's model in principle, but comprises four stages:

- **analysis** of the situation in which the curriculum development is required
- **design** of the curriculum to meet the needs identified in the analysis
- **implementation**, that is, the interpretation and introduction of the design
- **evaluation**, which includes the collection of monitoring data to ensure that design needs are being met and that the implementation process is appropriate.

The four stages have been diagrammatically represented in Figure 20 to illustrate their cyclic relationship.

FIGURE 20 FEU'S SIMPLE MODEL OF CURRICULUM CHANGE



FEU (1981)

In studying the introduction of TEC, the FEU identified several factors which helped the development process, that is, driving forces. These included:

- external contacts, meetings and working groups
- collaboration, which stimulated creativity
- facilitation and mediation by external agents
- an efficient information flow, where teachers have:
  - a clear understanding of the rationale of the change
  - opportunity for developing new skills
- the motivation of teachers to do their best for the students.

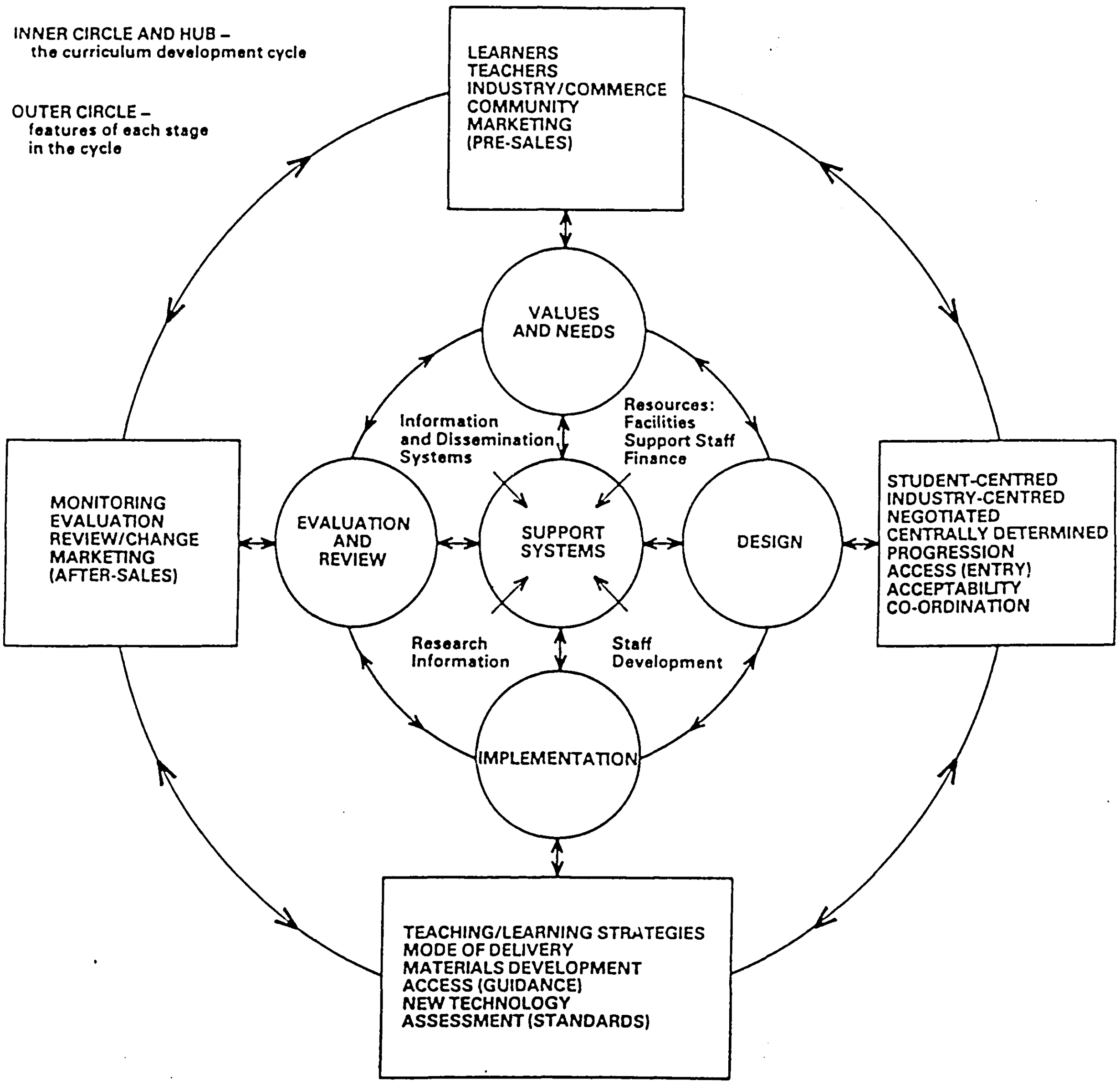
Factors found to hinder and create barriers, that is restraining forces, to the curriculum development process included:

- innovation that requires changes in values
- people preferring the status quo
- the creation of a climate of uncertainty because materials are inadequate
- lack of information and slow response in the early stages of development
- internal communications problems
- geographical separation of workrooms at sites
- unfamiliar jargon
- lack of clarity of purpose
- lack of resources and experience
- lack of formal allocation of time for developmental work
- lack of training and guidance necessary to undertake the tasks required to complete the documentation.

Following the TEC study, the FEU refined their curriculum development model (see Figure 21). This model developed is more complex. It specifies more of the processes and procedures operating within Further Education and indicates where change can be implemented.

FIGURE 21

THE FEU CURRICULUM DEVELOPMENT MODEL



FEU (1986)

In the model the FEU have included the notion of support systems which they believe are essential for the sustenance of all other elements. When applied to information technology systems the following uses have been identified from the information technology support systems project (FEU, 1987 see Figure 10, page 75):

- in **values and needs,** such systems are used for the storage of information about employers and record details of students
- in curriculum **design**, they are infrequently used
- they are used by most colleges for **implementation**
- in **evaluation and review**, they are infrequently used except to help record student assessment.

Educational change

There are a multitude of studies relating to specific aspects of change and those individuals who can facilitate change in educational settings. For this investigation the focus on educational change literature has been on studies that provide information and/or models related to the forces found to drive or restrain the change at an institutional level.

As specified in the introduction, little real theory exists in terms of a comprehensive theory or model towards bringing about change in a Further Education environment, especially relating to information technology. Glatter (1984) confirms this in a statement referring to post-compulsory education in the UK:

> *our knowledge about what produces change in education is very limited, so that nothing resembling a complete theory is available.*
>
> Glatter (1984)

Clark (1983) agrees and indicates why such knowledge is not available:

> *systematic approaches are hardly at hand ... since the encompassing systems are particularly complex and ambiguous.*
>
> Clark (1983)

Sources of change

Levin (1976) believes that education policy change comes from three sources:

- natural disasters
- external forces, for example, technology
- internal change needs, for example, the need for changing patterns of behaviour and practice brought about by changes in technology.

Three levels and four categories of educational innovation are identified by the Council for Educational Research and Innovation (CERI) for the OECD (1973). The levels include central, regional and school and the categories involve innovations concerned with:

- the objectives and functions of the educational establishment and its economic context
- the organisation and administration of the educational system
- role definitions and relationships
- the teaching and learning process, that is, the curriculum.

Phases in the history of educational change

Over the past thirty years a great deal has been learned about change in educational institutions. Fullan with Stiegelbauer (1991) divides this period into four phases:

- the **adoption phase** (1960s), where the pre-occupation is with the number of innovations being adopted
- the **implementation failure phase** (1970-1977), which examines the number of innovations that have been introduced but which had not been implemented
- the **implementation success phase** (1978-1982) where, learning from past failures, successful implementation stories begin to emerge
- the **intensification versus restructuring phase** (1983-1990) which involves two different waves of reform:
  - **intensification,** which aims to specify the content and structure of teaching as precisely as possible

- **restructuring,** which involves implementing revamps and developments to ensure the achievement of shared missions and goals.

The intensification versus restructuring phase has been called the **new waves of reform**. Both of the new waves of reform aim to ensure that comprehensive and systematic change is implemented using top-down or bottom-up approaches. The body of knowledge which has been accrued over the past thirty year about the factors affecting change have enabled those involved with both waves to focus more clearly on the process of change.

When looking at change in an educational context, one finds a proliferation of literature relating the forces instrumental in bringing about change. However, as most of these studies originate in America and Canada, care needs to be taken in extrapolating directly from the studies. As Weindling and Early of the National Council for Educational Research (NFER, 1986) found, in America and the UK the initiation of innovations came from different sources. In America the impetus usually comes from outside the school and in the UK from the head (particularly new heads). If this is so for one aspect of change it might well occur for others.

Understanding the meaning of change

Fullan with Stiegelbauer (1991) believes change to be a socio-political process. One of the fundamental problems in education is that people **do** understand the meaning of educational change including its purpose, composition and implementation. Understanding the meaning of change allows one to make sense of it and to comprehend its phenomenology, that is, how people actually experience change as distinct from the experiences intended by the initiator. According to Fullan (1991), two types of reality are important to understanding the meaning of change:

- **subjective reality** which represents the personal and collective experience of those undergoing change. This is characterised by:
  - ambivalence and uncertainty whilst the change is being implemented
  - the sense of accomplishment and professional growth when successful.

- **objective reality** which involves change in practice. In accepting change as a multi-dimensional process, Fullan (1982, 1986 and 1991) postulates three change components: materials, practices and behaviour. Change activities and strategies, if divided into these individual components, lose their dynamic interrelationship which might lead to lack of understanding and the adoption of some strategies but not others.

According to Fullan (1991), in order to facilitate the type of change which accommodates and addresses both subjective and objective reality, the following need to be considered:

- the authenticity of the changes, that is, the underpinning rationale and the implications for adoption
- the social setting and the implications for the individual and collective situations in which the change will be implemented
- the values and goals of the adopters
- the consequences of implementing the changes
- the dynamics of educational change with a view to socio-political process, that is, the interaction between and within each of the storeys of Weaver's five storey building (see Figure 4, page 32)
- whether those involved with the change can understand what it is that needs to change and how it can be best accomplished, including the realisation that these two facets of change are constantly interacting with and reshaping each other
- the type of structures which allow people to make sense of the actions of themselves and others
- the level at which the changes are being adopted, that is, either:
  - **surface changes**, where the adopter does not really understand but pays lip service to the change
  - **deep structures** which can pose a threat to occupational identity, sense of competence and self concept.

Thus Fullan (1991) asserts that innovations can be adopted for three reasons:

- symbolic
- political
- personal.

Processes in the successful adoption of change

Several ideas have been postulated about the process involved in the successful adoption of educational change.

Elements of change

Fullan (1991) believes that the change process comprises four elements:

initiation ⇔ implementation ⇔ continuation ⇔ outcome.

Initiation, requires three R's to be considered:

- the **relevance** of the change, which involves assessing the practicality of, and need for, the innovation
- the **readiness** of the educational establishment, that is, its practical and conceptual capacity to adopt the innovation
- the **resources** available for the innovation.

The factors affecting **implementation** relate to the characteristics of change. Fullan (1991) found three:

- the need for the change, its clarity, acknowledgement of the complexity of the change and its quality and practicality
- local characteristics, including the teacher, principal, community and district (as within the American educational system)
- external factors associated with government and other agencies.

For **continuation**, Fullan (1991) identifies four important insights:

- active initiation and participation as its impetus
- pressure and support, to facilitate action of the change process
- an identification of the changes needed to support the participants' behaviours and belief systems
- ownership of the innovation by the adopters.

Evolutionary change

In order for innovations to be successfully implemented, Louis and Miles (1990) propose an evolutionary structure which at the outset is small but grows and develops through action. Louis and Miles believe that to ensure successful implementation there is a need for:

- **vision building**, which is two-fold and includes a shared vision about:
  - the future composition and structure of the educational establishment
  - the processes and strategies for moving the organisation from here to there
- **evolutionary growth**, which allows for the adaptation of plans as the implementation process continues and unexpected developments are encountered
- **empowerment and initiative taking**, which encourages and supports delegation and power sharing
- **resource allocation and assistance for mobilising implementation**, which addresses the need to have appropriate resources to mobilise implementation
- **problem-coping**, which involves informing participants that any organisation undergoing change has problems but that it is important to expose those problems to enable participants to discuss and implement shared solutions

Mutual adoption

Berman and McLaughlin (1978) who conducted the Rand Study, an evaluation of the US federal programmes supporting educational change, believe *mutual adoption* to be the key to successful implementation. Mutual adoption is where the innovation itself and the users of the innovation both change during the course of implementation.

Institutionalisation

Institutionalisation is a concept highlighted by the Dissemination Efforts Supporting School Improvement (DESSI) research project (Crandall and Associates, 1982) which examined the effects of US federal
government strategies to encourage school improvement through the dissemination of good practice. Institutionalisation is the *built-in-ness* or the embedding of the innovation into the culture of an organisation and is felt by Holly (1986) to be a critical, but neglected, factor in successful school improvement programmes.

Holly (1986) sees institutionalisation as being two-fold. Firstly, institutionalisation is a *product* which becomes more or less embedded within the culture of an organisation and secondly it is a *process* within which changes are introduced, mediated and legitimised (or not).

The institutionalisation test, according to Miles (1983), is whether the innovation continues without its advocate and without continued funding, that is, whether the innovation has become embedded into the structure of the organisation with a critical mass of people who are committed to the change and will continue its implementation without the original advocate or funding.

Berman and McLaughlin (1978) found that institutionalisation did not occur with most federally funding programmes. According to Berman and McLaughlin, when federal funding ceases most programmes tend to terminate.

This has been confirmed in the author's own work in a position audit for the Learning Technology Unit of the DoE (Goodman, 1992b) which found that, as the funding ceased, so did the projects, especially if they had been developed and were owned by the technologists. An important aspect in the success of such projects was that funding was **not** granted for staff time, thus compelling the innovations to be integrated into the normal working practices.

Technical and administrative innovation

Daft (1978) studied innovations at thirteen suburban high school districts in Illinois to explore elements in the early stages of the innovation process that facilitate success. From this study Daft (1978) postulates the **dual-core model** of organisational innovation which acknowledges Evan's (1966) notion of two types of innovation:

- **technical innovation** which relates to the technology of the organisation, that is, the innovation includes ideas for new products or services. These ideas usually originate from technical core employees and move upwards through the organisation
- **administrative innovation** which refers to the social structure of the organisation, for example, the introduction of new policies of recruitment, allocation of resources, structuring of tasks, authority, reward etc., These usually originate near the top of an organisation and move downwards.

Evan argues that, to maximise adoption, ideas need to originate at both ends of the organisational hierarchy.

One of Daft's (1978) basic assumptions is that technical ideas proposed by administrators or people from outside the technical core are less likely to be successful because they will not be seen to be in harmony with the perceived needs of the technical core. Therefore, technical innovations tend to originate from the technical core. Daft further postulates that collaboration between the administration and the technical core leads to less resistance. However, collaboration is not as important when the core members are highly professional.

The results from the Daft study show that:

- **successful innovation** is contingent upon both types of innovation cited above and on the professional level of the employees
- **innovative ideas** tend to be instigated by individuals who are experts within the innovative area. Where this is the case, the innovators will use the innovation.

Daft (1978) believes that the precise role of organisational leaders in the innovation process is not clear. However, top administrators are in a position of power and authority which allows them to introduce change into the organisation. Indeed, Daft believes them to be the bridge between the organisation and the technological environment. Top administrators can equally be instrumental in implementing new ideas by searching for the funds to enable their introduction.

In many instances, Daft found that the two cores, technical and administrative, are *loosely coupled,* that is, the links between the cores are weak with each core retaining its own identity. This type of coupling happens mainly when teacher professionalism is high. Where teacher professionalism is low, the technical core will be *tightly coupled to it.* As professionalism increases, there are more likely to be innovations developed both across and within the cores.

Thus, when a technical innovation is required, it is better for the top administrators to acquire a highly professional employee for the technical core and allow them to take the innovation forward.

The need to change, according to Daft when writing with Becker (1978), is dependent on decision makers' perceptions of the effectiveness of current situation in terms of the performance and/or the procedures being used. Factors affecting the decision to innovate usually involve incentives and innovative ideas from the environment leading to the development of proposals which together with enabler variables culminate in the decision to innovate.

Concerns-based adoption

Hall and Loucks (1978) propose a Concerns-Based Adoption Model (CBAM) to address the problems concerned with diagnosing group and individual needs for the adoption of change within an educational setting. In order to be successful, the change process needs to provide practical reference points for individuals at each stage in the change process.

Assumptions underpinning the model are that:

- change is a process and not an event, that is, the decision to implement change in practice in educational institutions does not mean that it will happen instantly
- change can only be achieved in stages, which take time
- change is a personal experience, therefore the individual needs to be the primary target for any interventions designed to bring about change in the classroom
- the individual involved in the innovation will go through various stages in their:
  - perceptions and feelings about the innovation
  - abilities and skills in using the innovation
- staff development should be geared towards individual rather than trainer needs
- the staff developers or change agents must keep in contact with the individuals within the innovation-adoption procedure whilst remaining aware of the effect on the organisation and its constituent parts.

CBAM highlights three aspects of change:

- **Stages of Concern** (SoC) which are expressed by individuals going through the innovation-adoption process
- the way in which the innovation is **used**
- **how the innovation can be adapted** to suit the needs and styles of individuals.

The six stages of concern are shown in Table 6.

TABLE 6 STAGES OF CONCERN ABOUT INNOVATION
(source: Hall and Loucks, 1978)

Stage	Concern	Description of the focus on the:
6	Refocusing	the benefits and alternatives of the change activity need to be made clear to the individual so that he/she can consider the various alternatives
5	Collaboration	the co-ordination and co-operation with others about the use of the innovation
4	Consequence	the impact of the innovation on students
3	Management	the best way of using the innovation efficiently and effectively
2	Personal	the uncertainties and demands of the innovations as perceived by the individual
1	Informational	learning more about the innovation
0	Awareness	other matters, with little concern or involvement with the innovation

Hall and Loucks (1978) assert that the intensity of the stages differs throughout the innovation-adoption process. They found that during the implementation of an innovation:

- stages 0, 1 and 2 will be most intense at the conceptual stage
- stage 3 becomes more intense as implementation begins. At this stage, the intensity of 0,1 and 2 decreases
- stages 4, 5 and 6 become intense at the impact stage of the innovation.

Adoption of technological innovation

Naisbitt (1982) believes that there are three stages to innovative technological change. Stage 1, where applications provide advantages that are not controversial and do not compete with existing products. This creates the minimum of resistance from the stakeholders.

In the second stage, the technology can be used as a substitute for existing practices which are of value to the customer.

Finally, in stage 3, the technology can be used in an innovative manner.

The need for an implementation strategy

Bolam (1986) highlights the needs and difficulties in establishing the correct climate to facilitate the acceptance of change within an educational establishment, especially where the government is the interventionist, that is, implementing policy through specific grants. Bolam advocates the need for the initiators of change at national, local or institutional level to develop *a coherent implementation strategy.*

Implementation strategies according to Bolam (1986) need to include:

- planning that is adaptive and continuous
- support from the leadership and for the staff involved in the implementation of the innovation
- staff training: general for management and specific for innovation-specific components and users
- opportunities for staff in differing localities to adapt the innovation
- opportunities for teams of protagonists to be established.

In addition any implementation strategy must account of:

- the educational environment and the social system
- any aspect of the innovation that may cause resistance.

Intervention

Argyris (1973) puts forward a behavioural science view of **intervention theory and method** in relation to change. He defines intervention as entering into an ongoing system of relationships to come between or among persons, groups or objects for the purpose of helping them. According to Argyris (1973), the intervenor exists independently of the system and, although facilitating change through the commitment and actions of the client system, change is not the primary task of the interventionist. Integral to an interventional activity are three primary tasks.

- the collection **of valid and useful information.** Without such information it is difficult for the interventionist to give valid and useful help upon which the client system can learn and use as a basis for their choices and commitment to future action
- the provision for the **free, informed choice** by the client system. This is important because the interventionist needs high client motivation and commitment to ensure a change action or process will succeed
- the **internal commitment**, that is, the internalisation of the action or choice by each member of the client so that there is a high degree of ownership of and a feeling of responsibility about the choice and its implications.

The interventionist approach is particularly relevant to this study because the main focus of the curriculum change model developed relates to governmental intervention aimed at facilitating curriculum change to embed of information technology and AIT into Further Education vocational education and training courses.

The change agent's role

Cuthbert and Pike (1987) define intervention in Further Education as a deliberate and planned attempt to bring about change in the people within the college and/or the collegiate organisation.

The interventionists comprise one or more internal or external people whose job it is to facilitate change within the organisation.

The roles of such change agents (called *consultants* by Cuthbert and Pike, 1987) range across a continuum of directiveness, that is, from most to least directive.

The range includes:

- **advocate (most directive)**: someone who is given the role of arguing for a particular course of action
- **technical specialist**: someone who is included because of their specific expertise
- **trainer or educator**: someone who designs and conducts particular courses to meet an already diagnosed need
- **collaborator in problem solving**: someone who is invited to work on a particular problem
- **identifier of alternatives**: someone who is invited to examine the situation and to offer alternative courses of action
- **factfinder**: someone who is brought in to clarify a situation
- **process consultant**: someone who is invited to help improve group processes
- **reflector (least directive)**: an observer without an implied commitment to change.

Havelock (1982), in developing the change agent's guide to innovation in education, maintains that a change agent, a person who facilitates change or planned innovation, can have four roles. These include situations where a change agent is a:

- **catalyst** and endeavours to disturb the status quo in order to bring about changes to benefit the educational organisation
- **solution giver** who, as well as giving solutions to problems, needs to know enough about the clients to be able to intervene at the appropriate time using the relevant strategies to aid the change process
- **process helper** who helps ease the process of change by providing information about how change comes about in individuals and organisations

- **resource linker**, the person who brings people together and helps them to make the best use of the internal and external resources required for the change.

Change agents, according to Havelock (1982), can come from within or outside the educational institution.

Change agent effectiveness

To be an effective change agent Elliott-Kemp (1982) believes one needs appropriate:

- **personal qualities**, values and attitudes
- **skills**: updating, object related and interpersonal
- **knowledge**: professional and situational.

To aid change agent effectiveness, Elliott-Kemp developed a tool for surveying the field prior to the initiation of the plan for change (see Figure 22).

FIGURE 22

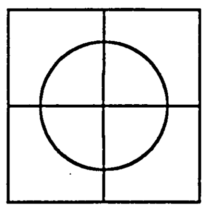
ELLIOTT-KEMP'S QUADRANTS
FOR PRIOR PLAN ASSESSMENT TO INNOVATION

POWER ↑	Low → CONCERN → High	
High	QUADRANT A High in power and influence without support for innovation	QUADRANT B Power and influence with support for innovation
Low	QUADRANT C Low in power and influence without support for innovation	QUADRANT D Low in power and influence with support for innovation

The tool is based on the needs of the change agent to assess the:

- **power**, that is, the ability of the person to reduce, restrict or limit the alternatives to others either by command (status in hierarchy) or by influence
- **concern**, that is, the motivation of the person to support (high concern) or not to support (low concern) the innovation.

This interaction has been illustrated in the quadrant matrix shown in Figure 22. Alongside the power/concern interaction, Elliott-Kemp (believing the cause of innovational failure to be due in many cases to lack of **understanding** of the adopters about the nature and purpose of the innovation) introduced the notion of understanding as a prime indicator of the informed decision making by adopters. This is included as a circle in the middle of the quadrant matrix thus:



Those who have understanding are placed in the appropriate quadrant inside the circle and those who lack understanding are placed in the appropriate quadrant outside the circle but within the matrix. When all of the elements proposed by Elliott-Kemp (1982) have been surveyed and analysed, the change agent can decide on the most appropriate people and strategies for change.

For Holly and Wideen (1986), the test for compatibility of the innovation is a filtering process towards institutionalisation or, as Holly calls it **cultural domestication.**

Holly and Wideen identify three forces to be analysed when considering innovation:

- **proculturation** - top-down imposition of an innovation
- **enculturation** - the institutional resistance to all innovation - the process of filtering and mediating process

- **acculturation** - the learning metaphor, that is, the school culture within the change process influences and is influenced by the change, that is, development through accommodation.

Schmucks and Schmucks (1974) links OD with school innovation stating that, to bring about change using an OD approach, one would have to modify the culture of the school by:

- leadership-sharing and principal support for change efforts
- developing the normative system - that is, creativity, adaptiveness and collaboration
- ensuring a high degree of trust among colleagues
- initiating innovative proposals by the teachers.

Change orientations, dynamics and variables

Numerous strategies and techniques have been proposed for people and organisations who wish to bring about change both in organisation and in educational institutions.

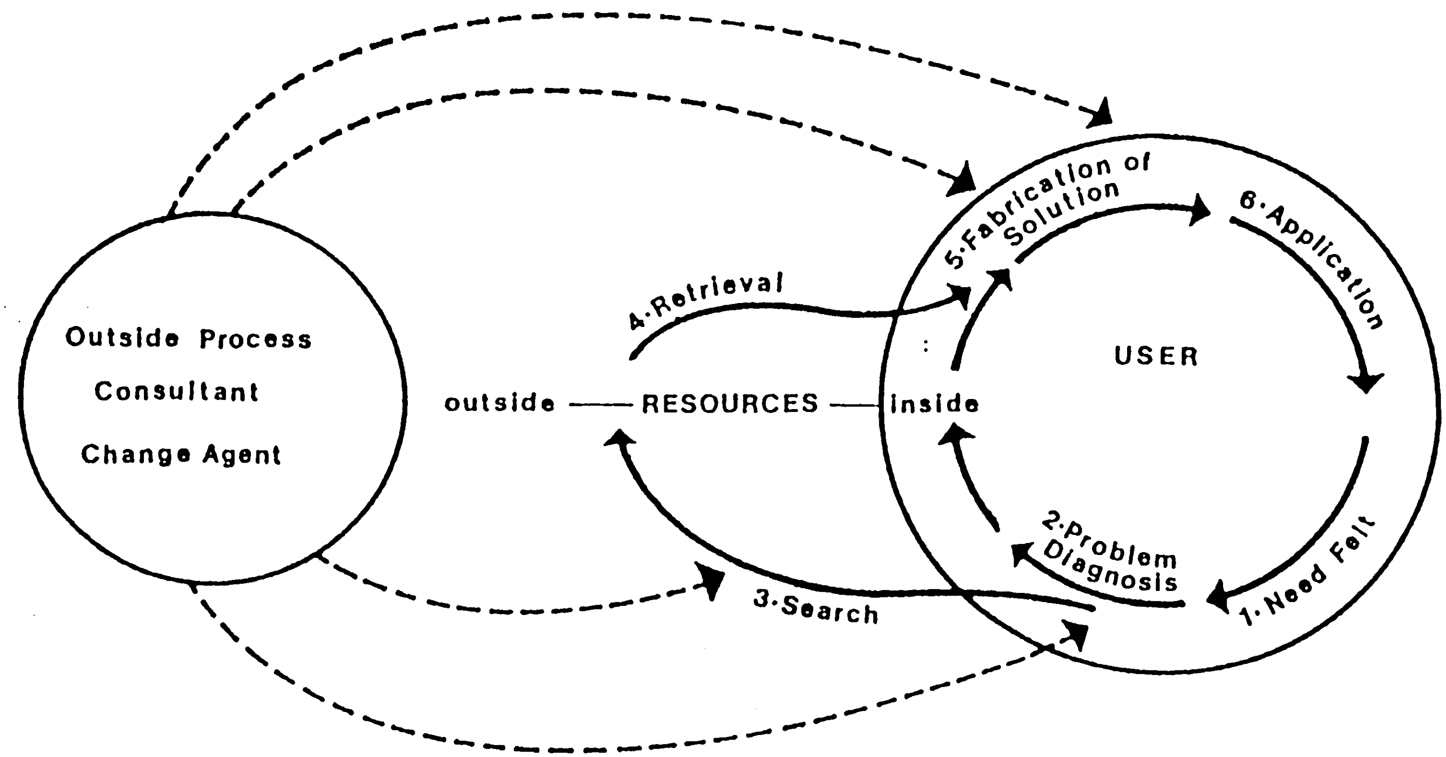
Strategic orientations

Havelock (1982) outlines three major strategic orientations (identified by Elliott-Kemp, 1982, as change models) into which he believes all strategies for change fit. When implementing change within an educational establishment, Havelock believes it is important not only to outline the strategy but also the *tactics* or action steps which allow the change to be implemented.

1. The problem-solving orientation

The problem-solving strategic orientation, illustrated in Figure 23, is based on a set of tactics which progress through: the felt need of the client, operationalised as a problem statement which instigates a search and retrieval for ideas that will facilitate the formulation and selection of appropriate innovative processes to pilot and evaluate the effectiveness of the change strategies selected to satisfy the original need.

FIGURE 23 THE PROBLEM SOLVER STRATEGIC ORIENTATION



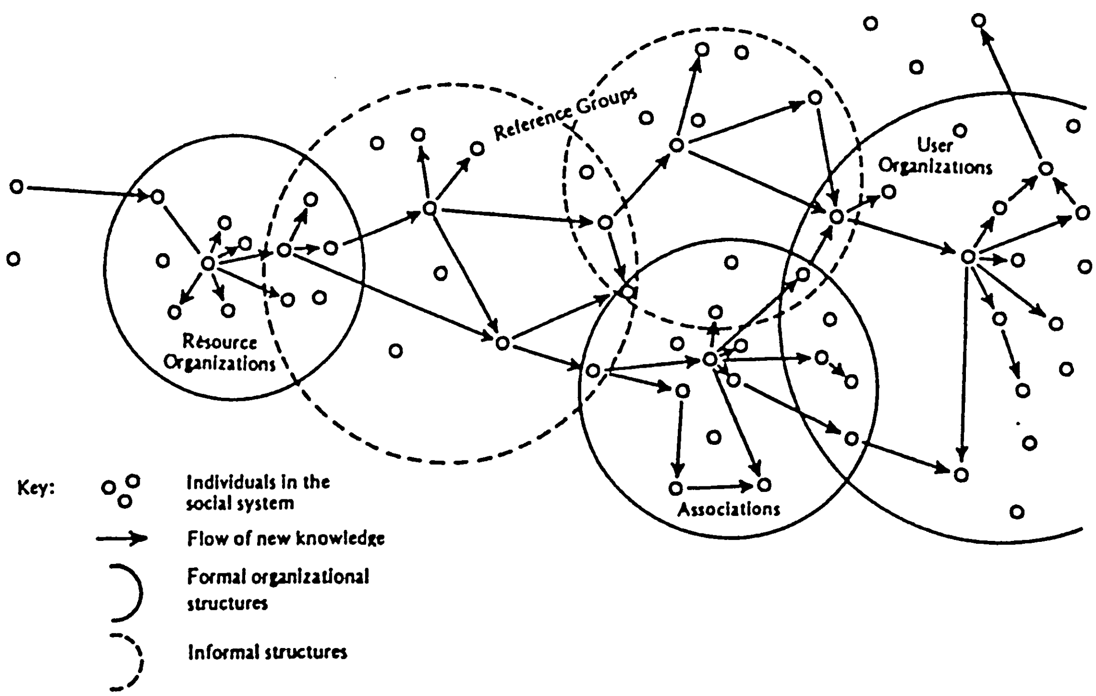
Havelock (1982)

2. The sociological orientation

The second strategic orientation follows a sociological approach associated with the social interactionist school of thought. This perspective is shown in Figure 24.

FIGURE 24

A SOCIAL INTERACTION PERSPECTIVE TO INNOVATION



Havelock (1982)

The social interaction perspective is based on the assumptions that:

- each individual belongs to a social relations network which influences the behaviour of that individual when using or adopting the innovation
- major influences and predictors of the rate and type of acceptance for the adoption of the innovation are:
  - the place the individual fills within the network, that is, on the periphery, in isolation or centrally

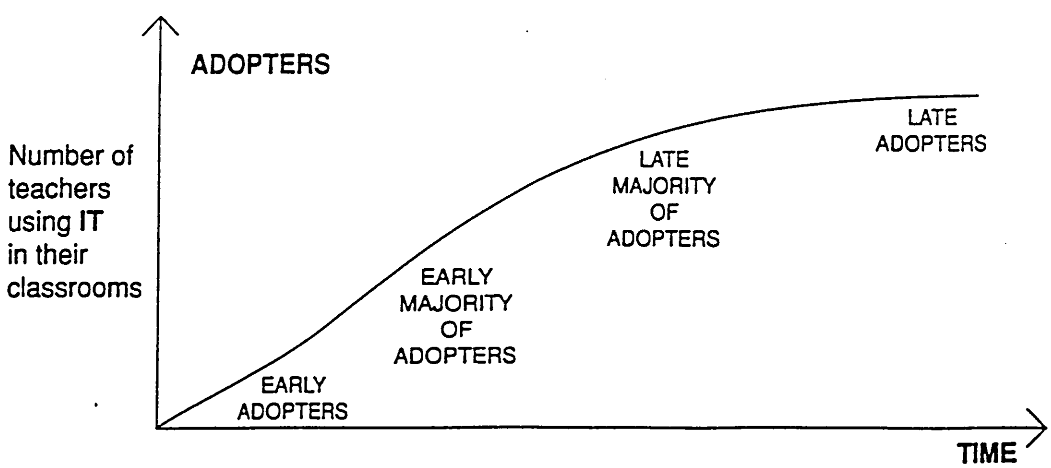
- informal personal contact
- group membership and reference group identifications

- the rate of diffusion will follow a predicted *S-curve*, that is, a very slow beginning, followed by rapid growth with the final period comprising a long late adopter period, or *laggard* period.

An application of the rate of diffusion model is shown by Steadman et al (1991). In developing a whole school approach for the introduction of information technology Steadman et al (1991) believe that it is important to establish the innovation's status, firstly with the opinion formers and moving on to the late adopters at the final stages of the innovation. Figure 25 illustrates the rate of diffusion model for the adoption of information technology into schools.

FIGURE 25

THE PATTERN FOR THE ADOPTION OF IT INTO SCHOOLS



Steadman et al (1991)

3. The research, development and diffusion (RD & D) orientation

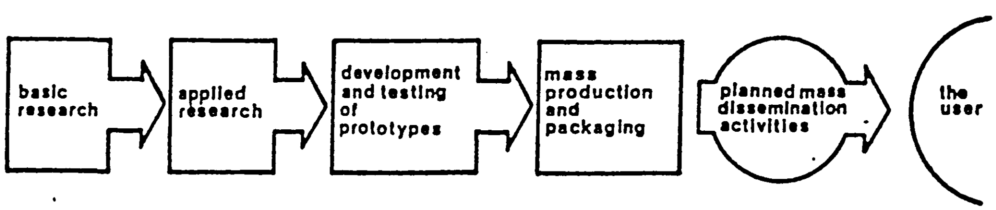
The third perspective identified by Havelock (1982) is the research, development and diffusion (RD & D) orientation. This is based on the assumption that there will be:

- a rational sequence to the adoption of the innovation
- a rational sequence of planning, which will be on a massive scale and be implemented by an appropriate co-ordination and division of labour
- passive acceptance and adoption of the innovation assuming it is introduced at the right time, place and in the right form
- high development costs prior to mass dissemination because of the assumed long term benefits which will be accrued from the innovation.

The RD & D perspective is outlined in Figure 26. As illustrated in the figure the procedure follows the application of basic and applied research, through testing and prototyping, to production, dissemination and use.

FIGURE 26

THE RD & D PERSPECTIVE TO INNOVATION



Havelock (1982)

Elliott-Kemp (1982) describes the applicability of the three perspectives, or models of change process as he calls them, to the educational system.

The traditional approach used within the UK is the social interaction perspective which is exemplified by inspectorial and adviser visits from the LEA and the DES and in-service courses to help and advise schools to disseminate ideas.

At the time of writing, Elliott-Kemp (1982) believed the favoured approach to be the RD & D perspective. This, although most appropriate to large industrial organisations such as aerospace, defence and agriculture, could be applied to an education system with a highly centralised curriculum control which stresses the executive rather than the creative functions of a teacher. Although this approach led to the production of materials and awareness of educational innovations, it failed to convert the awareness of the underpinning principles of innovations and the problems surrounding implementation into understanding.

An adaptation of the problem solving orientation

Elliott-Kemp (1982) adapted the problem solving model postulated by Havelock in 1972 into the cyclic approach to in order to accommodate national needs and to allow the teacher to become an *active interpreter* rather than a *passive receiver* of innovation. The adapted approach is shown in Figure 27.

FIGURE 27

ELLIOTT-KEMP'S CYCLIC APPROACH TO CHANGE

Stage 1 Felt need ↘

Stage 2 Problem diagnosis ↓

Stage 3 Decision making ↙

Stage 4 Central planning → Stage 5 Organisation-based planning ↖

Stage 6 Implementation ↑

Stage 7 Evaluation (↗ Formative, ↘ Summative) ↗ Stage 1

Dynamics of change

Leigh (1988) believes that change can be viewed in terms of the **dynamics of change,** following an intervention or in terms of its implementation. There are, according to Leigh (1998) three sub-categories into which implementation can be classified. Leigh does, however, offer a word of warning that the sub-categories are not mutually exclusively and, by necessity, will overlap in some areas. The sub-categories are:

- **strategies** which take account of overall foci which are likely to lead to the successful implementation of change. They include procedures and techniques that may be used as part of the strategy for implementing change, for example, models of change, leadership, vision and values, aspects of power and influence and resistance to change
- **procedures** which cover the differing practices which can be used to implement change, for example, planning, participant decision making and the use of outside agents
- **techniques** which include force-field analysis, sensing, mundane tools of change, arrangement by walking about, team building and verbal skills.

There are two types of change, according to Leigh (1988):

- **strategic change** which relates to the future direction of the organisation
- **operational change** which involves constantly occurring changes which are a day to day occurrence.

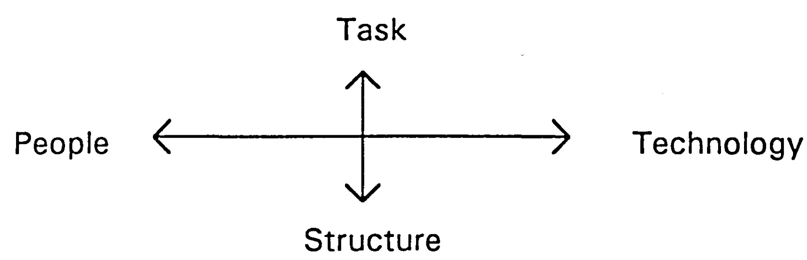
Huczyncki (1987) distinguishes between development approaches and proprietary programmes which can help in the change process:

- **development approaches** can be adopted and implemented by an organisation without payment to the originator. They are usually based on a particular theory of human behaviour which has been generated through research
- **proprietary programmes** offer ready to use organisational change courses which are copyrighted and the user requires a licence to use such materials.

Interacting variables

For Leavitt (1964) four interacting variables can be used to bring about change (Legge, 1984 calls them leverage points). These variables indicate the most appropriate entry point. The four interdependent variables are illustrated in Figure 28

FIGURE 28 INTERACTING VARIABLES FOR CHANGE



Leavitt believes that change can be directed at any one of the above **entry points**:

- **task modification** involves the introduction of change related to the overall purpose of the organisation
- **technology modification,** involves the changing of tools and techniques that are used by the organisation for the achievement of its main task. These changes, according to Leavitt, affect the knowledge, skills and often the roles of both managers and other employees. This type of change is important to this study as it includes the introduction of new forms of computing and information technology.
- **structure modification** refers to authority pattern changes and the redistribution of responsibilities amongst employees. It includes the design of communication strategies and work flows for an organisation. The resultant changes can alter the balance of power within an organisation. In Further Education changes in principalship can lead to structural changes which can help or hinder the introduction of new technology into vocational education and training curriculum

- **people modification** is one of the most common forms of organisational change at present. It includes changing the attitudes and values of people to allow for personal development. The government are advocates of this type of change, for example, their Investor in People organisational standard is based on investment, change and growth through the people within the organisation and other interventions delivered at arms length through the Training and Enterprise Councils. This type of change underpins Organisational Development principles and practices.

Response to change

Elliott-Kemp (1982) identifies five ways in which people, the *vital factor* for any change activity, might react to a proposed change. These categories are tabulated and explained in Table 7.

TABLE 7

ELLIOTT-KEMP'S INDIVIDUALS' RESPONSES TO CHANGE

Response category	Description
Drift	Unplanned change which has no direction or purpose
Defensive innovation	Preserving old goals in new circumstances
Innovation without change	Adopting the trappings of the innovation without its implementation
Crisis management	Change in reaction to crisis
Planned change	Change based on rational decision-making and which will be subject to evaluation when the needs have been identified

Elliott-Kemp (1982) proposes that the last category, *planned change*, is the most appropriate to ensure successful change. He believes that organisations which will *survive and flourish* are those where members have the capacity for self renewal and development and who are always looking for ways in which the organisation can be improved .

Kanter (1985) outlines innovative organisational practices as those where:

- work responsibilities are described in terms of outcomes and there is recognition of an individual's achievements
- all staff are aware the business components, strategies and policies
- staff are able to move easily between departments
- resources are available for projects outside those described in job descriptions and business plans and there is a networking structure which allows project teams to be drawn together
- new ideas are welcomed and most people are expected to be involved in at least one new initiative per year.

The three most important qualities of an innovative organisation, according to both Kanter (1985), are:

- flexibility in the work patterns
- that everyone is an innovator
- that information flows freely.

Contextual analysis

Pettigrew (1985) believes that organisations should be studied using an approach which he has called **contextual analysis**. This was derived by Pettigrew from his study of strategic change in Imperial Chemical Industries (ICI) between 1972 and 1982.

The contextual analytical approach is based on understanding the origins, development and implementation of organisational change. It includes the need to collect and analyse data at:

- **vertical** levels, which include a multilevel analysis of the processes and interactions at the various levels of the organisation being studied as well as those that exist between the levels and, if applicable, outside
- **horizontal,** process levels, which include a longitudinal study of the organisation including its historical, present and future perspectives.

In addition, Pettigrew (1985) believes that strategic change can only be theoretically sound and practically useful if it includes ideas about the interplay between the *context, process and content* of change. Coupled with this, a researcher has to possess the skills to regulate the relations between the three. As one can see, contextual analysis involves both a twofold and threefold analysis of process. The basic processes involved in contextual analysis include:

- a description of the process(es) under investigation
- exposure of the descriptions to any variability or constancy between processes
- analysis of the processes, using existing theories or developing new ones
- identification of the levels of analysis and the variables within the levels and across the contexts
- a description and analysis of the trends and developments across time
- exploration of new and alternative criteria that might be used to judge the outcome of the process(es) being studied.

Resistance to change

Elliott-Kemp (1982) cites resistance as an endemic problem of change. Throughout the literature, resistance is a common feature which needs to be taken account of when trying to implement change. As Elliott-Kemp points out, change needs to be *justified and justified well.*

Schein (1965), writing about the introduction of information technology points out that bringing about change is not the simple action of announcing the need for the change. Schein states:

> *Top managers often naively assume that simply announcing the need for change and giving orders that the change should be made will produce the desired outcome. In practice, however, resistance to change is one of the most ubiquitous organisational phenomena. Whether information technology be an increase in production, an adaptation to new technology, or a new method of doing the work, it is generally found that those workers and managers who are directly affected will resist the change or sabotage information technology if information technology is forced upon them.*
>
> Schein (1965)

Twiss (1986) asserts that information technology can be seen as a threat. Therefore, Twiss believes that an organisation, or at least the significant people who can affect information technology's implementation, **must** be receptive to the innovation. As:

> *innovation means change ...... information technology can be interpreted as a threat to people who are affected by information technology and is likely to arouse their opposition.*
>
> Twiss (1986)

Daft and Becker (1978), finding little resistance in their studies, maintain that the major barriers to innovation are created by:

- lack of information on the new technique
- the recipients not being able to see the relevance of the new techniques to the organisation's goals.

However, resistance is not always a negative factor. Where information technology has been effectively utilised, resistance can create an environment where innovators may evaluate their ideas and modify them. As Mercer (1985) writes:

> *There is evidence that resistance, testing out innovations and rejecting those that fail the test is an essential part in making sure that innovations are implemented.*
>
> Mercer (1985)

Types of conflict

OECD (1973), from seventeen cases they studied, identified four types of *conflict* which can create barriers to innovation. They are:

- **value conflicts**, which relate to values held by the recipients of the innovation
- **power conflicts**, created by the redistribution of power brought about by the innovation
- **practical conflicts**, which arise when the worth of the innovation cannot be proved or because management problems have not been resolved
- **psychological conflicts**, which relate to the recipients' fears of the unknown.

Levers which aid the change process

Lewin (1958) specifies group behaviour as an important facilitator of the acceptance or rejection of change. Lewinian theory postulates that organisations comprise a social system with many and varied subsystems which are primarily groups. If one tries to change the behaviour or attitude of the individual without attempting to change the attitude and behaviour of the group to which the individual belongs, the individual will be seen as a deviant who will be pressurised *to get back into line* or will be rejected. Thus, the farther the individual is from the group standard the more likely it is that they will resist the change. Should, however, the group standard be changed, such resistance will be eliminated.

Argyris (1973) believes resistance to change to be understandable in an environment which is:

> *low in openness, trust and risk taking and high in conformity, mistrust and crisis management.*
>
> Argyris (1973)

This can lead to the defences of participants becoming ineffective and leaving them exposed to resistance at least during the change process. Argyris (1973) also believes that the values held by management can create resistance to change. In outlining this type of resistance, Argyris utilises Lewin's (1947) concept of quasi-stationary equilibrium which assumes that, at any point in time, an organisation will have a particular level of effectiveness which is somewhat stable and balanced between two sets of forces. The stability being experienced by the organisation is constantly being affected by forces pushing upwards to increase the organisational effectiveness and forces pushing downwards, resisting or restraining upward movement.

Figure 29 illustrates Argyris's (1967) ideas. The figure shows the initial balance of 5 and 5 on the left side of the diagram leading to an increase in effectiveness (to 20) based on greater control and pressure from the top (that is, an increase in the pushing forces) but with the restraining forces being equally increased (to 20) by the feelings of mistrust etc. incited by the management's actions. The figure assumes that, through an initial failure of communication (that is, management assuming that the workforce will not resent being told that the company needs to become more effective), the whole process increases both the pushing and restraining forces creating a new balance at each point.

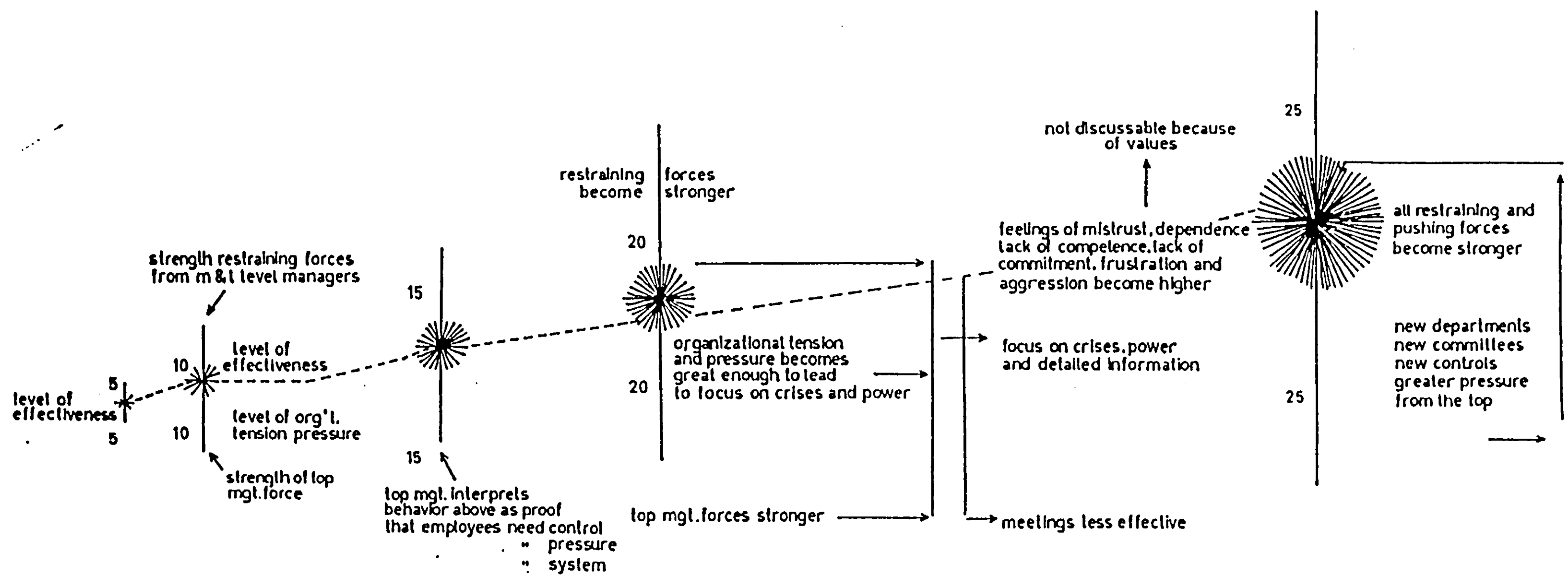
The people most affected by the innovation or change are those who are most likely to resist. These are often the:

> *defenders of the system the way information technology is.*
>
> Havelock (1982)

Beckhard and Harris (1987) believe resistance to be a normal part of the change process. Indeed they believe no real change can be brought about without some resistance. Resistance is an *attitude* that is usually based on some *fixed bias or frozen position.* As such, resistance needs to be unfrozen by the creation of a neutral position. A crucial part of bringing about change is that the intervention strategies being used create conditions where the people involved are committed, thus overcoming resistance. The intervention strategies that Beckhard and Harris feel can help include:

- **problem finding**, which involves those concerned with the change meeting, identifying and clarifying all aspects of the problem

FIGURE 29 FORCED BASED RESISTANCE CREATED BY DIFFERING VALUES OF THE PARTICIPANTS



Argyris (1967)

- **educational intervention**, which allows the change participants to understand the change problem by being placed in an learning situation
- **resistance management**, which involves the change managers analysing the type of resistance, working to overcome it and securing the commitment to move forward. A useful formula Beckhard and Harris (1987) propose to aid this process is C = [ABD] > X, where C = change, A = level of dissatisfaction with the status quo, B = the desirability of the proposed change or end state, D = the practicality of the change and X is the cost of changing. In order to be successful factors A, B and D must outweigh X. According to Beckhard and Harris, resistance will occur where anyone is not sufficiently dissatisfied with A; is not eager to achieve B; is not convinced of the feasibility of D and/or where the cost X is perceived as being too high for the person or group
- **role modelling,** which involves the norm setters exhibiting the appropriate change behaviour and thus being used as role models for the change activity
- **changing reward systems** which involves the organisation changing their priorities and reward systems in accordance with the new state of affairs
- **forced collaboration,** which brings together people in some collaborative low risk mechanism or activity.

Evaluation

The review of evaluation literature had a particular purpose for this study, that is, to ensure that the evaluation tools developed as part of this study were based on sound theoretical principles. Thus, the literature reviewed was mainly concerned with methodological issues and practices relating to evaluation.

The origins of evaluation

According to Weiss (1972), Legge (1984) and Norris (1990) the origins of evaluation are deeply rooted in:

- the objectives model of Tyler

- the use of positivistic paradigms, the explanation and predictions of which rest on hypothetico-deductive approaches which use experiments or quasi experiments.

This positivistic paradigm concurs with the thoughts of Suchman (1967) who defined evaluation research as:

> *the use of the scientific method of collecting data concerning the degree to which some specified activity achieves some desired effect.*
>
> Suchman (1967)

Norris (1990) describes how evaluation in Britain moved from an input-output driven psychometric approach to curriculum evaluation, which forms an integral part of the development of curriculum design and implementation. One of the main advocates for change, according to Norris (1990), was Halsey who used an action research approach to examine the Educational Priority Areas (EPA) introduced as an outcome of the Plowden report.

Stake (1976) maintains that officials, educators and evaluators have different expectations about what studies can and should accomplish. Thus, no single method is suitable for the evaluation of all the differing type of educational programme.

Stake (1976) outlines eight basic dimensions of evaluation:

- **formative-summative,** a distinction made by Scriven (1967) where formative evaluation is conducted within and informs the remainder of the programme and summative evaluation occurs at the end of the programme
- **case particular-generalisation,** where in the former the evaluation is of a particular study and the latter is used as a representative of other studies
- **process-product,** where an evaluator needs to focus on the processes and the transactions within the programme or its outcomes
- **descriptive-judgmental,** where the emphasis of the former is on describing the events in detail with little reference to the worth and value of the programme and the emphasis of the latter is on the provision of objective data

- **wholistic-analytic,** where the wholistic approach treats the programme in its totality and the analytic approach concentrates on a small number of key characteristics
- **internal-external,** where the evaluator is from within or from outside the institution responsible for the programme
- **formal-informal,** where the results of the former need to be communicated somewhere whereas the latter is part of the normal human environment, interactions and behaviour
- **pre-ordinate-responsive**, which are differentiated by the nature of the evaluation itself and the overall theoretical paradigms which underpin their execution:
  - **pre-ordinate evaluation** follows the hypothetico deductive approach where the hypotheses and objectives are set prior to the evaluation and the evaluators design the study to substantiate their initial stance
  - **responsive evaluation** which is organised around phenomena as they are encountered during the course of the evaluation.

The last of these dimensions has had a considerable influence on the evaluation movement.

Kemmis (1977), evaluating computer assisted learning, distinguishes between:

- **nomothetic approaches,** that are concerned with establishing laws and statistical generalisations
- **idiographic approaches,** that are concerned with the intensive study of an individual or particular cases.

The functions of evaluation research

According to Legge (1984), the functions of evaluation research are fourfold. They include the need to:

- identify the stakeholding audiences

- classify the different functions that the evaluation can fulfil for the various stakeholding audiences
- identify the most appropriate evaluation designs for the evaluation function
- highlight those functions and design aspects which are mutually incompatible either in theory or practice.

Alongside the evaluators (if external to the programme of change), Legge (1984) believes that at least four actors occupying different roles exist. They include:

- those who fund the programme
- those who design it
- those who implement it
- those who receive it.

Evaluation serves both:

- **overt functions,** that is, those functions that can be made public and provide information for future action. For example, Weiss (1972) and Legge (1984) both believe that one of the primary overt functions of an evaluation is to provide information for decision making. It can also lead to:

  group learning and facilitate the control of organisational and social change.

  Legge (1984)

- **covert functions,** that is, those functions that one or more stakeholding audiences consider inappropriate for publication within or outside the evaluation audiences. According to Legge (1984), this mainly happens when lack of publication serves the recipient's interests to the detriment of other stakeholders in the evaluation.

The FEU (1987b), in their guide for managers who are involved in planning staff development, differentiate between:

- **monitoring,** that is, the collection of data and information through the active and/or participative processes and in a variety of forms

- **evaluation,** which involves the:

  ordering, prioritisation and presentation of data and making judgements about it.

  FEU (1987b)

Both of these processes can be conducted formatively, that is, within the programme to allow feedback that can aid the continuation of the programme and/or summatively, at the end of the programme.

Models in evaluation

Norris (1990), although believing that an adequate definition of **model** is difficult to find, describes models in evaluation as representations that preserve or capture:

> *the most salient features of the reality or idea we are trying to represent or explain.*
>
> Norris (1990)

Models in evaluation include, according to Norris (1990): planning frameworks; exemplars; ideal types; theories of knowledge or significance; paradigms or prototypes; key evaluation beliefs and problem solving strategies. They also provide:

- a sequential framework of steps and principles for solving problems and guiding action
- a language through which to describe evaluation.

A responsive approach to evaluation

Scriven (1967) believes that it is the duty of the evaluator to estimate value and worth. He argues that goals and roles are **different,** and that the objectives model proposed by Tyler (1949) does not provide an adequate framework for judging the worth of the goals themselves. Values and facts, according to Scriven, can be separated and subjected to criticism, and hence evaluation.

Stenhouse (1975) also disagrees with the objectives model for evaluation. He postulates that the most effective way of improving practice is by teachers themselves criticising practice. Thus, Stenhouse proposes that teachers rather than external evaluators should be used to evaluate curriculum activities.

Stake (1967), working in an era in which educators had become mistrustful of evaluation, developed the **countenance model** which, at the time, extended the parameters for the range of data considered to be relevant for evaluation purposes. The model accounts for the complexities and characteristics of different educational programmes. The purpose of the extension, alongside contributing to short term judgements, was to enable evaluation outcomes to improve the understanding of innovative processes. As Stake says:

> *the countenance of evaluation should be one of data gathering that leads to decision making, not trouble making.*
>
> Stake (1967)

In line with the above, Stake discusses the need for evaluators to be credible and to provide relevant data directed towards the questions for which the decision makers need an answer.

A focus towards the particular, which takes a pragmatic view of the design and conduct of evaluation, is advocated by Simons (1987). It is important, Simons believes, to address the questions, issues, concerns and information needs of the stakeholders and decision makers in a situational context. The **situational responsiveness approach** has been accepted as an appropriate methodology by many evaluators. Situational responsiveness is a functional approach to evaluation which does not set definite rules about the methodologies to be employed. By its very nature, the methodological framework underpinning situational responsiveness requires that the methodology should arise out of the evaluation context.

The term situational responsiveness, according to Norris (1990), is used in two ways:

- to describe a programme that will drive the kind of methodology and questions to be asked
- to describe an evaluation strategy that responds to the different information needs and values of the internal and external stakeholders.

Patton (1978) agrees with Simon's approach and stresses the need to identify relevant decision makers and information users to facilitate collaborative working relationships. Patton believes that evaluation should be *utilisation-focused* which requires evaluation questions to relate to:

- the purpose of the evaluation as perceived by the stakeholders
- the information requirements of the stakeholders
- how the stakeholders intend to use the evaluation results.

Patton's (1978) primary concern is with improving the utility of evaluation for those who *can make a difference*.

Evaluation questions, according to Patton, should be empirical, focusing on the impact or change rather than subjective, that is, asking respondents to differentiate between elements that are good and bad rather than how they feel about the change. Once the evaluation questions have been set, the most appropriate evaluation methods can be selected depending on the type of questions. Thus, Patton (1978 and 1981) believes that good evaluations are characterised by situational responsiveness. Reaffirming this, Guba and Lincoln (1982) see the main purpose of evaluation as:

> *responding to an audience's requirements for information, particularly in ways that take account of the several value perspectives of its members.*
>
> Guba and Lincoln (1982)

Guba and Lincoln believe that it is an evaluator's duty to identify **all** the stakeholders and to incorporate the issues and concerns raised, to ensure that the evaluation framework is just and fair for all. However, Guba and Lincoln acknowledge that evaluation is a service to the client and, as such, they believe that there should be a firm understanding by both parties about:

- the scope of the evaluation
- the nature of the outcomes
- the methods to be used.

Becher (in Norris, 1990), from the Nuffield Foundation, drew together a number of eminent evaluators for a series of conferences which ran in1972, 1975 and 1979. The conferences aimed to identify a way forward for evaluation theory and practice. The participants agreed that evaluation should be:

- responsive to the needs and perspectives of the differing audiences
- illuminative of organisational, teaching and learning processes and issues
- relevant to public and professional decisions
- written in language that can be understood by the recipients.

Important to the above are recommendations that:

- observational data should be used
- the design should be able to accommodate unanticipated events through progressive focusing
- the position of the evaluator should be made explicit to the sponsors and the other evaluation audiences.

Parlett and Hamilton (1972) advocate an **illuminative approach** to evaluation. This approach lies within the social anthropological domain which follows a paradigm of investigation in naturalistic settings. In illuminative evaluation, the evaluator is immersed in the working worlds they are evaluating. In this way, the evaluator is able to build up an overall picture of the evaluation context. The results from such evaluations give an interpretative commentary on issues and phenomena raised within the evaluation context.

Political perspectives

Norris (1990) believes that evaluation studies should take account of local variations and context. Furthermore, Norris believes that evaluators should work within a standardised methodological and political framework.

Cronbach (1981) agrees with the scientific approach because it reduces uncertainty. However, he believes that an evaluator needs to accommodate *pluralist political assumptions* with applied science. To this end, Cronbach sees the evaluator's role as a public scientist serving the public interest as far as is possible within the terms of reference for a particular evaluation. The ideas of Cronbach contrast with the experimentalists in five specific ways which relate to:

- the exclusive use of experiments
- the need for operational definitions and measurements of change
- the use of random sampling
- control over the assignment of cases for treatment or otherwise and the standardisation of treatments
- the definition and importance of internal and external validity.

House (1980) and MacDonald (1976) also believe evaluation data should be subjected to a politically oriented analysis. Both theorists agree that evaluators need to empower both citizens and the managers of the programmes by:

- maximising democratic values
- ensuring fairness of results
- considering how the results will be utilised and the consequences on those concerned.

MacDonald (1976), provides a typology for evaluation studies based on political dimensions. Three types of evaluation are proposed:

- *bureaucratic*
- *autocratic*
- *democratic*

MacDonald (1976)

These categories provide a framework into which evaluations can be classified. The salient indicators for classification depend on the way in which the evaluator defines his/her service role, values, techniques, criteria of evaluation success and forms of independence and justification. MacDonald favours democratic evaluation.

The primary concern of House (1980) is with:

- justice
- validity

- fairness
- social purpose in evaluation.

House (1980) provides a bridge between those theorists who work within the tradition of applied science and those who are equivocal about its social efficacy or who reject its political and epistemological assumptions. House is particularly concerned with the moral consequences of the epistemological position in that, if evaluation information is not compelling, commitment and decision-making lies with the recipient of the evaluation rather than the evaluator. He is critical of other approaches and believes that there should be a moral basis to evaluation which accounts for:

- moral equality
- moral autonomy
- impartiality
- reciprocity.

Exchange relations: a reflexive approach

In line with House's (1980) view of fairness and the consideration of all, Carnall (1982) advocates a *reflexive approach* which analyses exchange relations in order to examine the impact of change on the different interest groups within the organisation. The basic assumption of the reflexive approach is that organisations comprise complex networks of economic and social exchanges. The analysis takes place within the employment structure and the normative structure to which it is connected . The basic unit for analysis is the *interest group.*

Two categories of exchange relations exist:

- **authoritative allocation of rewards** which refer to exchange relations linked to rewards and sanctions that can ensure the compliance or commitment of employees
- **reciprocal exchange relations** which are exchanges between individuals that are not work-related but which are still important to work experience.

Carnell (1982) draws on the work of Gouldner to highlight the framework for evaluation which has been derived from this approach. The evaluation framework is based on the notion of *fairness of exchange* which focuses on the *norm of reciprocity*. To conduct the analysis, one has to understand the nature of the exchange processes and the interactions between actors in the work environment. Where an exchange relation is conceived as being unequal, the norm of reciprocity cannot apply therefore *compensatory mechanisms* have to be introduced into the analysis. Important to this approach are the facts that:

- the normative order for this type of evaluation framework arises out of social comparison processes over time or with reference groups
- people's response to unfairness of response will depend on the socio-economic circumstances and the tactical position of the exchange participants
- repertoires of behavioural responses may be identified for a particular reference group. Given its socio-economic and tactical position, resistance, acceptance, accommodation and opposition can occur.

Evaluation of management development in Further Education

Cuthbert and Pike (1987), outline the need for evaluation of management development programmes in Further Education institutions. They say that there are at least four levels of evaluation for a management development programmes:

- **the reaction level** which collects data from stakeholders in the evaluation about the value and worth of the initiative being evaluated. Cuthbert et al believe this can be undertaken at:
  - an informal level, through meetings, discussions etc.
  - a formal level by using structured instruments such as questionnaires
- **the testing level** which collects data about what the recipients of the initiative have learned or how they have changed, for example, through knowledge and skills testing and/or with pre and post testing instruments

- **the behavioural change level** that seeks to identify and assess the changes which have taken place in the individuals involved in the initiative, for example, with attitude testing, observation etc.
- **the cost benefit level** that attempts to assess whether the benefits accrued from the activity are worth the cost of the activity.

Evaluating organisations

Cameron (1980), advocates four main approaches to **evaluating the effectiveness of an organisation** but believes all of them to be inappropriate for the evaluation of the effectiveness of schools, colleges and universities which he describes as **organised anarchies.** This type of organisation has:

- loosely connected parts
- sub-units that are semi-autonomous
- few common structures to enable linkages between sub-units. This leaves the organisation weak and leads to a wide variety of criteria of success being used within the various sub-units of the organisation
- ill-defined goals
- little or no connection between the way the work is done and its outcomes which leads to more than one strategy producing the same outcome
- no feedback loop for the exchange of information between recipients of the service provided by the organisation and the organisation itself
- sub-units which relinquish monitoring and evaluation responsibility because the influences from the external environment are diffused within the sub-unit.

Table 8 outlines the models proposed by Cameron (1980) and the reasons for their inappropriateness to organised anarchy organisations.

TABLE 8

INAPPROPRIATENESS OF MODELS OF EVALUATION FOR ORGANISATIONAL EFFECTIVENESS WITH ORGANISED ANARCHIES

Model	Explanation	Reason for inappropriateness
Goal model	Evaluates the effectiveness of the organisation against how well it is achieving its goals	Indistinguishable goals do not allow the organisation to evaluate clearly
System resource approach	Assesses the effectiveness of an organisation by the extent to which it is able to acquire the resources it requires	No clear connection between the outputs of the organisation and the resources it receives makes measurement difficult
Process model	Focuses on the efficiency and effectiveness of the internal processes and operations of the organisation	The same outcomes being produced by more than one sub-unit and operating system. No flow of information between the work processes and the output. Ambiguity of organisational characteristics making the internal processes of the organisation difficult to define and measure
Strategic constituencies approach (sometimes called the participant satisfaction model)	Examines how well the organisation responds to the demands and expectations of the groups of individuals (the organisation's strategic constituencies) who have a stake in the organisation	Loosely-coupled parts and semi-autonomous sub-units make response to the organisation's strategic constituencies difficult

Cameron (1980) points out that organised anarchies are particularly difficult organisations to evaluate because:

> *no single approach to evaluation of effectiveness is appropriate in all circumstances or for all organisations.*
>
> Cameron (1980)

Furthermore, Cameron (1980) believes, because organised anarchies are not easily evaluated, that their evaluation tends to focus on simple, uncomplicated indicators of effectiveness leading to a priori conclusions.

In response to his concerns, Cameron says that the only way to evaluate organised anarchies is to use what Weick (1976) called *fine grained analysis* which focuses on a specific part of the organisation, examining that part in detail.

In his work with colleges and universities, Cameron found four main domains which could be the focus of evaluation activity:

- the **academic domain** which includes teaching, research and professional development activities
- the **external adaptation domain** which emphasises the adaptation of the organisation to external pressures and its provision for career and job skills training outside the institution
- the **extracurricular domain** which addresses the personal, social and cultural development of the members of the organisation
- the **morale domain** which includes an appraisal of the satisfaction and morale of students and staff and the absence of internal conflict and strain.

Other aspects which must be addressed, according to Cameron (1980) include:

- the **constituent's point of view,** which should be the main focus of the evaluation
- the **level of analysis to be used,** for example, the individual or the organisation's point of view. Cameron found that the needs changed as the organisation developed
- the **time frames to be used**, for example, short term or longitudinal evaluations

- the **type of data to be used**, for example, primary or secondary information, subjective or objective
- the **type of referents to be used**, for example, **comparative** i.e. relevant to a competitor; **normative**, relative to a theoretical ideal; **goal-centred**, relative to a goal; **improvement**, relative to past performance and/or **trait**, relative to effective traits.

Evaluating planned organisational change

Legge (1984) believes that evaluation research is:

> *the systematic assessment of programmes of planned change*
>
> Legge (1984)

This type of evaluation is an activity where managers and administrators attempt:

> *to control and reconcile two images of immanent change.*
>
> Legge (1984)

Legge (1984) postulates three crises facing evaluation research which create a dilemma for the professional evaluator.

Firstly, **utilisation** is a problem because decision makers only tend to accept the results when they confirm the existing beliefs of the decision makers or when they support that which is already known or suspected. This means that most evaluation results are ignored where they are discongruent with the opinions of the decision makers. This problem represents a more fundamental issue in evaluation, that is, the examination of the functions that evaluations should fulfil.

The second crisis, according to Legge (1984) is that of **verification** which involves confirming the correctness of the evaluation data by setting up some comparative means or a separate investigation. Legge (1984) believes that evaluators do not seek to verify facts or theories but to make propositions that can be refuted by experience. Refutation, according to Popper (1959), is essential for any research work. Legge

(1984) further asserts that it is not enough for evaluation findings to be true or valid - they must also be meaningful.

Accreditation is the third crisis postulated by Legge (1984). This crisis has implications for the professional and social values of evaluators. If the results from evaluation research are ignored by managers and administrators and doubt is placed upon the practical, methodological and theoretical basis of the evaluation a crisis of credibility arises about the utility and validity will arise.

In the main, evaluation research tends to be conservatively biased according to Legge (1984) and Weiss (1975). Weiss (1975) states that to administrators the only objective evidence is that which is developed from government sanctioned assumptions and values and which fits in with their own perceptions of the situation. If evaluators seek to maximise the utility of their evaluations with decision makers, they will need to adopt a more conservative stance. This creates a dilemma for evaluators, in that, if they take an overtly radical position, they lose credibility with the decision makers.

Evaluation exercises tend to be commissioned by those who are responsible for the change programme rather than those to whom it is directed. These people, as the initial recipients of the report, can limit its publication. This can greatly modify the potentially reformist impact of negative findings, thus protecting the conservative administrator's position according to Weiss (1975).

Independent evaluation

The needs of this study specifically relate to the development of evaluation tools, initially to aid an independent evaluation by Sheffield City Polytechnic (now Sheffield Hallam University) of the impact of the DoE's AI applications to learning programme in Further and Higher Education.

Independent evaluation according to Simons (1984) means that an evaluator should be able to:

- report events and value perspectives fairly, accurately and impartially
- make the results accessible to all groups who have a right to know.

Over the years MacDonald (1987) has observed a change in the political climate for independent evaluations. Independent evaluators are now being replaced by evaluators who are specifically contracted to government departments and agencies and where the ownership and power lies in the hands of the contractors.

Policy evaluation

Monitoring and evaluation form an essential component of the policy process (Hedges and Richie, 1987). Within the policy process monitoring and evaluation involve collecting:

> *regular or ad hoc information to determine how effective the policy is.*
>
> Hedges and Richie (1987)

According to Hedges and Richie (1987), there are four main categories of policy research:

- **contextual research**, which describes what exists
- **diagnostic research,** which examines the reasons for what exists
- **evaluative research**, which appraises operations or actions
- **strategic research**, which provides data for the development and formulation of future plans of action.

As one can see evaluative research is an important element of policy research.

The Treasury evaluation framework

Policy evaluation according to Treasury (HM Treasury, 1988) is:

- *a process of examining policy while it is in operation or after it has come to an end....*

which:

- *requires a detached look both at the objectives and how they are met*
- *enables the decisions taken as a result of the appraisal to be reviewed afterward with the same rigour in the light of what has happened*
- *helps policy managers achieve their objectives*

HM Treasury (1988)

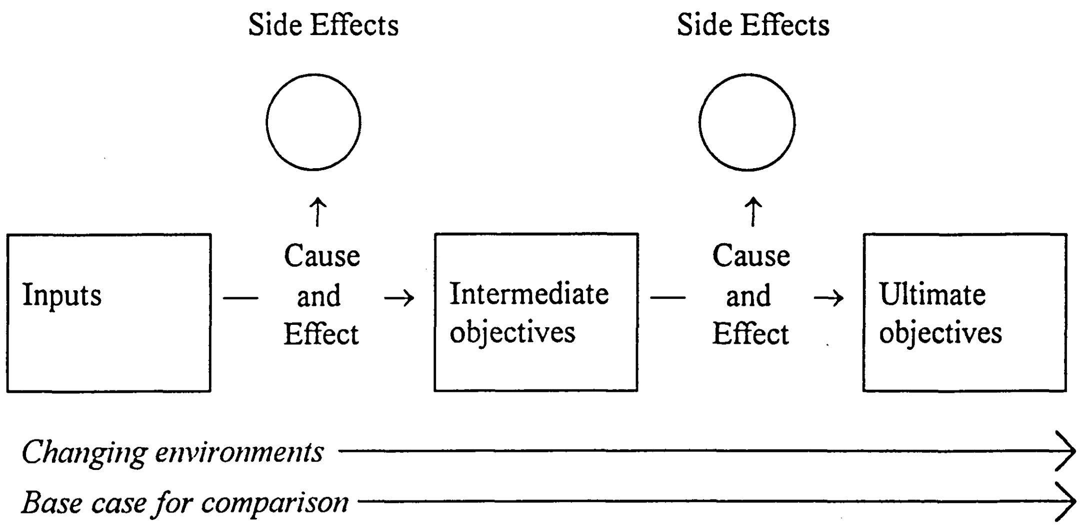
There are certain basic assumptions underpinning any evaluation of policy following Treasury guidelines. These are that:

- the evaluation should be comparative, that is, the programme or initiative being evaluated should be evaluated against a base case which takes account of what would have happened without the intervention
- in line with the idea of a base case, the evaluators need to account for other factors which might have an effect on the programme or initiative, that is, how much the evaluator can confidently say was attributed solely to the programme or initiative, and how much to other factors
- the evaluation should be based upon exact measures where applicable and indicators where not. These measures should include:
  - effectiveness measures and indicators which assess the achievement and relevance of the policy
  - input measures and indicators which include the costs of the initiative to all concerned. These measures should account for deadweight (unproductive inputs) and additionality (extra funds accrued from elsewhere because of the programme)
  - efficiency measures and indicators which relate to the ratio of inputs to outputs.

The evaluation framework outlined by Treasury has been shown in Figure 30.

FIGURE 30

A POLICY EVALUATION FRAMEWORK



HM Treasury (1988)

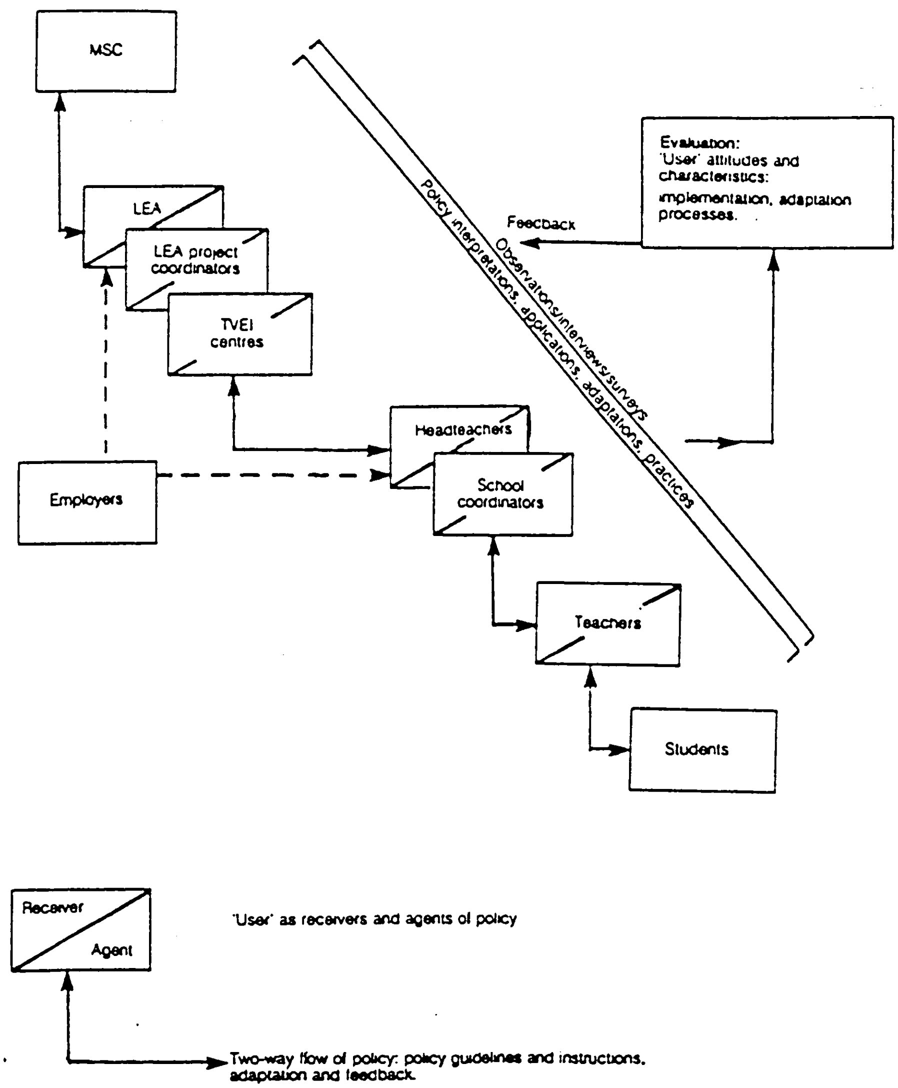
The implementation staircase

Another important technique utilised in the development of the evaluation tools for this study was the implementation staircase. Saunders (1986) adapted Leithwood 's implementation staircase to accommodate the two-way flow of policy for use as part of the focusing procedure to identify the various agents and recipients for the implementation of a particular policy. Saunders used this idea to highlight how policy moves and is re-addressed by different recipients at differing stages in the mplementation process. Each in turn becomes an agent and their interpretation reflects the priorities, pressures and interests not only of themselves but of others in that location on the implementation staircase.

Figure 31 summarises the implementation staircase model developed by Saunders (1986) for the evaluation and feedback of TVEI implementation.

FIGURE 31

THE POLICY IMPLEMENTATION STAIRCASE



Saunders (1986)

Implications from the literature review

Given the breadth and nature of the texts reviewed in this chapter it is important to summarise their implications for this research programme.

Further Education

Further Education provides the context for this study. It forms a major part of the post school education provision in England and Wales. Vocational education and training courses provided through Further Education colleges are the focus of this research. These courses are essential for the present and future economic performance of the UK because they link with the employment needs of individuals, organisations, local labour markets and the UK's national and international interests. One of the most important changes to affect Further Education over the past fifteen years has been the move by government to lessen the power of local authorities and take more direct control over the curriculum of vocational education and training courses and students. Through a series of White Papers (HMSO, 1981b; 1984; 1985 and 1986) the government has moved progressively towards a system of qualifications based on national standards acquired through evidence of a competent performance whilst in the workplace. This has created a threat to colleges, where their vocational training has been taken out of the college and provided by a variety of independent training providers. Some colleges seeing this change as an opportunity have become training providers and assessors within the NVQ system.

The model of education and training proposed by Jessop (1991) seems to provide a long term aim rather than something that can be imminently achieved. However, with government money and pressure focusing on the implementation of NVQs the transition to a fully functional framework of national qualifications running alongside the academic qualifications is more likely to succeed. The future role of Further Education within this system will be dependent on the framework that emerges and on the will and ability of individual colleges to change their working patterns to accommodate the needs of NVQs and the new GNVQs.

Information technology

Historically, information technology and particularly AIT have become important to vocational courses (Evans, 1982; Cotterell and Ennals, 1985 and Cotterell et al 1988). With the advent of the fifth generation computing at the beginning of the 1980's the need for the UK to keep abreast and preferably ahead of its international rivals prompted several government committees and reports (ALVEY, 1982; Butcher, 1984 and Bide, 1986). Butcher's second report, which stated that information technology and AIT should be used across all technician level courses, has been the most influential for Further Education vocational education and training. This report initiated a series of studies carried out by, and for, the FEU. The first survey (FEU, 1984a) led to the FEU's Framework for Action for information technology (FEU, 1984b) which was important for the use and embedding of AIT because within the framework the FEU acknowledged the beliefs of Ennals and Cotterell (1985) and Cotterell et al (1988) that fifth generation computing, which could process knowledge rather than data, would revolutionise teaching and learning for all, but particularly for Further Education vocational education and training course students.

All of the FEU studies, as with the HMI survey (1987), have identified problems and issues and most have proposed solutions. However little, with the exception of promotion events by the FEU/MSC for the dissemination of project outcomes, has been done to utilise the knowledge gained to promote change in practice within the vocational education and training curriculum. A prime example of the lack of such utilisation is shown in Table 5 (see page 90) when, as part of the literature review, the NCET's 1991 survey was compared with the FEU's 1984 study. The number of problems still existing outweigh the progress that had been made over this period particularly in relation to the policy, provision and staff development for the use and embedding of information technology.

If one considers the millions of pounds that have been spent by central government over this period to embed information technology across vocational education and training courses not traditionally associated with computers one has to question the validity of the funding strategies and change methods used. On evaluating the type of work completed over this period, there is a proliferation of studies and surveys examining the introduction and use of information technology and AIT rather than the attempting to produce an effective change theory or model which indicates how information technology and AIT can be successfully embedded across Further Education vocational education and training courses. One exception is Cotterell's ITDU model which has been implemented into his own college, however, the durability of the model in other colleges has yet to be proved.

Change theory

Change theories, frameworks and models have provided a major emphasis for this study, unfortunately, little of this literature relates to Further Education in the UK. The type of model postulated by Leigh (1988) which has been rigorously tested, explains how organisations work and highlights a set of levers of change is needed in Further Education.

Four distinct uses have been made of the change literature reviewed. The uses indicate their relevance and worth to this study. They include:

1. **General change models and orientations** which identify overall change processes and strategies (Tichey [in Leigh], 1988; Leigh, 1988; Legge, 1984 and Havelock, 1982). These have been used to highlight the complexities of developing any model of organisational change. The OD model, as a *total system approach* (Burke, 1987) has some relevance in highlighting change processes and practices however, the use of an external OD consultant would make this approach inaccessible to colleges because of the cost. Also, as the focus of OD is on a progressive educational programme, colleges are more likely to believe that they can implement this themselves. A descriptive model of change (Legge, 1984), because of its focus on the features within the change process, offers the most practical framework for change in Further Education.
2. **Models with specific features that are of relevant to this study**. One of the most useful areas of change literature to be reviewed has been that which highlighted specific features of successful change in practice, for example, the educational change work of Fullan (1982, 1986 and 1991); the FEU's curriculum led change model (1986) specifically developed for Further Education; the Halls and Loucks's (1978) CBAM which focuses on the individuals involved; Elliott-Kemp's (1982) ideas derived from his study of educational change, particularly the need to establish the power and influence patterns and the focus of the teacher as an *active interpreter* rather than a *passive receiver* and Pettigrew's (1985) *contextual analysis* which actually describes the processes used for the present research.

3. **Ideas, concepts and theories with direct relevance to specific features of this research**, for example, the *intervention theory* (Argyris, 1973) because of the focus of this study on government intervention, the concept of the change agent and their role (Cuthbert and Pike, 1987 and Havelock, 1982) in bringing about change in Further Education; the ideas of *mutual adoption* (Berman and McLaughlin, 1978); *institutionalisation* (Crandall and Associates, 1982; Miles, 1983 and Holly, 1986) and *continuation* (Fullan and Stieglebauer, 1991) which relate to the concept of embedding which is used in this study and then need for a *project champion* (Twiss, 1986).
4. **Tools** that have been utilised within the models developed in this study and to aid their description. They specifically include the use of:
   - *CSFs* (Rockart and Bullen,1979) to highlight those factors which, through all strands of the study, have been critical and sufficient for successful embedding
   - *force field analysis* (Lewin, 1947 and 1958) to provide a framework which highlights the most important driving and restraining forces that need to be considered when implementing change practices which will ensure the embedding of information technology / AIT into Further Education vocational education and training courses. The use of the concept of force was felt to be important because those items identified could individually and/or collectively *force* the success or failure of the embedding process.

Evaluation literature

For this study evaluation literature relating to the development of the evaluation tools to assess the impact of government programmes has been the most useful.

The *situational responsiveness approach* (Simons, 1987 and Norris, 1990) and Stake's (1976) proposition that no single method is suitable for evaluating differing educational programmes is fully supported by the author. It is also reflected in the evaluation tools developed for the study, that is, they too are not prescriptive about the type of methods that should be used for an evaluation.

The problem with many of the approaches postulated, for example, the *countenance model* (Stake, 1967); the *illuminative approach* (Parlett and Hamilton, 1972); the *reflexive approach* (Carnall, 1982) and those that take a *political stance* (MacDonald, 1976 and House, 1980) is that they are idealistic. In the real world evaluations, particularly for evaluations externally commissioned by government, funding is directed and utilisation, as indicated in the literature review, is a central issue for evaluators. This limits the scope for purely democratic evaluations of the nature postulated by many evaluation theorists.

Allied to the utilisation issue is the whole area of policy evaluation which requires the consideration of specific evaluation elements. The evaluation tools developed as part of this study endeavour to address some of the issues identified by Treasury in their policy evaluation guidelines (HM Treasury, 1988). For example, the Total Growth of Impact graph which involves the notion of comparison and the need for a base case against which to measure the impact (see Figure 35, page 198) alongside this the cost effectiveness bars and the taxonomy of variable determinants which allow efficiency and effectiveness measures to be accommodated.

Equally, one important technique discussed in the literature review and adapted and used within this study (see Figure 34, page 193 and Figure 39, page 252) is Saunders version of Leithwood's policy implementation staircase (Saunders, 1986).

CHAPTER 3

RESEARCH METHODOLOGY

The methodology used for this research was inductive. This approach allowed the study to develop through an exploratory period, comprising a casing study and some initial desk and field research, to the full scale research programme. The scope of the research spanned national, regional, local, institutional and individual levels of investigation and involved a triangulation of methods including interviews, group discussions, observation and self completion questionnaires.

The use of an inductive approach

An inductive methodology was used as the overall approach in this study for four main reasons:

1. Lack of research in curriculum change for the implementation of information technology into Further Education vocational education and training meant that proceeding from particular observations (collected from the differing parts of this research) to empirical generalisations and to theory (the final model of change) was the best way to approach the research problem.
2. Pre-determined deductive hypotheses could not reasonably be established, given the scarcity of research. The only way in which such hypotheses could have been derived would have been to base them on a priori reasoning. The derivation of hypotheses of this type might have focused on one set of variables to the exclusion of other more important variables because of bias in the original hypotheses. An example from the study was the inclusion of information technology in examination syllabuses. This was found to be one of the most effective ways of ensuring the introduction of information technology but at the beginning of the study this had not been considered. Certainly no previous

research studies had documented this course of action for Further Education vocational education and training.

3. The newness, complexity and volatile nature of information technology and Further Education (in that both were constantly subject to change during the research period) meant that the use of *sensitising concepts* was more appropriate because they:

> *give the user a general sense of reference and guidance in approaching empirical instances. Whereas definitive concepts provide prescriptions of what to see, sensitising concepts merely suggest directions along which to look. The hundreds of our concepts - like culture, institutions, social structure, modes and personality - are not definitive concepts but are sensitising in nature.*
>
> Blumer (1954)

4. Using an analytical inductive approach allowed the research to change and develop as the study unfolded.

How the exploratory research developed

The study commenced with an initial exploratory period. The conclusions drawn from the exploratory research were used as sensitising concepts to guide the author about the direction the research should take. The conclusions from this period also led to the development of the initial models of change.

Resource and time constraints meant that it was not possible to use theoretical sampling to the point of absolute theoretical saturation, that is, where all research contexts and audiences are sampled until all deviant cases have been identified and investigated. Therefore, most of the work was based on critical case analysis. Alongside this, the AI applications to learning programme evaluation allowed data from a Further Education census and follow-up survey to be utilised.

At the outset of the research, and to help define more precisely the best focus for information technology, a *casing exercise* was undertaken at national, regional and local levels (see Figure 32). The objectives of this, as Schatzman and Strauss (1973) specify they should be, were to:

- determine the suitability of prospective research sites
- measure the feasibility of conducting the research at the sample sites given the resources available
- collate information about the places and people in order to decide tactics for negotiating entry into the sample institutions.

These three aspects were not investigated in isolation. Indeed, the casing exercise itself was constrained by the resources available.

From the casing exercise, the sites, strategies and tactics for entry for the initial part of the study were identified. The components for the second part of the study, although being outlined as possible options, were not finalised in the initial stage of the study but emerged as the investigation progressed.

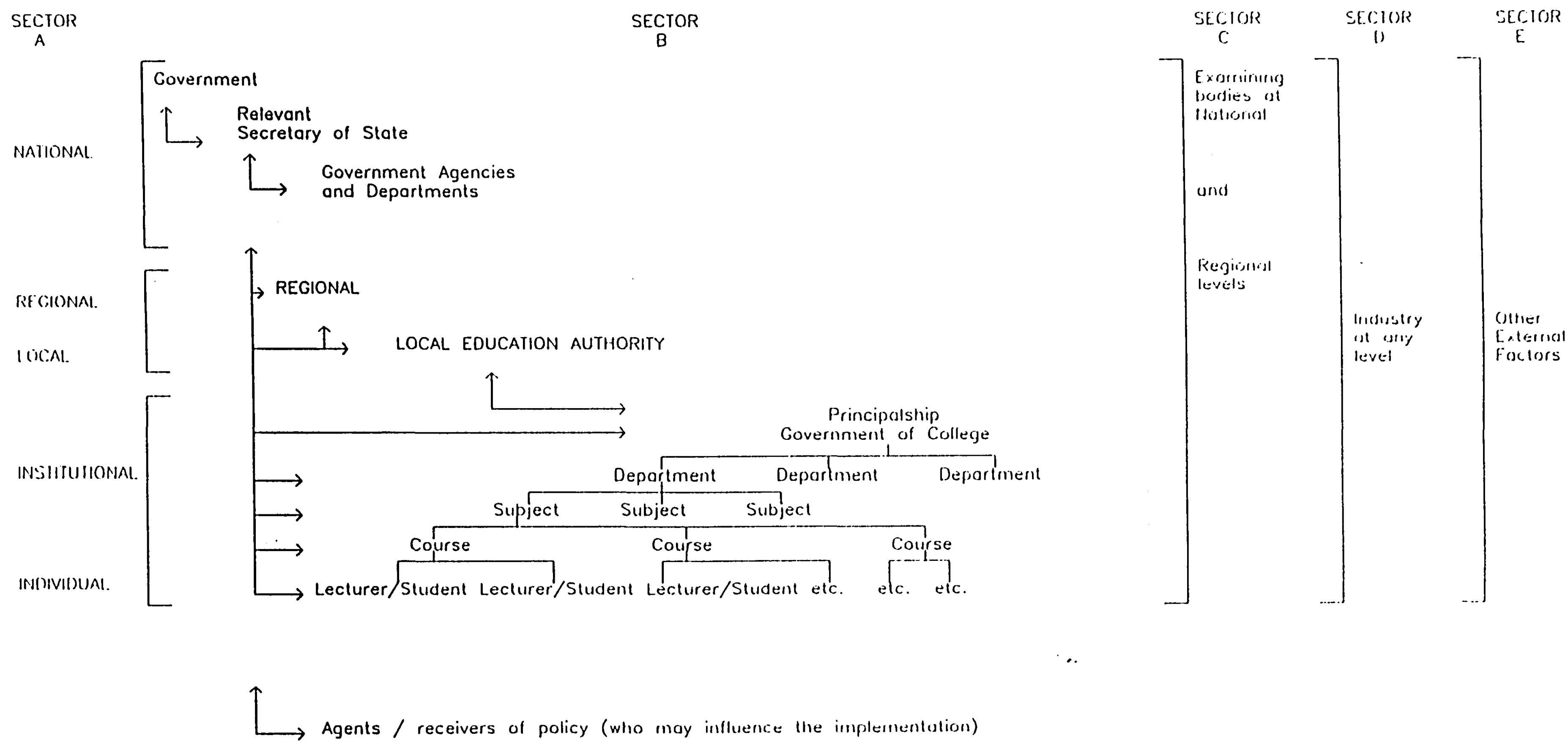
Levels of investigation

Figure 32 diagrammatically illustrates the levels of the investigation and how these relate to the each other.

- **Sector A** highlights the five possible levels of study identified from the initial literature review (Coombe Lodge, 1975; OECD, 1973 and Weaver, 1983)
- **Sector B** shows the specific levels of investigation
- **Sector C,** the examining bodies, were studied from two perspectives:
  - the examining bodies themselves
  - the recipients of the examination syllabuses (the colleges, courses, lecturers and students)
- **Sectors D and E** were not used as a source for the collection of primary data However, their influence on the introduction and use of information technology / AIT was elicited from data collected from the college staff and students interviewed.

FIGURE 32

LEVELS OF INVESTIGATION



The overall approach (see Figure 32), as well as being inductive, was conducted using the principles of *contextual analysis* (Pettigrew, 1985). Based on an understanding and exploration by the author of the origins, development, introduction and embedding of information technology into the Further Education vocational education and training curriculum, data was collected and analysed at two levels:

- **vertical**, where the research was conducted with stakeholders at all levels that impinge on the functioning and operation of Further Education vocational education and training courses (see Figure 32, vertical dimensions)
- **horizontal**, which included an examination, over time, to identify the implications of the study for the participants and the organisations involved (see Figure 32, horizontal dimensions).

At both levels, the context, process, content and implications for change to the adopters and instigators was examined.

Sources of data

Both primary and secondary data was used. Most of the secondary data was collected from the literature review. Secondary source data, in the form of papers, policy documents, teaching materials, syllabuses, prospectuses etc. was used at all levels. The three main sources of primary data were:

- government officials, at national, regional and local levels
- college staff, principals, vice principals, heads of department and lecturers
- college students.

Data collection

For the primary data, the main data collection procedures included:

- a census of Further Education colleges carried out at a national level

- survey work which was undertaken at a:
  - national level with the follow-up sample survey
  - LEA/college level for the Sheffield survey
- case studies at a college level. Three types of case studies were used:
  - two longitudinal studies, one bottom-up and one top down
  - the CUSTOM implementation case study
  - three one shot success cases.

Research methods and techniques

Four methods of study were used for the collection of primary data: interviews, group discussion, observation, and self-completion questionnaires.

For validation purposes, the study involved a triangulation of methods, data collection and analysis. These were complemented with sound theoretical underpinning using primary and secondary source material.

Interviews

Interviews were conducted with the stakeholders at national, local, institutional and individual levels.

The degree of structure imposed on the interview was dependent on the timing (within the study), the interviewees, and the amount and type of data required from the interview.

Non-directive and semi-structured interviews were used over the research period:

- non-directive interviews:

  > *where the interviewer plays a more passive and adaptive role, giving only enough direction to his/her questions so that the respondent will cover a topical area in-depth, while having more responsibility and freedom of expression*
  >
  > Smith (1975)

  were used in the initial stages of the research

- semi-structured interviews derived from the outcomes of the initial non-directive interviews followed.

Group discussions

To elicit the views of the whole group of students from the Further Education vocational education and training courses, selected discussions were arranged and held within normal information technology lessons.

Observation

Observation was conducted at an individual and group level in the classroom environment. To complement the primary data, secondary source material was collected from the interviewees and their institutions, both prior to, and following, the interviews.

Unstructured open observation of classroom procedures for Catering students was undertaken. This was included to elicit qualitative data about the information technology learning environment in an area where computers were not a central theme of the course.

Self-completion questionnaires

Self-completion questionnaires were used for the collection of census and follow-up survey data at an institutional level (see Figure 32, page 180).

Due to limited time and access to students, an explanatory/descriptive self-completion questionnaire for groups of students was incorporated as part of the research strategy. This allowed quantitative data to be collected from a larger sample than could otherwise have been covered by interview. However, the content of the questionnaire reflected that of the student semi-structured interviews which were conducted with a sample of students from particular vocational education and training groups.

The focus of the study

The case studies, census and survey data allowed the examination of the driving and restraining forces working at an institutional, departmental and curriculum level. The focus of much of the data was on AIT in Further Education institutions that had little experience or knowledge of the techniques. However, this focus allowed the processes of change for a new technology to be studied more closely. The introduction of AIT allowed the author to investigate whether there was a development threshold before the technology could be introduced into Further Education institutions.

A second focus of the study included the development of evaluation tools and techniques which could be used to focus, carry out and document evaluation studies particularly relating to the impact of governmental initiatives. These tools were mainly based on the evidence collected from the the AI applications to learning programme alongside the appropriate underpinning evaluation literature. Although specifically devised, it was anticipated that the tools and techniques devised would have more generic applicability. To this end, some of the evaluation tools which are described in detail in Chapter 4 have been used in other evaluation studies conducted by the author (Goodman, 1989a, 1989c and 1991).

CHAPTER 4

THE EVALUATION TOOLS

The author's involvement in the evaluation of the DoE's Artificial Intelligence (AI) applications to learning programme (the AI programme) illustrated the need for evaluation methods directly related to the evaluation of impact in a Further Education environment. There was also a need for specific evalaution tools that could provide a systematic way of appraising the value of the factors that may affect the introduction of leading edge technology in Further Education vocational education and training. Five tools were devised by the author for the evaluation (SCP 1991b and 1991c and Goodman, 1989b):

- the taxonomy of variable determinants and analysis matrices
- the pyramid model
- the awareness index
- total growth of impact graphs
- cost effectiveness bars.

However, because Treasury cut short the AI programme, only the taxonomy of variable determinants, the pyramid model and the awareness index were fully developed and used to evaluate the programme. The taxonomy and the pyramid model have also been used successfully in:

- an evaluation of two training courses run by System Applied Technology (Goodman, 1989a) for the DoE to expose industrialists to AI
- the evaluation of AsSyst (Goodman, 1989c), an expert system approach to initial self-assessment for Employment Training (ET) trainees
- a project to develop an evaluation structure of Sheffield TEC's Business Development Team (Goodman, 1991).

The taxonomy of variable determinants and associated analysis matrices

The taxonomy of variable determinants is a focusing instrument which can be used by any researcher or evaluator to help them make explicit all the variables that might need investigating within their research activity. Once identified, the variables can be examined and validated by key stakeholders and other individuals concerned with the study. There are various ways in which the taxonomy can be used:

- in its entirety, as with the AI applications programme
- partially, if some variables are the same as those developed for the AI programme taxonomy, for example, if one was researching curriculum change in a school or Higher Education context or for any other initiative (that is, not AIT) in a Further Education context
- as a template into which a researcher or evaluator can insert the variables (from broad to single indicator level) specific to their own investigation.

Alongside the taxonomy, a set of matrices have been developed to be used for the systematic documentation of the research outcomes.

The conception of the taxonomy

At the outset of the AI programme, it was apparent that most of the concepts being investigated had several dimensions, for example, lecturer perceptions and curriculum change. This necessitated the use of multiple indicators to ensure a more precise measurement and to lessen the risk of a single indicator being contaminated by some other concept which was of no interest (and may be confounding variables) to the evaluation.

As the AI programme projects varied in nature and content, a profiling system was thought to be the most appropriate method of ensuring a comprehensive evaluation of the programme.

Thus, the taxonomy of variable determinants was developed. It was used by the evaluation team to highlight areas which needed investigating. From the findings the evaluation team could determine the extent to which the AI programme had achieved its aims. This allowed the researchers to focus on **all** the factors that should be considered to ensure a comprehensive evaluation of the success of the AI programme in terms of:

- the programme aims
- its management and administration
- other criteria which were felt to be important for the successful introduction of new technologies into Further and Higher Education.

The taxonomy was used as an initial focusing tool for the evaluation but was not intended to be prescriptive. The methods used to collect and analyse the data were not stipulated; indeed the researchers used a triangulation of methods, data collection and analysis to complete the evaluation.

The components of the taxonomy

Appendix A includes the complete taxonomy (presented in tabular form) for the AI programme variables which consisted of:

Classification variables

The classification variables were a set of multiple indicators which represented the broad areas of investigation that needed to be considered when evaluating the impact of the AI programme on the Further and Higher Education.

The classification variables established for the AI programme (see Appendix A) were:

- **exploration variables** which explored the impact of the various projects
- **resister variables** which investigated the extent and type of resistance being experienced by the various projects
- **acceleration variables** which examined the factors which might enhance the speed with which the project process and outcomes might have an impact
- **ergonomic variables** which identified environmental factors that might affect the impact
- **learning variables** which highlighted the areas where the AI programme might have an impact on learning
- **industrial variables** which identified the links with industry that might be enhanced through the AI programme
- **competence variables** which outlined those areas where an enhancement in the knowledge, skills and social and vocational abilities might have been advanced through the AI programme
- **market variables** which identified elements related to the economic impact of the programme
- **effectiveness variables** which examined the factors that might improve the effectiveness of teaching/learning situation including the cost implications
- **management variables** which referred to the management of the AI programme
- **evaluation variables** which covered the usefulness and effectiveness of the evaluation components of the programme.

Each classification variable was divided into **general areas** and **component variables.**

General areas

The general areas were the major areas of concern that the research team needed to investigate under a particular classification variable.

Component variables

The component variables were a list of questions or statements which required some type of response to ensure comprehensive coverage of the effectiveness of the programme for the people and institutions involved.

From the component variables, specific questions that related to the objectives, processes and outcomes from each project included in the AI programme were devised and used in questionnaires, interviews and for observations. Analysis of responses to the questions posed, together with observational and other research data, was used to measure the strengths and weaknesses of each of the cases being examined.

An example of part of the taxonomy is shown in Figure 33 covering one classification variable — resistance — together with two general areas — barriers and minimisation of resistance — and their component variables.

As the main focus of the evaluation for which the taxonomy was developed was the AI programme, the variables related specifically to the needs of the evaluation of that programme, especially the sections about projects and programme which refer only to the DoE's programme and funded projects.

If another programme or policy was being evaluated the variables could be substituted by other more relevant features.

The matrix approach to the analysis of the taxonomy outcomes

On examining how to analyse the taxonomy, quantification of data was found to be an inappropriate method for two reasons:

- the diversity of the AI programme projects, for example, they differed in subject area, objectives, occupational bias, type of technology etc.

FIGURE 33 AN EXAMPLE FROM THE AI PROGRAMME TAXONOMY

Classification variables	General areas	Component variables
Resister	**Barriers**	What are the greatest barriers to the acceptance of the development? a) Personal (individual lecturers) i) technology negative ii) needs negative - for self and students iii) incentive negative iv) personal conflicts b) Departmental i) management negative ii) needs negative iii) resource negative iv) incentive negative v) intragroup conflict c) Institutional i) management negative ii) "core mission" conflicts iii) inter-departmental conflict
	Minimisation of Resistance	Is there any one thing (or a series of things) that: a) initiated b) resistance overcame? Are there any factors which indicate when and if resistance should be: a) quelled b) re-channelled c) ignored ? Is there a critical stage whereby resistance should be: a) quelled b) re-channelled ? Is there a specific time span for lecturers / management to become: a) aware of the innovation b) responsive to it c) involved with it in order that resistance be minimised ?

- for each project, the project teams and the target audiences started at differing points in terms of expertise of the project team, their organisation, the development stage of the software etc.

For the analysis of the research data, summary profiling matrices were devised to accommodate the outputs from taxonomy variables. These evaluation matrices took account of the threshold (or starting) point of the AI programme project teams, their organisation and the developmental stage of the software being investigated as an application to learning.

The matrices provided the complete coverage of the evaluation issues raised in the taxonomy of variable determinants. A set of empty AI programme matrices have been included as Appendix B.

To be highly effective in terms of bringing about change in practice relating to the introduction of AI in Further and Higher Education a case would have to be rated:

- high on exploration
- low on resistance
- high on acceleration
- high on effectiveness
- high on links with industry
- high on competence
- high on market variables
- high on cost effectiveness.

This type of generality was not possible with the AI programme projects as some projects were aimed at:

- the exploration of AI
- the development of AI techniques
- the acceleration of AI techniques,
- training, specifically related to the dissemination and use of the methods outside the project time.

Therefore, each project needed to be evaluated against its own aims in terms of attributing success.

Another important issue when completing the matrices was the need to adopt a gestalt approach, as the whole might not equal the sum of the parts. Significant impact might not have been derived from any one project or case but from the development of the **critical mass** of projects which constituted the AI programme. The collation of the matrix results allowed an overall profile of the impact of the programme to be established.

The pyramid model

The pyramid model utilised the implementation staircase approach (Saunders, 1986). In its original form, the implementation staircase was used to identify agents and receivers of policy who might affect its implementation. For impact evaluation, it retained its original purpose but was adapted to cover the identification of potential and actual impact.

The pyramid model (see Figure 34) was constructed to make explicit potential areas of impact. It focused on individuals within Further and Higher Education institutions who may be affected by, or who may affect, the implementation of the programme at any level.

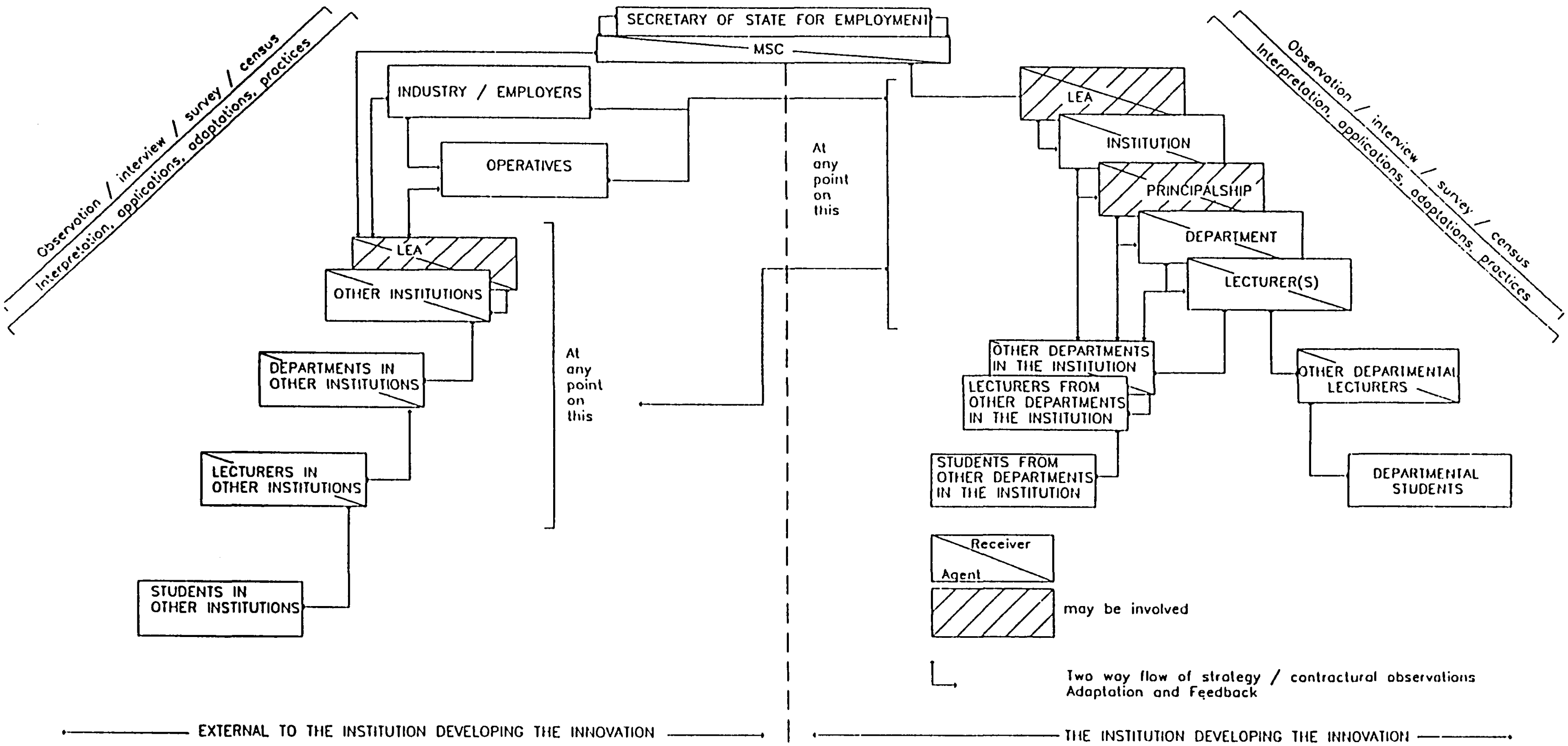
The areas of potential impact identified in Figure 34 reflect the educational emphasis of the evaluation. Each box represents a possible opportunity group, that is, a group who could introduce AI into learning / training. The construction of the pyramid model allowed the evaluation team to:

- ascertain and highlight areas of actual impact
- extrapolate areas of concern for the research team's evaluation at various points in time and for people within the possible opportunity groups
- identify and explore the effectiveness of impact within these areas for individual projects and for the programme overall.

FIGURE 34

THE PYRAMID MODEL

Adapted from "The Policy Implementation Staircase, Evaluation and Feedback" (Saunders, 1986)



An example application of the pyramid model has been included in Chapter 5 as Figure 39 (see page 252), in the section dealing with the longitudinal case studies. This method of evaluation allowed the evaluation team to appraise the merits of individual projects as part of the programme whilst, at the same time, giving scope for critical mass analysis. The pyramid model also allowed the type of effect each AI programme project had on the Further and Higher Education sector in terms of density and awareness to be plotted.

The awareness index

Based on the findings from the AI programme, an awareness index was devised (see Table 9). Its purpose was to document awareness levels of AI programme project users and developers and it aimed to classify the impact of the programme on individuals in Further and Higher Education. From the evaluation and the surveys conducted at the outset of the AI programme, it was clear that there were several routes by which one could reach developmental ability. Therefore, the awareness index did represent a hierarchical continuum but formed a nominal scale.
When used for the evaluation of AI programme projects, the table was adapted to accommodate two further categories: **use without knowledge and awareness** and **enhanced use of IT**. These were identified from the Castle College case study and have been incorporated in a new awareness index shown in Table 10. Codes were also added to the awareness index (U-K, A, AE, DK, K, DU, U, DD and D, see Table 10) and the pyramid model (see Figure 39, page 252) to indicate depth of knowledge and awareness accrued from each project within the AI programme.
As evaluation has been described by Treasury as a:

> *comparison as well as a test of achievement.*
>
> HM Treasury (1988)

Alongside the taxonomy, the pyramid model and the awareness index, there was a need in the AI programme to establish a base case against which to measure impact.

TABLE 9

AWARENESS INDEX

Awareness	The realisation that AI exists as a concept and that it may have applications in the learning environment.
Desire to know about Al	The wish to have more knowledge about AI and the will to go and explore its potential theoretically perhaps at conferences or through reading magazines.
Knowledge	The ability to recognise and recall the main concepts concerned with AI, either specifically in learning uses or as general knowledge of AIT.
Desire to use AI	The wish to learn more about the availability of AI software to enable the use of it in a learning environment and the will to explore how AI can be applied in one's own situation.
Use	The use of AIT leading to a change in practice either because the individuals have used AI techniques themselves or have used them with students / trainees in the learning environment.
Desire to develop AI	The wish to possess the skills to develop AI techniques for use in la learning environment and the will to go out and find out about them e.g. through courses or books.
Development	The ability to develop AIT and evidence that development of some AIT work has taken place either for use in the learning environment or more generally in AI.

TABLE 10

THE REFINED AWARENESS INDEX

Use without knowledge (U-K)	The use of AI without any knowledge or awareness of what AI is. The focus of use is on content of the package only
Awareness (A)	The realisation that AI exists as a concept and that it may have applications in the learning environment
Awareness of AI & enhanced use of IT (AE)	Awareness that AI exists and exposure to it leading to an enhanced use of IT
Desire to know about AI (DK)	The wish to have more knowledge about AI and the will to go and explore its potential theoretically perhaps at conferences or through reading materials
Knowledge (K)	The ability to recognise and recall the main concepts concerned with AI, either specifically in learning uses or as general knowledge of AIT
Desire to use AI (DU)	The wish to learn more about the availability of AI software to enable the use of it in a learning environment and the will to explore how AI can be applied in one's own situation
Use (U)	The use of AIT leading to a change in practice either because the individuals have used AI themselves or have used them with students / trainees in the learning environment
Desire to develop AI (DD)	The desire to possess the skills to develop AI techniques for use in a learning environment and the will to go out and find out about them e.g. through courses or books
Development (D)	The ability to develop AIT and evidence that development of some AIT work has taken place either for use in the learning environment or more generally in AI

In order to address this issue, two more tools were developed — the total growth of impact graph and cost effectiveness bars. Although these tools from their appearance may look as though they are able to provide objective and quantitative data it must be remembered they have not yet been used in practice. Certainly for the AI applications to learning programme, as with most other government intiatives and programmes, the units of impact and the cost effectiveness bars would have to be developed using subjective judgements as exact base case and other data against which to plot actual numbers or percentages would not be available.

Total growth of impact graphs

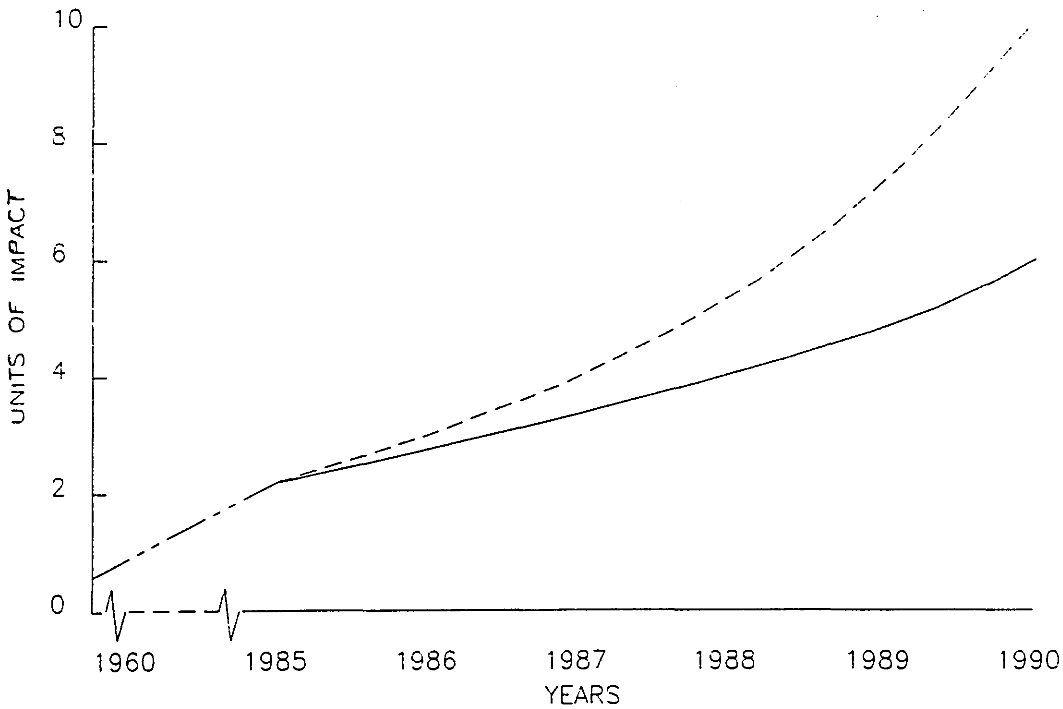
Specifically for the measurement of the AI programme, the author devised the concept of the total growth of impact as part of the summative evaluation strategy. Total growth of impact was represented graphically. The aim was to compare the cumulative impact against the base case (i.e. what would have happened if current practices had continued), and both were measured over time in **units of impact**. From this one would be able to establish the actual impact achieved by the programme.

If generally adopted, a unit of impact would differ dependent on the policy or the intervention being measured. One unit of impact may comprise a single measure, for example, the market penetration of a product or service, or multiple criteria, for example, a unit in the AI programme would involve the aggregation of a combination of the variables outlined in the taxonomy of variable determinants, to ensure an accurate measurement of impact.

Figure 35 illustrates, hypothetically, how this concept would be presented if the tool was used. For illustration purposes, line b-c on the graph in Figure 35 assumed an incremental growth of 25%, that is, continuous growth of 25% in the base case. In the base case, 2.5% growth of impact was added to account for additionality. This would be derived from the projects chosen for the AI programme which might have

FIGURE 35

HYPOTHETICAL TOTAL GROWTH OF IMPACT GRAPH FOR THE AI APPLICATIONS TO LEARNING PROGRAMME



——- - -—— = Pre Training Agency intervention

———— = Growth of impact for the Base Case of the Training Agency's 'AI Applications to Learning' programme (assuming 25% constant growth of impact from 1985)

- - - - - - = Growth of impact due to Training Agency intervention and its 'AI Applications to Learning' programme (assuming 35% growth of impact following Training Agency intervention in 1985 and 40% growth of impact since the commencement of the 'AI Applications to Learning' programme in April 1987) received partial or complete funding elsewhere if the programme had not existed. Line b-d presumed a constant growth of 35% through the two years of MSC (now DoE) intervention prior to the AI programme (1985-1987) followed by 40% growth from the commencement of the programme April, 1987. As AIT was already being developed prior to 1985, a mandatory two units of impact were included as growth over the period 1960 to 1985. The distance between c and d was to represent the growth of impact due to the AI programme or alternative.

Cost effectiveness bars

As cost effectiveness was an important feature of the AI programme evaluation, a specific tool was devised by the author which allowed the evaluation team to plot cost effectiveness in terms of % increase or % decrease against the base case (see Figures 36 and 37).

The criteria identified for the positive cost-effectiveness of any one project were:

- extra competences, gained by students when using the system, product or process. This would be measured by the % amount of extra **units of competence** (or **elements of competence** if an NVQ measurement was used) gained as compared with normal practices
- more throughput of students, measured by % increase of student throughput as compared with normal practices
- less study time required, measured in % time saved for a course / lecture as compared with the normal course / lecture time.

The first of the bullet points above was seen as critical for cost-effectiveness. Any project that lessened the competence normally gained by the students would not be considered cost effective. Individual cases were to be measured according to the specific needs that they were addressing; for example, if less time off the job was crucial to the project under review, this would have high priority when assessing its cost-effectiveness.

FIGURE 36 AN EXAMPLE OF A PROJECT WITH INCREASED COST EFFECTIVENESS ON ALL CRITERIA

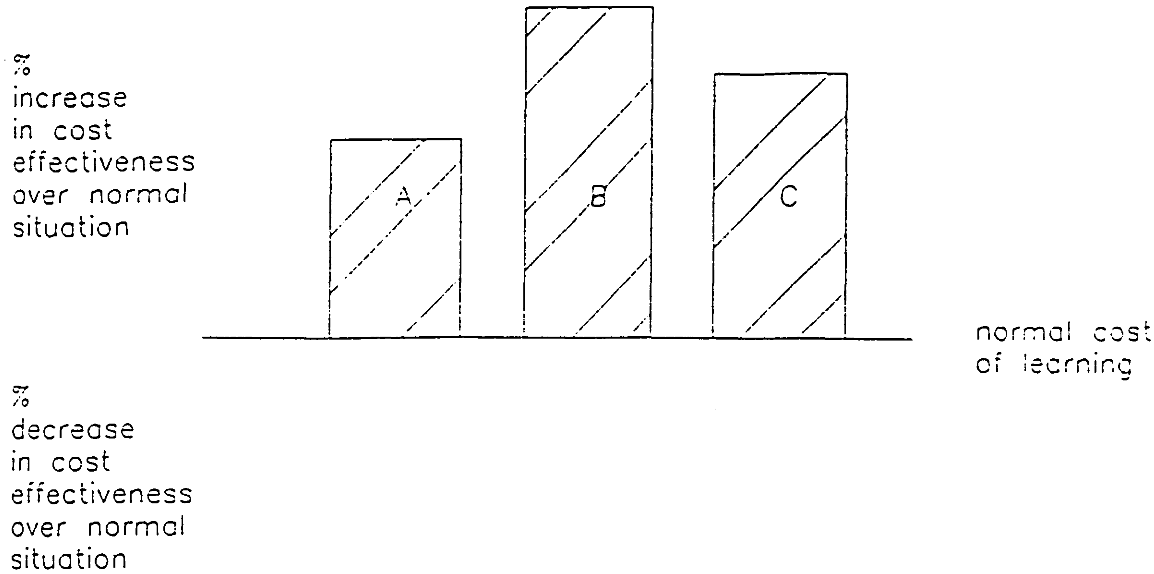
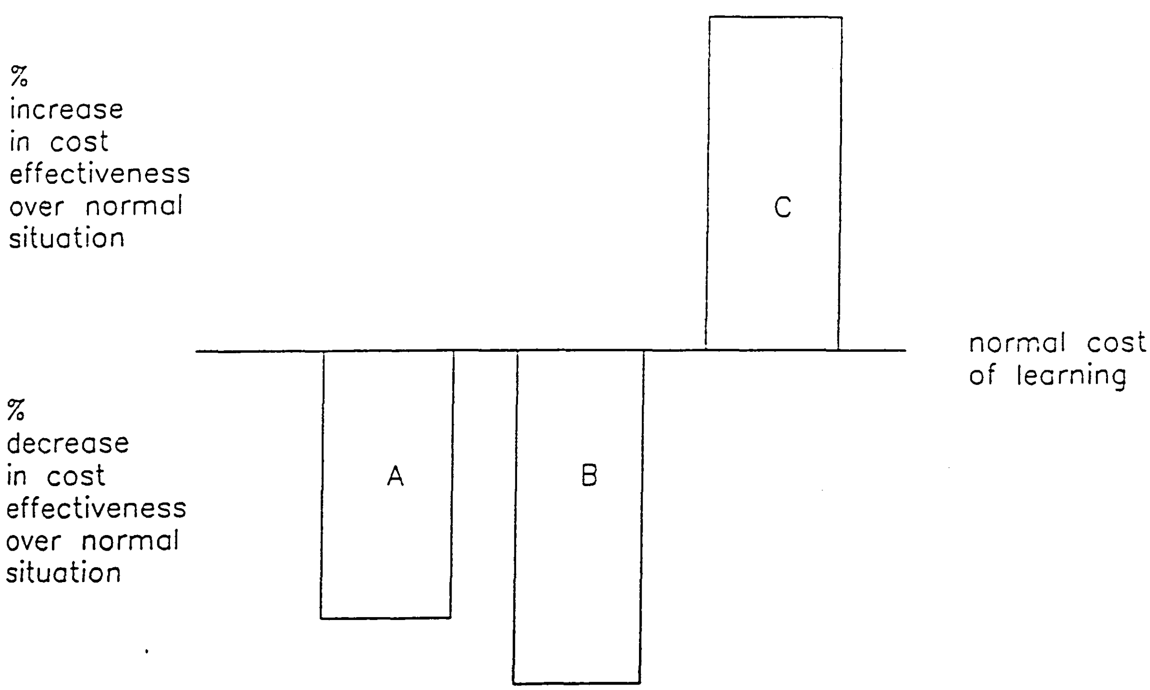


FIGURE 37 AN EXAMPLE OF A PROJECT WITH DECREASED COST EFFECTIVENESS ON MOST CRITERIA



Key to Figures 36 and 37

A = Competence of students (measured in units of competence)
B = Throughput of students
C = Time taken to cover course material

stand alone system   system plus tutor

Where an AI system was developed, the use of the system alone or with tutor support was another important variable.

Figures 36 and 37 give two illustrations of how the results from the evaluation of the projects could be finally represented.

The use of the tools in practice

As stated at the beginning of this chapter, not all the tools were used in the AI programme because of its early demise. Those that were used by the author and others involved in the AI programme were utilised with differing amounts of success. The taxonomy of variable determinants (see Appendix A) was found to be a useful way of deriving the interview schedules. It also made explicit, at the outset, the areas to be considered. In terms of the evaluation, the taxonomy was also used as a reference document to examine, analyse and collate the results. This information was then documented on the analysis matrices (see Appendix B) which were devised for this purpose. These provided a useful way of organising and summarising the data collected. However, in their original form, they contained too much detailed information for inclusion in the main body of a report. Thus, the material needed to be collapsed into overall areas of impact to be acceptable for reporting.

The pyramid model was used to highlight both areas of potential and actual impact. Unfortunately, very little actual impact and density were found in the Further and Higher Education sector thus limiting the scope of the pyramid models.

The refined (see Table 10, page 196) Awareness Index categories were used within the actual impact pyramids (see Figure 39, page 252) to indicate the awareness raised by the AI programme.

Cost effectiveness bars could not be used for the evaluation because of the lack of impact. Also, because of time constraints, the outputs from the projects were not sufficiently developed to make an objective evaluation of cost effectiveness.

For similar reasons, the total graph of impact was inappropriate for use with the AI programme because the programme ceased prior to the completion of all phases.

CHAPTER 5

THE FIELDWORK,

FINDINGS AND CONCLUSIONS

This chapter describes the fieldwork completed within this study. At the end of each of the different sections describing the fieldwork, the findings and conclusions have been documented. Finally, at the end of this chapter, the conclusions from each of the fieldwork components have been drawn together to highlight the critical success factors relating to the introduction and embedding of information technology in Further Education vocational education and training courses.

Fieldwork components

As described in Chapter 1 and illustrated in Figure 1 (see page 16) the fieldwork had four main components.

1. A casing exercise at national, regional and local levels.
2. The Sheffield survey: a survey of a sample of Further Education vocational education and training courses in the Sheffield LEA area conducted over the 1986/1987 period.
3. Three types of case studies:
   - two longitudinal case studies running concurrently with all other aspects of the study. These provided an in-depth look at change in practice from a top-down and a bottom-up perspective from 1986 to 1992
   - an implementation case study in which the CUSTOM system, developed as part of the AI applications to learning programme, was field trialled. This involved fourteen colleges who participated in the field trials in 1989/1990

- three positive one-shot case studies which had succeeded in embedding information technology into their Further Education vocational education and training courses. The data collected from these sites was mainly historical and much was from secondary sources. However, each of these cases was visited on at least one occasion.

4. Further Education sector data from the AI applications to learning programme. This was important because it broadened the scope of the study and included the Further Education census and follow-up survey. It also allowed the author to highlight other factors which were important when the government, through intervention, was trying to embed AI technology into the Further Education vocational education and training curriculum.

Alongside these components, as described in Chapter 3 and illustrated in Figure 32 (see page 180) there were five differing levels of investigation.

The primary focus of the fieldwork was at an institutional and individual course level. However, fieldwork at national, regional and local level, although mainly confined to the casing exercise, was used to follow-up the changes in governmental funding processes. These procedures continued throughout the study. The census and follow-up survey were conducted at an institutional level.

The case studies and Sheffield survey included both institutional and individual level data collection. However, in the main, the Sheffield survey concentrated on the collection and analysis of data at individual and course level.

The casing exercise

The casing exercise was conducted at national, regional and local levels. Its purpose was to determine how and at what level the remaining part of the study should be conducted.

The data collected from this exercise highlighted:

- the Sheffield survey sample and longitudinal case study sites
- the scope and nature of the overall data collection strategies and procedures, as perceived as being possible and feasible at this time in the study
- tactics for sample site and case study entry.

National level casing

Interviews were arranged and some secondary source documents were obtained from the DES, DoE, DTI and FEU. The complex gatekeeping system in the civil service meant that obtaining interviews with personnel in the top two sections of Sector B (see Figure 32, page 180, Government and relevant Secretary of State) was not possible. However, national government staff, involved in the development and implementation of government policy and funding initiatives relating to the introduction and embedding of information technology/AIT into Further Education vocational education and training, were interviewed. These included senior personnel from the:

- DTI, that is, the person who was responsible for their information technology initiatives
- DES, that is, the person who was responsible for ESG implementation
- DoE's Learning Technology Unit and Further Education Branch. Throughout the AI applications to learning programme, a series of interviews were conducted with staff from these DoE sections.
- FEU, including the Chief Officer and relevant FEU information technology development officers.

At this level, the interviews were exploratory. Thus, the type of interviews that Smith (1975) called non-directive were used with respondents. Using this type of interview ensured that the scope of the research would not be limited by the knowledge and perception of the author at this time.

From these investigations, national level departments, bodies and agencies were found to act as external change agents. The initiatives were administered:

- **directly**, that is, where the government department or agency was directly involved in the execution of the funding, for example FEU/DoE projects
- **indirectly**, as *arms length* policy (HM Treasury, 1988), where the administration was handled through some other responsible person or organisation.

By their very nature, national level initiatives and influence, whether direct or indirect, used what has been described as *interventionist* (Argyris, 1973 and Bolam, 1986) or *legislated (or administered) change* (Havelock, 1982) strategies. Strategies of this type aimed to bring about change in education by providing direct or indirect funding. Most national initiatives and projects were administered through specific grant mechanisms e.g. ESG, WRNAFE and LEATGS.

Government papers specifically relating to the introduction of information technology in Further Education vocational education and training have already been identified and described in the literature review. From the fieldwork the most beneficial initiatives for the introduction and embedding of information technology into Further Education vocational education and training courses were:

- the ESG (latterly under GEST) funded by the DES from 1984 to 1992
- under ESG, the setting up of Regional Centres for the development and dissemination of information technology courseware and staff development
- from the 1984 White Paper (Training for Jobs), in 1985/86, the DoE were awarded 25% of NAFE funding to *pump prime* areas considered to be of *priority importance,* one of which was information technology .
- Grant Related In-service Training (GRIST latterly LEATGS) funding was available for training on, and about information technology. For example, many lecturers who attended the 5th Generation Computing Conferences initiated by Kingston College/FEU (Goodman and Holt, 1987) were funded from GRIST.

At national level, some research on information technology and AIT was also being commissioned by the FEU (which was mainly funded by the DES). Two examples relevant to this study were:

- a survey of twenty colleges which highlighted the variables affecting information technology in survey institutions (FEU, 1984a)
- a staff development model for the introduction of information technology to Further Education lecturers (FEU, 1985a).

Joint ventures (where the projects were commissioned by the FEU but funded by the DoE) included two projects investigating the use of Expert Systems in Further Education and industrial training environments. These were completed at Kingston (upon Thames) College (Briggs, 1987 and French and Walker, 1987) and were used as part of one of this study's longitudinal case studies.

Examination body casing

Casing the examination bodies involved desk research using the 1984 Education Year book to identify all existing examination bodies that might provide Further Education vocational education and training awards. A telephone survey was then conducted to establish the information technology policies and philosophies of the awarding bodies plus any examinations that might contain an information technology component. The documents received from the examining bodies were analysed.

As highlighted in Figure 32 (see page 180), at the outset of this study, examining bodies existed at both national [e.g. Business and Technician Education Council (BTEC), City and Guilds (CGls) and Royal Society of Arts (RSA)] and regional levels (i.e. the six regional examining bodies e.g. East Midlands Further Education Council).

At the beginning of the study, all of the examining bodies had specific information technology-related course components and courses. Some of these were integrated into the Further Education vocational education and training syllabuses whilst others comprised bolt-on units devoted to information technology awareness or use.

By the end of the study and with the emphasis of the government funding being placed on the use of competence based NVQs (NCVQ, 1993 and Jessop, 1991), many of the regional examining bodies have been amalgamated into the national awarding body system. Also, an information technology lead body, the information technology industry training organisation (ITITO) for the development and accreditation of NVQs for information technology has been established (DoE's, 1993a). The qualifications which have, and are being developed under, the NCVQ structure will eventually cover all Further Education vocational education and training courses and content.

Regional level casing

The regional level casing investigation was inter-related with the local and institutional level casing, because, although regional boundaries were used to define the scope of the exercise, the work conducted was at Local Education Authority (LEA) level and institutional level.

Resources and time constraints restricted the regional and local level field study. Preliminary investigations indicated that going into the field to study the information technology policies and provision for all regions/LEAs was not feasible. Therefore, the local level investigation focused on the Further Education vocational education and training provision for all LEAs in the South Yorkshire and Humberside region. Also, it was not possible within this study to investigate fully the *typicality* of South Yorkshire and Humberside in relation to other regions. However, in the casing exercise, the different County Council areas were examined and compared with South Yorkshire and Humberside using the 1984 Education Year Book and information received from the examining bodies. From the casing exercise, South Yorkshire and Humberside was found to:

- cover both urban and rural areas, although there were many large urban areas
- have a large component of mining areas and therefore mining courses

- have its own Regional examining council which was formed in 1982 (Yorkshire and Humberside Council for Further Education which now includes Higher Education)
- cover a typical range of national Further Education vocational education and training examinations.

The use of a different region was not an option because the original funding for the study, a LEA/Sheffield Hallam University research grant, specified South Yorkshire and Humberside as its research area.

However, from the limited casing investigation, because of the diversity of the different regions, South Yorkshire and Humberside was found to be as typical as any other might have been for the initial survey.

The regional casing exercise had three components:

- an examination and analysis of the LEAs' Further Education Statistical Returns for South Yorkshire (1984/85) and other appropriate documentation. This was completed to ascertain the typicality of Sheffield in terms of numbers, levels and male / female ratio of students
- a study of other secondary source material relating to the information technology content for the Further Education vocational education and training courses in South Yorkshire and Humberside, including BTEC. Information from BTEC regarding their *Centres Approved to Offer National Awards under Regulations applying to Computing and Information Systems courses 1984/85* revealed that, of the twenty two approved centres, five resided in Humberside and one in South Yorkshire
- study of, and a visit to, the ESG Regional Development Centre (RDC) for information technology.

Part of the regional level casing included the collection and analysis of all prospectuses from South Yorkshire and Humberside colleges. A detailed content analysis of the prospectuses was undertaken to establish the type and level of courses offered.

The findings from this part of the casing study revealed that:

- only six college prospectuses indicated information technology content of specific courses
- many BTEC courses offered some information technology units but it was not clear whether these were compulsory
- the subject areas with a large information technology component were Business Studies, Engineering (especially electrical), Maths, Science and Secretarial skills
- most colleges offered specific computer courses.

As stated above, the regional level casing also included a visit to, and interviews with, the joint project leaders of the regional ESG centre at Kirklees. This centre was one of nineteen established under the ESG in 1985 to:

> *assist authorities in providing, for students studying vocational subjects, courses which take account of the increasing use of information technology in the world of work, and in enabling teachers in a range of subjects - not just those associated with computing technology - to become sufficiently knowledgeable and skilled to take account of this in their teaching*
>
> DES (1985)

Eleven LEAs were covered by this centre: Barnsley, Bradford, Calderdale, Doncaster, Humberside, Kirklees, Leeds, North Yorkshire, Rotherham, Sheffield and Wakefield. Originally these were to have a life of at least three years. In the event they continued as staff development centres until March 1990 (NCET, 1991).

The main aims of the Kirklees RDC, as required by the DES and specified in their documentation, were to:

- respond to the information technology needs of the region
- identify expertise in colleges and LEAs in the region
- develop and present information technology courses
- act as an information bureau
- collaborate with other colleges/LEAs to develop courseware
- supervise the initial use of courseware.

In 1986 Kirklees RDC found that:

- the LEAs had no *pressing needs* for information technology support
- information technology expertise in the region had not been identified
- some paper-based support materials were being developed
- staff development activities were being devised around the need for motivation, through:
  - an introductory staff development package (using the Leeds College of Building/FEU package as a basis for this development)
  - applications within subject areas
  - updating for knowledge and experience
- there was little difference between the LEAs within the RDC's remit
- most of the work was centred around the Kirklees area.

Local level casing: the Sheffield LEA area

As previously indicated, the ESG funded LEAs for hardware, software development and staff development.

Before finally accepting Sheffield as an appropriate research area, an analysis of the Sheffield college and student populations was conducted to establish if the area could be considered representative of the whole of South Yorkshire and Humberside.

From the desk research, Sheffield was found to be representative in terms of numbers of students, ratios of male to female students and the subject areas covered. Indeed, the only subject not catered for in Sheffield was mining which was rejected as a research subject because of its specific geographical connections.

The only reservation about the use of Sheffield for the fieldwork was the specific vocational bias of the colleges. At the time of the study (two college reorganisations have taken place since the initial fieldwork), the colleges differed fundamentally in their student intake and special care was needed when the sample was being selected. The presence of uncontrolled confounding variables, if unchecked, might have led to a systematic bias within the sample institutions, thus weakening the external validity of the findings (that is, the degree to which one can generalise to other Further Education colleges). However, the identification of a **typical college**, should one exist, would be very difficult given the historical development and the influence of national and local government politics and policy on most colleges.

After selecting Sheffield as the research area, further casing was completed to identify the course and student sample. Firstly, an analysis of the type and overall student populations for each of the Sheffield colleges was conducted to establish their suitability as a research sample. Secondly, in order to assess the feasibility of using only full-time 16-19 year old students, an analysis of the full-time 16-19 year vocational education and training student population was undertaken.

From the data collected, a heterogeneous purposive sample was found to be the most appropriate for the study. The variable dimensions used to select the sample courses were:

- the gender split
- the amount of information technology in the course
- the level of the course i.e. low level (e.g. City and Guilds and YHCFE) and high level (e.g. BTEC).

Table 11 outlines the research sample derived from the casing study. It also shows the reasons for the sample selection. As one can see, four colleges were used and five vocational areas of study were identified from the casing exercise.

At the time of the study the colleges functioned as separate entities but two major reviews and reorganisations have taken place over the period of this study.

Firstly, the colleges in Sheffield were reorganised but remained separate entities. At this time, the policy of the LEA was to provide community education, therefore the number of colleges increased so that the Sheffield community had easy access to the Further Education provision. The names of the colleges and the provision offered by them changed. This was undertaken to break the association of specific colleges with their previous vocational areas.

Secondly, in 1992, the separate colleges became one entity, headed by a single Principal. At this stage the differing colleges became Centres of the Sheffield College.

TABLE 11

PROPOSED SHEFFIELD SURVEY SAMPLE WITH VARIABLE DIMENSIONS

College	Course	Reason for selection
Shirecliffe (now Parklands Centre)	Construction	Predicted male population over 90%* Medium / low IT component Low level courses
Stannington (now Loxley Centre)	Engineering & Electronics	Predicted male population over 90%* High IT component High level courses
Granville (now Castle Centre)	Hotel Reception & Catering	Predicted male population 33%* Variable use of IT High & low level
Richmond (now Norton Centre)	Business Studies	Predicted male population 33%* High IT component High level courses
	Secretarial	Predicted male population under 10%* High / medium IT component High & low level courses

* Prediction made from the 1984/85 Further Education Statistical Return figures.

The final stage of the casing exercise involved establishing the *tactics* (Schatzman and Strauss, 1973) for negotiating and gaining entry into the sample institutions and courses.

This investigation was long and protracted. It revealed a multiplicity of gatekeepers. The bureaucracy through which one had to go to gain access extended from LEA officers, through the Principalship, to heads of department, heads of courses and finally to the lecturers responsible for teaching the sample courses and their information technology components.

Institutional and individual level casing

The results from the national, regional and local level casing revealed that the Further Education vocational education and training structure and courses were similar to those for which the author had in-depth knowledge and experience. The author's background, experience and career as an Further Education lecturer across all vocational areas of a large tertiary college was sufficient at this stage to devise suitable and feasible research tactics for the main study without need for casing at these levels.

Conclusions from the casing exercise

Given the resources available and Sheffield LEA's typicality in terms of course provision and student population in relation to the rest of the South Yorkshire and Humberside, Sheffield LEA was accepted as a suitable research setting for the in-depth survey of a purposive sample of Further Education vocational education and training courses.

However, it was noted that the study needed some other colleges where information technology had been successfully introduced into their vocational education and training curriculum, plus some other areas of investigation that would allow the study to extend outside the Sheffield LEA area. Initially, two case studies were identified:

- Kingston-upon-Thames College of Further Education from the national casing
- Castle Centre of Sheffield college (formerly Granville college) from the local level casing.

These two studies comprised the longitudinal case studies.

The Sheffield survey

The Sheffield survey was mainly at the individual course level. However, it did include some work at a local and institutional level.

Local level investigation

At local level, a non-directive interview with the Sheffield LEA information technology adviser was conducted. This established the LEA policy and funding regarding the introduction of information technology into Further Education vocational education and training courses.

According to the LEA information technology adviser, the main thrust of the £200,000 Sheffield bid for 1985/86, was *seeking to upgrade the computer facility on a network for CAL work.* Sheffield was guaranteed £150,000 in 1985/86 with indicative money of £110,000 given for 1986/87.

The impact of ESG funding in Sheffield

The procurement of ESG information technology in Further Education funding necessitated co-ordination between colleges and liaison with the LEA. The dispersal of funds was agreed at a meeting of college representatives. Each college was allotted £25,000 for hardware and £5,000 for staff and courseware development. The dispersal of this funding was investigated at an institutional level. Each college selected a representative who was responsible for the allocation of the funds in accordance with Sheffield LEA and ESG policies. The rules for the allocation of the money at the college level were that:

- the computer equipment purchased (although different because of differing college needs) had to be linked to a network so that eventually all colleges could be part of networked system
- there was to be a notional split of £3,000 for staff development and £2,000 for courseware development
- staff development could include staff release to develop courseware

- courseware development could include the purchase of ready-made courseware to be adapted by lecturers.

The advantages of ESG funding were that:

- the amount of money would never have been allocated from the Rates Support Grant specifically for the introduction of information technology in Further Education vocational education and training courses
- the way in which the funds were dispersed through the DES, that is, definite and indicative funding based on an information technology plan at LEA level, ensured that money was spent on information technology, without it being diluted at local or college level.

The disadvantages were seen to be:

- national government not being sufficiently informed, for example, a local authority might have an urgent need to fund a housing programme rather than the embedding of information technology in Further Education vocational education and training courses
- that rate-capped authorities had to find more than 30% funding which could have prevented some LEAs from participating. According to the LEA interviewee, it was a close decision whether Sheffield should tender for the funding because of the LEA's contribution.

ESG funding had a substantial effect on the introduction of information technology into the Further Education vocational education and training curriculum in Sheffield colleges:

- the institutional investigation showed that the hardware funding was used to upgrade the college computers in all cases
- the staff and courseware funding was used in different ways depending on the person in charge of the funds.

At one end of the continuum, where the funds were placed in the hands of a computer department lecturer, the policy for dispersal was to enhance the knowledge of the computer department staff. Funding was given exclusively for attendance at courses which would further the knowledge and programming skills of the computing lecturers. The reason given for this decision was that, if other lecturers learned to use the computers more effectively, the college would not have the computers to resource the lecturers' and student needs. At the other end of the continuum, one college insisted that all staff underwent staff development on the use of computers. This, according to the person in charge, brought with it its own difficulties when lecturers who did not want to learn about computers were forced into attending such courses.

The sample courses

Following the initial interviews with key college personnel, the final choice of courses was made based on the criteria outlined in Table 11 (see page 212). Time constraints did not allow investigation of computer courses within the first year of the study but these were included in the second year.

Table 12 shows the courses researched. Wherever possible:

- equivalent courses at high and low levels were studied
- for two year courses, the field investigation covered both years of the course.

Interviews with college staff

Interviews were conducted with the following course and college staff:

- college Principals
- heads of department (and deputy, where possible) from the sample colleges who were responsible for the courses under review
- lecturers in charge of the sample courses
- lecturers who taught any information technology-related subjects within the sample courses.

Initially, the interviews with college staff were non-directive to allow the interviewees to express their own ideas, thoughts and feelings on the subject. As the research progressed, semi-structured interviews were developed and used to facilitate the exploration of areas highlighted by the initial contacts. Within the semi-structured interviews there was, however, always scope for interviewee intervention to identify new areas which were of potential interest and influence to the research.

TABLE 12 COURSES RESEARCHED IN SHEFFIELD SURVEY

College	High level courses	Low level course
Richmond (now Norton Centre)	BTEC National Diploma in Business and Finance 1st & 2nd year Private Secretaries with Business Studies 'A' level 1st & 2nd year * BTEC National Diploma in Computer Studies 1st & 2nd year	Private Secretaries 1 year course
Stannington (now Loxley Centre)	BTEC Mechanical and Production Engineering Diploma 1st & 2nd year	
Shirecliffe (now Parklands Centre)	* BTEC National Diploma in Computer Studies 1st & 2nd year	Signwriters - City & Guilds 1st & 2nd year Carpentry & Joinery- City & Guilds 1 year course * City & Guilds 418 - Certificate in Computer Programming and Information Processing 1 year course
Granville (now Castle Centre)	BTEC Certificate in Front Office Operations and Accommodations Services 2nd year only (no 1st year) BTEC Diploma in General Catering 1st & 2nd year	Hotel Reception and Book keeping City and Guilds 1 year course (this course was not operational for the 2nd year of the study) * City and Guilds 726 Introductory Certificate in Information Technology Modular - time length variable

* = researched in the second year of the study only

The following interviews were conducted with senior members of staff:

- two face-to-face interviews with college Principals
- one telephone interview with a college Principal
- one face-to-face interview with an assistant Principal
- two face-to-face interviews with heads of department
- one face-to-face interview with a deputy head of department.

One college Principal declined to be interviewed. Other departmental heads gave permission but passed the responsibility to specific lecturers.

Over the two year period, twenty four interviews with lecturers were conducted. Eighteen lecturers were interviewed in the first year with follow-up interviews in the second. Six further Computer Studies lecturers were interviewed in the second year of the study.

Student contact

Three methods were used for the collection of data from students within the sample courses.

1. Student interviews

For each sample course, at least two students were interviewed over the research period. Semi-structured interviews were used to help the less able students verbalise their thoughts. In all, seventy seven students were interviewed, twenty nine in the first year and forty eight in the second.

In the first year, the sample of students interviewed was dependent on the availability of students and the access permitted by lecturers. Some allowed the whole of the class to be interviewed (for example, the Private Secretaries course with eight students), but, in the main, only two or three students could be interviewed from each of the sample courses in the first year.

In the second year of the study, a random sample of four students was selected from each second year group of the sample courses. With the computer courses (as they had not been included in the first year and were of specific importance to the study), four students from each year of the course were interviewed.

In what we called **special case groups**, i.e. male or female dominated subject groups, any students of the opposite gender were purposely selected within the sample population of four students. Consequently, in these cases a true random sample was not used. Also, for the observation group, all students were interviewed.

2. Student observation

Unstructured open observation of classroom practices was undertaken with all sample courses for at least one session when the students were using computers. This allowed qualitative data about information technology in use to be collected.

In the second year of the study, an extended period of observation was included for the BTEC Certificate in Front Office Operations and Accommodations Services and the BTEC Diploma in General Catering. These two courses were from the same vocational discipline and included the same information technology content taught by the same lecturer. The second year students for these two courses were observed for four to six weeks and all students were interviewed.

3. Student questionnaire

Due to limited time and access to students, an explanatory / descriptive self-completion questionnaire for groups of students was incorporated as part of the research strategy. This allowed data to be collected from a larger sample than could otherwise have been covered by interview. The content of the questionnaire reflected that of the student semi-structured interviews which were conducted with a sample of students from particular groups in the overall sample.

The questionnaire was piloted during the first year and at the beginning of the second year of the study.

The questionnaire was administered to groups of students within their normal lecture time. Overall 271 students completed the questionnaire, 107 females and 164 males. Table 13 shows the number of respondents from the various subject areas.

TABLE 13 STUDENT QUESTIONNAIRE RESPONSES

Courses	Number of respondents
Hotel and Catering	54
Engineering	41
Secretarial/Business Studies	55
Signwriters	25
Carpentry and Joinery	25
IT/Computer Studies	70

(1 missing case)

Results of the institutional and individual level study

The Sheffield survey generated a vast amount of data. The results obtained from the various data collection methods were collated and analysed as a collective enterprise. The major findings from this survey have been summarised below and were instrumental in the development of the FAIIT model (see page 286).

College and course staff interviews

From the primary and secondary source data and the observation of classroom practices, the following was observed either verbally, through documents and / or through observation in practice.

1. Access to computers

Across all colleges where information technology was relevant to the industry / or vocation discipline, more money was being invested on specific information technology equipment, for example with Secretarial and Engineering courses.
There was one notable exception: the Principal at one college had been instrumental in the purchase of a Graphix computer specifically for the Signwriting course. This, according to the lecturer, was useful to students as well as promoting the use of the technology in industry when students on the course were employed. This computer has now been updated through the efforts of the lecturer who won the £23,000 computer for the college in 1993. Since becoming a Centre of the Sheffield College, there has been a move to place this new signwriting computer in the Computer Department and the signwriting lecturer is now fighting to prevent this move.
In colleges where lecturers had to book the use of computer facilities, it was more difficult for the lecturers of subjects where information technology was not seen as a priority to gain access. The facilities were usually block-booked by high information technology courses.
Departmental computing equipment was usually associated with high information technology courses. An exception to this was the Hotel and Catering courses at Castle college. However, the computers available were those that had been discarded by the computer department.

2. Course content

The industrial/commercial orientation of the course usually prescribed the type of information technology studied. Thus, for those areas where information technology was not seen as being relevant to industry needs, little to no information technology was contained in the course. For example, in the Carpentry and Joinery course, it was believed that students would only use computers if working for a large company which might use computers for the production of windows. Information technology-related industrial links were mainly found in Computing, Electronic, Engineering and

Secretarial courses. Other areas where industrial information technology links were found included Signwriting and part of the Hotel Reception courses. This, however, was due to lecturer commitment and Principalship support.

Across all vocational areas, staff agreed that:

> *the only way all lecturers will become involved and see the potential of computers is if examining bodies incorporate it into every syllabus.*

Even in areas which were not traditionally information technology oriented (for example, Carpentry and Joinery), it was agreed by the majority of staff that presence on an examination syllabuses was the best way to ensure the introduction of information technology into the course. Indeed, when visiting the college that had just received instructions from City and Guilds that information technology had to be included into their wood related syllabi, a previously computer illiterate lecturer commented: *I suppose I'll have to learn about it now.* This was further ratified by the Head of Department and lecturer who was responsible for the courses stating: *that means we'll have to teach information technology now.*

BASIC programming, although included in many courses, was found to be difficult especially in areas such as Hotel Reception, Catering and Secretarial subjects where students could not see the relevance of such work for their future careers.

The amount of time allowed for tuition positively correlated with the perceived need for information technology within the vocational area.

3. Staff development

Staff development for information technology was mainly funded through the ESG. Although under ESG funding it was necessary for every LEA to have a central policy and plan, the staff development offered differed from college to college. The differences were found to be in:

- **access**. One college where the funding was held by the computer department only allowed computer staff access to funds for staff development. At another college, all staff were compelled to attend a course of staff development for one and a half hour a week for a term

- the **time allowed for study**. This was either in set periods of time or flexible
- the **content**, for example, at one college it was formalised, at another it was flexible. At one college, the Principal had purchased a computer for each staff room some years earlier, in the belief that the presence of a computer would lead some lecturers to learn how to use them and this would cascade down to others within the department.

Staff development was said to be lacking or inappropriate to the needs of low information technology course lecturers. Staff perceived a bias towards certain lecturers, for example, Engineering and Secretarial staff.

4. Future use of information technology

Staff perceived the future use and introduction of information technology to require:

- more software developments by lecturers
- greater information technology content and integration into Further Education vocational education and training courses and administration
- the purchase of more hardware and specific software.

5. Previous experience of students as noted by staff

Some students had little prior exposure to information technology, for example, Construction trades and Secretarial students. Others had extensive prior knowledge, for example, Engineering students.

Previous information technology learning experiences often produced negative attitudes towards information technology, for example, the teaching of theoretical aspects first or the incorporation of programming into areas where it was seen as irrelevant, as in BASIC programming for Hotel and Catering students.

6. Lecturer motivation and incentives

Positive attitudes and motivation from lecturers towards information technology was found in the following:

- many lecturers were funding themselves to attend information technology courses of all types and at all levels
- in all subject areas investigated, some lecturers were prepared to give their own time to learn about and introduce information technology into their teaching
- lecturers themselves were writing relevant vocational programs, for example, a roofing program and a program to give BTEC Electronics students a visual representation which would help them better understand the concepts involved in the programming of silicon chips
- some appropriate assignments and adaptations of software packages were being prepared by lecturers.

Demotivating factors cited by staff included:

- lack of time and interest by lecturers to learn about information technology
- information technology not being held in high esteem in most vocational areas. Therefore, as information technology was not seen to enhance promotion prospects except in the leading edge technology areas, it was found to be low on the list of lecturer priorities
- hardware soon becoming *out dated*
- hardware, in some cases being inappropriate and expensive.

Student data collection

The main findings from the student interviews, observation and questionnaires split into seven areas.

1. Students' thoughts and feelings about computers

The collection of data regarding the thoughts and feelings of students about computers, although being derived from all sources, was mainly taken from the questionnaire data and comments from observation and group discussions.

Table 14 summarises the analysis of the comments made by students about their thoughts and feelings towards computers. This analysis is mainly derived from the self completion questionnaire data. To ensure concurrent validity, the data was compared with the data collected from other sources.

The question used for the responses shown in Table 14 was open ended. It was analysed using the **verbatim counting technique** developed and used by the author for the analysis of the AI conference questionnaires (Goodman and Holt, 1987) and has been used for the analysis of qualitative response in all evaluation projects undertaken by the author since.

The **verbatim counting technique** is a data driven process which allows for the quantification of qualitative data. The process involves the analyser taking each verbatim comment (that is, each individual comment and not the whole response, as there might be several comments in an individual's response) made by one respondent and counting how many other comments reflect the same idea, thought etc. This technique, although used for qualitative questionnaire data analysis at a micro level, is similar to the idea of *grounded categories* used by Saunders (1986) for the *interpretative analysis* of tape transcripts from the TVEI interviews.

As one can see from Table 14, some differences were found between vocational subject areas. The results cited below are based on the proportionate number of comments, that is, based on the total number of respondents in the category and the number of comments made under a specific heading:

- across all vocational areas computers were seen to be helpful/useful. This comment was most often supported by the Engineers
- overall more positive comments than negative ones were accrued from Computer Studies students

TABLE 14

ANALYSIS OF QUALITATIVE RESPONSES ABOUT COMPUTERS

Comment made	Hotel & Catering	Engineering	Signwriters	Carpentry & Joinery	Secretarial & Business Studies	Computing
Positive						
Helpful/useful in industry & society	11	25	12	9	27	12
Like/enjoy/ find interesting	12	4	0	2	5	20
Time saving	3	2	6	1	8	1
Educational	0	7	0	0	0	5
Fun/play games	1	2	1	2	0	7
Good for the future	0	3	0	0	6	10
Easy to use	0	3	0	0	3	0
Qualifications	0	0	0	0	0	2
Negative						
Not liked	12	1	3	2	5	0
Hard to use	9	5	0	2	7	0
Boring	8	5	1	1	0	0
Put people out of work	5	1	3	2	0	0
Not useful at present	4	0	0	0	0	0
Overrated	0	4	0	0	0	4
College computing not good	5	0	0	0	0	0
Frightening	1	0	0	0	1	0

- Hotel and Catering students made both positive and negative comments
- computers for educational purposes were only cited by Engineering and Computer Studies students
- comments about the future usefulness of computers to students were mainly made by the high technology users: Engineers; Secretarial and Business Studies and Computer Studies students
- most students across all subject areas recognised that computers were important to their industry, although some students feared that this would lead to a loss of jobs. The latter was not the case for Business Studies / Secretarial and Computer Studies students
- only the Hotel and Catering students commented that computers were not relevant to their present needs. However, in consulting other sources, the most negative feelings towards computers were mainly found in the Hotel Reception courses. These students found their course computer work difficult to understand, except when using computers specifically designed for hotel bookings. An important variable with these groups was the nature of the content of the college computing. The main focus of the computing lay in the teaching of BASIC programming skills which students felt were inappropriate to their needs
- the perceptions of students that *computer people* had to be *clever people with a wide knowledge of and skills in using computers* were found from Hotel and Catering students (3 comments); Engineering students (8 comments) and the Signwriters (3 comments). The Computer Studies students refuted this believing *computer people* to be *ordinary people*.

2. Main reason for using computers

Using quantitative data from the questionnaire feedback which had been subjected to statistical analysis using SPSSX, the main reasons that students used computers were found to be:

- enjoyment (63% responses)
- future career (60% responses)
- to gain qualifications (49% responses)
- to help with work (39% responses).

40% of respondents felt that computers would make work more interesting, 52% were ambivalent and only 5% felt that computers would make work less interesting. There was an almost even split between those student respondents who had been encouraged to use computers at home (52%) and those who had not been encouraged to use computers (47%).

Although fear of computers was not often cited in the questionnaire responses, this problem was raised in interviews and in discussions with students when observing them in practice. This was particularly the case with Secretarial and Hotel and Catering students. The initial fear, according to students, did subside with experience. In some cases, it turned to *hate* for students who were having particular difficulties with the computer component of their course. This was especially so with the Hotel and Catering students.

3. Future needs of students

In the main, students believed that most of the computing included in the courses did reflect their future needs. From the questionnaire analysis, 51% of respondents believed the computer content of the course to be *right.* Alongside this, 35% of respondents believed that they had too little computer content in their courses.

In a closed-ended question which asked students how often they believed they would use computers at work (3% did not respond):

- 9% responded never
- 26% occasionally
- 33% some of the time
- 23% a lot of the time
- 6% ticked all of the time.

4. Previous knowledge and experience of computers

The main source of previous computing experience for students was *at home*. On average, twice as many students had used computers at home compared with use at school. Significant others involved with computers were mainly family members, particularly brothers and sisters.

The most common age for students beginning to use computers was thirteen/fourteen years for boys (38%) and fifteen/sixteen years for girls (27%). Table 15 shows a breakdown by gender and age group.

The main type of previous experience at both school and home was computer programming (75%) with 33% having programmed at school, 14% at home and 28% at both school and home.

57% of students had used a computer for information processing: 35% at home, 11% at school and 11% at both school and home.

54% of students had used a computer for word-processing. Again the majority of these had used a computer for this function at home (32%), 15% had completed word-processing exercises at school and 7% had used a computer for this function both at home and at school.

66% of respondents did not complete Computer Studies as an examination option at school. Of the 34% remaining, 10% had gained a CSE pass and 17% had gained a GCE pass.

TABLE 15 BEGINNING AGE FOR USE OF COMPUTERS

Age group	Number of respondents beginning to use computers		
	Males	Females	Both
Below 7	1 (< 1%)	0	1 (< 1%)
7/8 years	0	1 (< 1%)	1 (< 1%)
9/10 years	9 (5%)	2 (2%)	11 (4%)
11/12 years	39 (24%)	11 (10%)	50 (19%)
13/14 years	62 (38%)	26 (24%)	88 (33%)
15/16 years	20 (12%)	29 (27%)	49 (18%)
17/18 years	5 (3%)	13 (12%)	18 (7%)
+ 18 years	18 (11%)	19 (18%)	37 (14%)
Missing	10 (6%)	6 (6%)	16 (6%)

As the students' previous computer knowledge expanded, lecturers were having to change their syllabuses to maintain student motivation. This was found to be particularly so with the Engineering courses studied.

5. Perceptions of school computing

School computing was found, in the main, to have a mathematical bias. This was especially the case for the 'O' level computing syllabus which was, at the time, based on the writing of mathematical programs. This bias often led students to believe they could not operate a computer if they were *not good at maths.*

Unfortunately, this was reaffirmed for some Hotel and Catering students who had to devise a form which would calculate an electricity bill after being taught BASIC programming. The difficulties encountered (on observation of two groups of students) were not due the programming itself but understanding the mathematical concepts underpinning the programming activities.

All but six of the interviewees thought that computers should be introduced into schools at an early age.

6. Gender issues

The gender bias found in schools (that is, boys liking and choosing computing more than girls) was also found in Further Education vocational education and training. Very few women enrolled on the computer courses studied. The only information technology course well subscribed by women was the City and Guilds 726 which was modular and office oriented.

Little difference was found between the family encouragement given to male (53% encouraged and 45% not) and female students (50% encouraged and 48% not) across all vocational disciplines.

Consistently 11% more females gained their computer experience exclusively at home. On the other hand, more males were found to use computers across both school and home. This was particularly the case for programming where 40% boys had experience at home and school whereas only 9% of girl had this dual experience. 30% females compared with 14% males said they had only used a computer since being 17 years of age. Indeed, males consistently started using computers at an earlier age than girls (see Table 15).

The number males achieving a GCE pass (27%) was much higher than females (2%). However, no difference was found between males and females taking CSE (both 10%).

7. Creative use of computers

Although not included in the questionnaire one unique difference between vocational areas came from the Electronics and Engineering students. Over 50% of the Electronic and Engineering students interviewed cited robots as a common feature in the future of computers whereas in other vocational areas no students cited this.

The case studies

As documented previously three types of case studies were involved in this research: two longitudinal case studies, the CUSTOM implementation case study and three one-shot case studies.

The longitudinal case studies

The two longitudinal case studies were identified when the casing exercise was being undertaken. The reasons for using a longitudinal approach were to:

- study change in practice over time
- identify the forces and factors which may influence the change adoption process. From this the driving and restraining forces and critical success factors could be outlined
- establish a set of indicators for central funding bodies to better focus money on the processes and procedures more likely to facilitate the adoption and embedding (or institutionalisation, as Miles, 1983 and Holly, 1986 call embedding) of information technology and AIT across the Further Education vocational education and training curriculum.

The two colleges: Kingston-upon-Thames College of Further Education and Castle (formerly Granville) College were chosen because they:

- both had a key person (named a *technological entrepreneur* or *project champion* by Twiss, 1986) to lead the introduction and embedding of information technology and AIT into the vocational education and training curriculum and were therefore uniquely positioned to be major case studies for this investigation
- were both recipients of governmental funding, thus allowing the interventionists' (Argrys, 1973; Cuthbert and Pike, 1987 and Havelock, 1982) approach to governmental funding to be evaluated

- were using very different approaches and strategies to bring about curriculum change to facilitate the embedding of information technology / AIT across the Further Education vocational education and training curriculum. Kingston used a top-down approach and Castle a bottom-up approach.

The Kingston-upon- Thames College case study

The Kingston College case study was selected because it represented a top-down or proculturation approach (Holly and Wideen, 1986) to the embedding of information technology/AIT in the Further Education vocational education and training curriculum. The driving force or the project champion at Kingston college was the Principal who insisted that information technology should be offered to all staff and students.

The methods used in this case study included:

- a yearly interview (from 1986 to 1991) with the Principal
- interviews with staff of the Information Technology Development Unit (ITDU), the unit set up by the Principal to ensure the embedding of information technology and particularly AIT across all college courses
- interviews with other key stakeholders (for example, the FEU and the DoE project managers) at differing times throughout the study
- observation of the ITDU whilst undertaking development work, at conferences, with groups of Further Education vocational education and training students, and at staff development courses as part of the national centre, with in-service teachers
- desk research using historical and current government and other documents relating to the college.

The historical perspective of the Kingston College case study

The Principal, joining the college early in the 1980s, had a particular philosophy about the need to embed information technology/AIT into the Further Education vocational education and training curriculum. He was committed to the use of information technology across all vocational education and training courses and believed that the development of the new *knowledge processing* (Ennals and Cotterell, 1985 and Cotterell et al, 1988) expert systems software was going to revolutionise information technology, making it easily accessible to all Further Education staff and students. His philosophy was founded on the assumption that:

> *you'll never get information technology into vocational education and training courses if you leave it in the hands of the computer department.*

This assumption was based on negative previous experience in his former position as the Vice Principal of a college where he:

> *had seen all the resources for computers go into the Computer Studies Department which meant that other departments' budgets were reduced, causing ill feeling between departments and, because the computers were in the computer department, lecturers and students from other departments could not use them. This prevented the expansion of information technology across the college.*

At this point, he was determined that, should be become a Principal, he would not allow the power and resources for computers to be held in the hands of one department (particularly a Computer Department) at the expense of others. To this end, he developed a model which would eradicate the practice. The model was based on the establishment of a self-supporting unit that would operate *independently* of other departments and be dedicated to staff and student development and support in information technology. Its role would be to service the **whole** of the college's information technology needs. This would combat inter-departmental rivalry and resistance as it would function and be funded separately from the other departments in the college. Thus, the idea of an ITDU was conceived.

Immediately the Principal joined Kingston College, he reviewed the college situation and set about establishing an ITDU. At the time of his appointment, advances in computing technology allowed for the introduction of computer software that facilitated the processing of knowledge rather than that of data (see Table 2, page 54, 5th generation computing) and he became interested in the development of expert systems which he believed would revolutionise information technology use in education (Cotterell et al, 1985 and 1988). At this time contact with the FEU was also established.

Alongside the technological developments, other important milestones were occurring that highlighted the need for Further Education vocational education and training to be restructured and respond more closely to the needs of industry especially in terms of new technology. These included reports and government White Papers and initiatives such as: the ALVEY report (1982) and the Butcher Report (1984); the New Training Initiative (1981); the IT Year 1982 (1983); Training for Jobs White Paper (1984); the Education and Training for Young People White Paper (1985).

The ITDU model in operation

In October, 1984 with Nuffield support, the ITDU was established and in February, 1985, following the DoE's intervention into Further Education, the MSC's Chairman visited Kingston College.

This visit was crucial not only to Kingston College and the development of expert systems in a Further Education environment. It also highlighted the important role that Further Education could play in the introduction of AIT into industry.

Following his visit, the MSC Chairman described the potential importance of the Further Education sector to his senior officers in relation to the development and advancement of AIT in the form of expert systems

At the time of this visit, the scope of the ITDU centred on the use of expert systems for training with particular emphasis on work at technician level. Contacts with personnel from the Learning Technology Unit (formerly the New Technologies in Training section) led to two projects being accepted by the DoE:

- the development of expert systems in the Further Education curriculum
- the development of expert systems for industrial training.

This and other funding (through the FEU, DoE, ALVEY and ESG) amounted to £300,000. Alongside this, the Principal was able to secure the letting of the college roof to private enterprise.

The externally funded projects

Two externally funded projects played a critical role in the establishment and acceptance of the ITDU. The money accrued from the external sources permitted the ITDU to function, at least overtly, as a self sufficient enterprise (some money was actually allocated from college funds but it did not reduce the budget of other departments because the shortfall was replaced by the external funding). This also allowed appropriate computer development staff to be appointed for the duration of the projects. However, this led the ITDU to focus on the developmental side. This was useful because some of the software was vocationally related, for example, twelve staff were involved in the development of *small pilot studies in their own subject specialisms*. But it was also detrimental in some ways because the ITDU staff were seen as gurus.

The lessons learned from these projects were also important to this study as they highlighted important issues for the development, introduction and embedding of AIT across all vocational education and training courses in a Further Education college.

1. Expert systems for curriculum design

The expert systems for curriculum design project was a jointly funded venture with the FEU. This project originated at Garnett College with FEU support but was shelved due to loss of funding and subsequent loss of personnel. However, as the project was considered to have merit by the FEU, the DoE was approached to be a joint partner in funding the project to be continued at Kingston college. The intention of the sponsors was that the project would:

> *explore the curriculum implications of expert systems within Further Education.*
>
> Briggs (1987)

The expected outcomes of the project were seven demonstration packages of courseware using an expert system that would:

- *show the benefits of the technology in curriculum design and for its introduction into the Further Education sector*
- *validate the technology and give evidence to help DoE project managers make decisions about the future use of the medium*
- *have a direct impact on the courses run in colleges of FE and offer potential for similar developments elsewhere.*

DoE (1985)

During the project, staff were seconded on a part-time basis to the ITDU to explore the use of expert systems within their own curriculum area. Although time was limited, it was sufficient, according to the project leader, to allow most secondees to master the concepts and to at least begin to explore the potential of expert systems for use with their students.

The project used commercially available expert system shells and the ITDU's own systems for staff and students:

> *to investigate the implications of this technology without requiring lengthy formal study of more complex systems.*
>
> Briggs (1987)

The demonstration starter pack, marketed by the FEU, consisted of a small selection of demonstration systems on nutrition, careers advice, and a central heating fault diagnoser. It also contained two empty shells for purchasers to use for their own knowledge bases plus a limited sample of material devised by secondees in their own subject areas.

Although several recommendations were made by Briggs (1987), those appropriate to this study highlighted the need for:

- technical and teaching support at an institutional level, i.e. for staff development
- sufficient 'thinking time' for persons undertaking such ventures
- curriculum development to be seen as more important than the technical problems.

2. Industry/commerce support group for the application of AI systems in training

The second project to be funded by the DoE was the establishment of an Industry / Commerce Support Group for the Application of AI Systems to Training (DoE Memo 508/22, MSC, 1985b). This group was established as part of the DoE's initiative:

> *to support relevant initiatives in education and training and to investigate the part-funding of courses on AI applications to training for trainers and teachers.*
>
> DoE (1985b)

The DoE's perception on funding the project was that the group would:

> *promote the development of expert systems within industry and commerce*
>
> DoE (1985c)

The objectives of the project were to:

- set up and pump-prime a resource unit for industrial / commercial use to develop AI Systems applied to training
- train industrial/commercial staff in AI methodology to produce and test courseware for this use
- provide empirical evidence on the use of AI systems as applied to training.

In the project, personnel from industry were seconded to the ITDU for a period of 10 to 20 days over a period of 3 months, their purpose being to create an expert system to be used at their place of work. It was anticipated that secondees would produce a piece of courseware after approximately 10 days of secondment. This would then be refined, extended and tested in appropriate ways in the remaining time (French and Walker, 1987).

Problems encountered in the execution of this project were:

- lack of appropriate tools
- time lag between the first contact and take-up of secondment
- insufficient time for formal evaluation in the lifetime of the project
- the reluctance of industry generally to recognise that a Further Education college has the expertise to help in the area of AIT.

3. The implications of fifth generation computing for Further Education conferences

Alongside the two major DoE/FEU projects, Kingston College ran a national conference on the implications of 5th Generation Computing for Further Education. Following this, the DoE/FEU funded four conferences to disseminate the work of Kingston and to raise awareness of the potential of AI in learning and training for college and LEA senior management. These conferences were evaluated by the author using a self-completion questionnaire (Goodman and Holt, 1987). The results from the evaluation of the conferences highlighted factors that were seen by delegates to be important if new technologies were to be successfully embedded into the Further Education vocational education and training curricula. These included the need for:

- relevant software, such as the curriculum based expert systems developed by Kingston, to be available to Further Education colleges at an acceptable price
- lecturers and support staff with *relevant expertise*
- staff development and training in AIT that is not exclusively designed for computer studies staff and which is *available to all*

- external funding (which was felt to be critical to the successful development and embedding of expert systems within a Further Education environment) to:
  - enhance the awareness of all Further and Higher Education personnel not already involved in developmental work in AIT
  - allow the remission of teaching hours for lecturers (subject and computer specialists should be working in collaboration to develop software) who wish to develop AIT software and/or attend courses / conferences on AIT.

The strength of the above projects led to Kingston applying to become a National Centre for expert systems under Category V of ESG (see pages 78 to 80) which granted funds for:

> *the development of the use of information technology at Further Education establishments, by providing equipment, preparing or providing course material and computer software and training teachers at such establishments.*
>
> DES (1985)

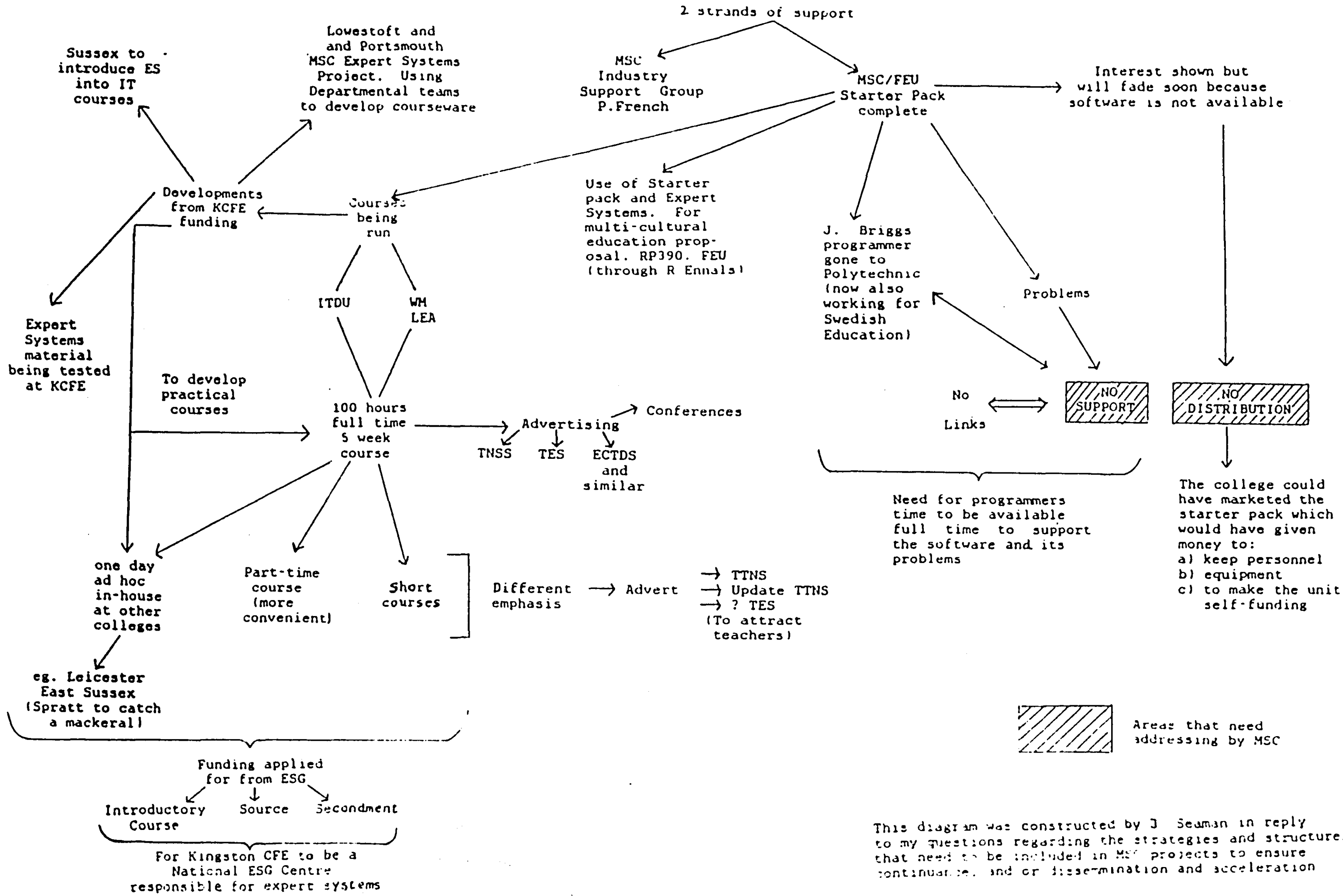
Kingston was awarded the funds and became a National Centre for expert systems in 1988.

By this time, the original ITDU staff had left. With its new remit as a National Centre for expert systems the focus of the ITDU moved to staff development and training in the use of existing expert system shells, including those developed from the previous DoE/FEU funded projects. It now runs very successful information technology courses for teachers and lecturers within and outside Kingston college.

A useful diagram which summarises the development of Kingston *after DoE funding* is included as Figure 38. This was compiled by one of the ITDU staff who had worked on the externally funded projects in response to a semi-structured interview that was conducted on an observation visit to Kingston college.

The top of Figure 38 shows the initial strands of support from the DoE (named MSC on the diagram): the industry support group and the starter pack. As one can see, according to the interviewee, nothing really became of the industry support pack.

FIGURE 38 ARTHUR COTTERELL CAME TO COLLEGE AND ESTABLISHED THE ITDU



Indeed the researchers who developed this moved to the then polytechnic and functioned as a self financing research organisation where they continued with their original development work.

With the starter pack four points of interest emerged: two were beneficial and two detrimental to the pack's exposure and use in Further Education.

The two advantageous routes included:

- its use in another project, on multi cultural education, supported by the FEU
- the use of the starter pack for further development work and as a teaching media for courses being run by Kingston. These led to the use of expert systems by other colleges and LEAs, for example, Sussex and Lowestoft and Portsmouth. This supported Kingston's case to become a National Centre for expert systems.

The two detrimental routes highlighted the need to ensure that the appropriate personnel were in place for development work. These included:

- problems of attracting support which led to the loss of the key developers which, in turn, made it more difficult to attract support without staff of the correct calibre to ensure the completion of the development work
- the time taken for the FEU to market and disseminate the package leading to fading interest and lack of motivation to buy, which could have been avoided if Kingston themselves had marketed the starter pack. This would also have brought in money to resolve the problems of keeping personnel, updating equipment and ensuring that the ITDU remained self financing.

Did the ITDU model work?

As cited previously, in order to run the projects, new staff with particular computing skills had to be contracted for the duration of the project. This caused problems at the end of the funding period as insecurity of tenure led the majority of ITDU staff to move to Kingston Polytechnic.

However, the ITDU did survive but, in order to do so, it changed its role from research to staff development/support. The Principal commented on this change:

> *the first stage was crucial and has served its purpose but it is now right for it to change as it has done.*

The Principal remained convinced that the ITDU model *was the right way to do it* (that is, to integrate information technology across the curriculum). Indeed the ITDU, after undergoing the changes in staff, had actually improved its standing to other departments because it had changed its role from research to support.

Clearly the ITDU model worked at this college. Its introduction facilitated the introduction and embedding of information technology/AIT across the college. As stated in Her Majesty's Inspectors (HMI) report:

> *The ITDU has developed fruitful working relationships with staff in the departments and individual secondments are offered to lecturers from the college and outside for periods of work in the unit. The unit is now focusing attention on further applying the results of initial projects to work across the Further Education curriculum and central computer service facilities have been developed as an extensive open access provision for student and staff, supporting the use of word processing, databases, spreadsheets and expert systems on Nimbus networks in the college*
>
> HMI (1988)

There were inevitably some resistors. These came from two sources. Firstly, there were some senior departmental staff were not happy at the attention that the ITDU was attracting. Even though the ITDU was seen as being self-funded, some departments who formerly attracted funds for computers believed that some of the money allocated to the ITDU should have been directed to their department. Secondly, there were those departments who originally resisted because they were not confident about using computers. However with skilful handling, these fears were eventually overcome by the ITDU staff.

The college had learned from the experience. The original research slant had been important as it had allowed funds and resources to be attracted to the college so that the ITDU could function as a self-sufficient entity. It also allowed expert systems to be developed that Further Education lecturers could relate and were relevant to non-computer Further Education vocational departments.

This method of funding had its disadvantages. The research team, because they needed to secure their employment, began to run the unit as a fund raising research establishment. Thus, when they moved, the research component ceased. The support role at this time was seen as secondary but, when the leader of the ITDU, who was previously a technician, took over the unit, the support role became its primary function. As the National Centre for expert systems, this function operated both internally and externally.

The process by which AIT was accepted by departments was developmental. In fact for many individuals, the process through which they went to be able to develop their own expert system package followed much the same stages as outlined in the Hall and Loucks (1978) CBAM (see Table 6, page 130).

The organisation also progressed in an evolutionary way. The first set of departments to become actively involved were those who were *doing it anyway*, for example, the Engineering Department. This slowly expanded across all college departments. However, within this process much *confidential advice* was given to newly participating departments to combat the *attitudes of the Computer Department*. This type of help led to the ITDU being viewed by the departmental staff *not as a threat but as a help.*

Implementation of information technology/AIT was successful across all departments at Kingston College. The self-supporting ITDU model, driven and supported by an innovative Principal with external funding, ensured that information technology was available through a department's own or the central computer services. Also, the development of appropriate and accessible software that could be used and understood by lecturers and students aided the process of cross-curriculum use of information technology/AIT.

Problems that emerged from the expansion of the ITDU's role and its acceptance by other departments not conversant with information technology were:

- *the need for support from departments with their own computer equipment*
- the pressure placed on the limited staff resources within the ITDU to fulfil the support needs of new users (needing a great deal of initial support) and existing users (needing updating and more sophisticated programming and other support)
- some departments wanting *to keep ITDU staff to themselves*
- lack of resources to replace equipment seen as outdated.

Clearly, the ITDU model did work at Kingston college. However, the external validity of this model, without the driving force of this Principal, remains unproved. Embedding was achieved in that the innovation (the ITDU) has continued beyond the national funding period, albeit fulfilling a different, and maybe a more appropriate role to the initial vision by this Principal. The true embedding or institutionalisation (Miles, 1983) test, would however, require the ITDU to continue without the Principal as its advocate.

The Castle (formerly Granville) College case study

Castle College was identified as a case study at the outset of this research. It was the first college to agree to take part in the Sheffield survey and to allow access for observation of students on a long term basis. It differed strategically from the Kingston case study in that the driving force, or the project champion (Twiss, 1986), was a catering lecturer who taught computing to Hotel and Reception students. In the initial stages of the investigation, the lecturer had no real vision for embedding information technology across all curriculum areas. However, as the study progressed and this lecturer became involved as project manager for one of the AI applications to learning projects, his experience with expert systems technology led him to believe that this was an invaluable tool for use with Further Education vocational education and training students.

The impetus therefore for the embedding of AIT was bottom-up, adopting a disjointed incrementalism approach (Braybrooke and Lindbolm, 1963) because of the changes in structure and leadership of the college over the period of the study.

The methods used with this case study included:

- interviews with the senior management at various milestones throughout the duration of the study
- interviews with other internal stakeholders outside the Catering department
- interviews with external stakeholders (for example, the FEU and the DoE project managers) at differing times throughout the study
- observation of classroom practices where students were using computers and latterly CUSTOM
- desk research using historical and current government and other documents relating to the college and the Hotel and Catering courses.

The historical perspective of the Castle College case study

At the beginning of the study, all colleges within the Sheffield LEA area had a specific vocational bias. Although covering other vocational disciplines including Computers, Castle College's bias was Catering. The college at that time was run by a Principal who delegated responsibility to his Heads of Department. The then Head of Catering agreed for his department to be involved in the study.

The nominated contact person was a Catering lecturer, who was running the information technology components for all Catering qualifications offered by the college (that is, BTEC and City and Guilds).

Over the period of this study, the college, indeed all Sheffield colleges have undergone two radical reorganisations. Firstly, there was a move over to a matrix approach with the appointment of new Principals, the attempted dilution of subject bias, and the move over to a community college culture with the aim of having sufficient colleges to ensure that each could be close enough to facilitate education for all. It was not possible to eradicate the subject bias totally because of the cost of duplicating catering and other equipment and resources. However, the removal of the computer department from Castle college radically altered the computer provision for the rest of the college. Prior to this time, the computers available for Catering students were machines which had been discarded by the Computer Department. When the Computer Department moved, two computer rooms became available and information technology was offered across all vocational education and training courses.

Recently, although still remaining separate elements, the colleges have been re-structured into one corporate entity with one Principal. Castle College has now become Castle Centre of the Sheffield College.

As with the Kingston case study, this was conducted against a background of government reports, initiatives and papers. Of particular importance at this time was the fact that Catering was seen by government as a priority area for the introduction of computers and their applications.

The difference with the Castle case study was that, although it became involved in the AI applications to learning programme project, there was not political motivation or overall organisational vision prompting the actions of the participants. The prime motivator for this project was intrinsic. The lecturer involved was interested and believed that computers could be widely used as an educational aid. Coupled with this, the AI project brought much prestige and autonomy to the lecturer who led the project. From his work on the AI project he became the information technology co-ordinator for the college prior to its integration into the Sheffield College.

Having entered college after successfully running a Catering business for several years, the lecturer involved was an entrepreneur in his own right. When in business, he had used computers and become an enthusiast. Therefore, when the BTEC Catering submission was accepted with a computer unit, he agreed to teach the unit.

CUSTOM the AI applications to learning project

As with the Kingston case study, Castle College was selected because it was receiving governmental funding to carry out a project using AIT which, it was hoped, would accelerate the implementation of AIT across vocational education and training courses and into industry.

Being aware of the Kingston work on expert systems and given that Catering was seen by government to be a priority area for the applications of information technology, the lecturer concerned attended an open day at Kingston College. At this time, Kingston wanted Catering representatives to help develop expert system materials in Catering. This aroused the lecturer's interest as he felt that this type of technology might offer a more appropriate way of teaching information technology to reluctant Caterers. In the event, Kingston never responded to Castles's offer to help so the lecturer took his idea and made a direct application to the DoE for funding from the first round of the AI applications to Learning programme.

After funding was agreed, the lecturer became the project manager and was remitted teaching time to develop the package. During the development period, the Head of Catering Department, who controlled the finances, protected the project manager from others whom he and the project manager, agreed wished to see the project fail. The Head of the Computer Department was one such person. He believed that the project should have been placed within the Computer Department with staff who were experts in computers.

The Head of Catering made sure that the project manager was not interrupted and that the appropriate resources were allocated for the execution of the project. Indeed for this project the Head of Department was critical to the success of the project. As the project manager commented, ***I couldn't have done it without him***. When the Head of Department left, the project manager had great trouble to secure release from his duties to carry out the field trials.

The aim of the development phase of the project was to develop a simulation using computer software which utilised deductive logic to resolve customer complaints.

This was to be used as a training package primarily for students and trainees working in the Catering and Hotel Reception field. The package developed into two distinct parts. One contained tutorial material and the other reinforced the principles taught by providing a simulation where the computer took the role of an aggrieved customer. The name given to the system was CUSTOM.

A supplementary aim to the project was to *expand staff and student awareness of the use of AI techniques in the form of expert systems.* The hope was that the development of the package would allow the expansion of information technology throughout other college departments and to other Further Education colleges.

For field testing, the developed package was distributed to a number of Further Education institutions and industrial outlets. The field testing sites were allowed to use the package as they felt appropriate for their needs (Margetts and Goodman, 1991). Continuous monitoring was conducted over the field testing period both for the Castle college and the other field trialling case studies.

The **expected impact of this project on individuals** was on five types of audiences:

- people directly involved in development of the demonstrator
- other lecturers (both within and outside Castle College)
- students from a variety of disciplines
- industrialists working in the Catering professions
- DoE staff involved with the AI applications to learning programme.

The perceived impact on these audiences was that:

- the developers, would become more familiar with AI techniques, the processes involved in developing a deductive logic system, and the way in which the subject matter had to be adapted to suit this media
- other lecturers, would become more familiar with AI techniques, see their value and use them in the teaching environment

- students, would be presented with a more stimulating way of covering the subject matter. It would also be more motivating for students who, in many vocational areas, disliked computers
- industrialists, would receive an on-the-job training tool for trainees in areas of need
- DoE staff, would receive a demonstrator in a unique area: the affective domain. The way in which the content was to be presented was novel. It was being developed by a lecturer whose background was in Catering and the development was, according to the government, in a priority need area, Catering.

The **perceived impact on the organisation** was that:

- it would bring AI into an Further Education college environment
- the use of the system would motivate others to use and develop expert systems for other vocational areas
- the prestige accrued from the project would allow Castle College to have expertise which could be exploited for the good of other Further Education organisations
- the developed system would be marketed by the college
- the system would become part of the BTEC Catering syllabus and therefore would enhance the teaching of information technology in this subject area.

The **expected impact on Further and Higher Education** was mainly in the Further Education sector. Colleges in the Yorkshire and Humberside BTEC consortium were to be specifically targeted to create an awareness of the advantages of such systems which would enhance the knowledge and expertise of AI in Further Education overall. The **funding itself had an expected impact**, in that colleges, seeing other colleges with little initial expertise being funded, might investigate the feasibility of using AI themselves and seek funding to do so.

Figure 39 shows the **areas of actual impact** found for this project. As indicated that the numbers involved and the depth of knowledge acquired differed between stakeholders.

Within Castle College itself, the main impact was on the Catering Department, its students and those of other departments. This was because the project manager had been involved in the teaching of the students from within and outside his own department.

From the analysis of impact at this site, two new awareness index categories (see Table 10, page 196) were identified. These were *use without knowledge and awareness of AI* and *increased use of IT.* It was found that awareness, as initially defined in the awareness index, was really inappropriate for the majority of students who saw CUSTOM as *another computer package*, hence the use of the term use without knowledge of AI emerged. Also, in the department where CUSTOM was being developed, as other lecturers became aware of AI techniques, there was an increased use of ordinary information technology mainly in terms of spreadsheets and wordprocessing for the development of teaching aids. Unfortunately these lecturers, were not offered the opportunity to use CUSTOM because the system was used exclusively by the project manager at that time.

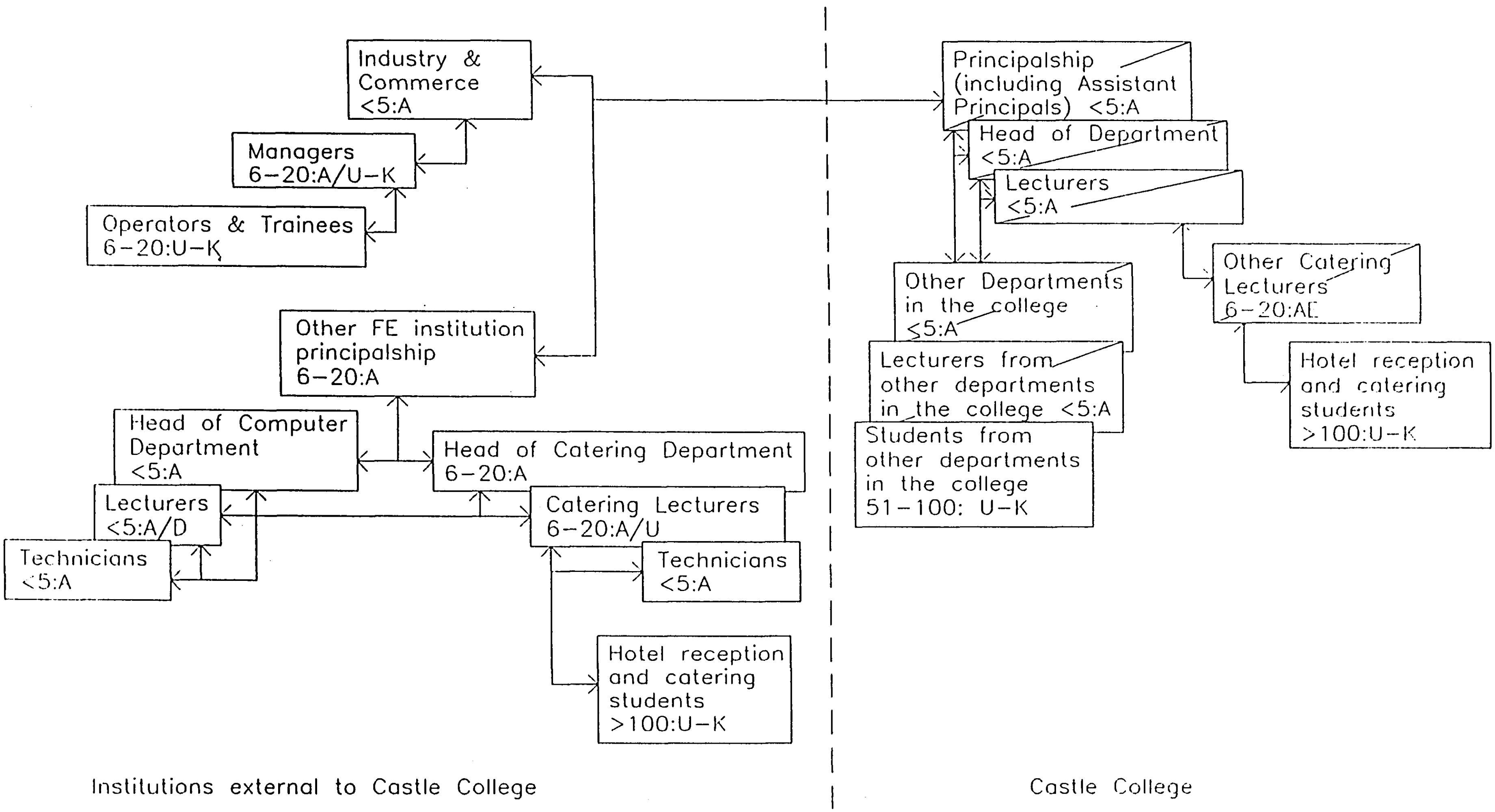
In the field testing period which involved several other Further Education establishments, lecturers did use CUSTOM with students. Also, technicians became involved with its installation.

The actual impact on organisations outside Castle College was not significant. There was a small amount of impact on some of the departments from the other colleges involved but this focused on one or two committed lecturers.

Although staff development courses were set up, the attendance was low even within Castle college, with only two lecturers attending.

Opportunities to market CUSTOM (although HMSO granted Castle a license) were not taken up as the college management, in particular the college Marketing Director,

FIGURE 39 — THE CASTLE COLLEGE CASE STUDY



felt that *the risk capital was too great for the possible rewards.* However, CUSTOM is now being translated to French under DELTA project funding.

Did the bottom-up approach work?

This intervention was seen by DoE as a way of integrating information technology / AIT across the Further Education vocational education and training curriculum.
At Castle College this did happen but in an unstructured, *disjointed incrementalistic* (Braybrooke and Lindbolm, 1963) way.Under the first reorganisation in Sheffield, the Computer Department of the college moved to another site and the project manager procured two rooms of newer computer equipment for Catering and other remaining departments. Also, following the AI project, he was promoted and took up the new role of information technology co-ordinator for college.
As the reorganised college had its own computers, it required technician support. Thus, the technicians, who were no longer associated with the Computer department were sited next to the computer rooms which were used by **all** vocational education and training students at the college.
Most students at the college now go through a information technology programme using word processors, desk top publishing, spreadsheets, databases etc. Many complete CUSTOM as part of their vocational training on customer complaints.
The spread to lecturers has been much less successful. The teaching of information technology has remained outside the domain of many vocational lecturers. Other lecturers saw the project manager as the AIT guru and CUSTOM as *his* system.
The perception of the project manager as the AIT guru had other implications. When the project manager was seen as the expert in information technology, the other Catering lecturers relied on the project manager to use information technology for developing lesson notes. After he moved on to AIT, the use of information technology for lesson notes (but not to teach) expanded with the lecturers themselves using a computer which had been brought into the staff room. At this stage the

CUSTOM project manager fulfilled a support role for lecturers who used the computer extensively used for lesson preparation.

Resistance to this project came from three main sources:

- at the outset of the project, other Catering staff became suspicious and resentful of the activities of the project manager who they believed was:

  having a cushy time, being able to order whatever he wanted, passing his teaching on to others and stealing one of their rooms to do it in

  In order to overcome this, the project manager gave a presentation to the departmental staff which allowed lecturers to see what he was doing and what he hoped to achieve. It also gave the lecturers an opportunity to question the project manager about the usefulness of such a system to them
- the Head of the Computer department was unhappy to see a non-computer department lecturer *being called an expert on AI* by the college Principal. The comment made in interview was *how he can be an expert I don't know*
- at the end of the project, resistance to information technology remained in other departments such as Hairdressing.

In a recent interview, the project manager (June, 1993) unsuccessfully applied for his senior lectureship under the reorganised Sheffield College. He was required, under the new restructuring, to apply for his position in the Computer Studies department where he would have been teaching Computer Studies 'A' level, which he did not want to do. His greatest fear was that, if he left the Catering Department, all the teaching of information technology would cease. His comment was:

> *if I move out, computers in catering will die because the industry does not see a use for them and there will be no one to teach it.*

In the event, a job of co-ordinator of information technology in Catering was created for him, but he felt that this was seen as an unimportant job by senior management.

The implementation case study

The implementation case study comprised an evaluation of the implementation sites for CUSTOM. This involved fourteen colleges of Further Education who agreed trials the system for Castle college and the DoE. In the end, only seven sites were fully used. However, the reasons given for the colleges failing to participate did provide valuable data for this study.

Although the primary purpose of this study for the DoE was to examine the use of CUSTOM in practice, the DoE agreed that author could collect additional data about the organisational implications of using and implementing AIT into the Further Education vocational education and training curriculum. It was anticipated that, over the field trials, much information could be collected that would highlight critical success factors and the driving and restraining forces for the introduction of AIT into Further Education vocational education and training courses.

The methods used with the implementation case study involved:

- desk research
- a telephone survey to all sites
- wherever possible, two student observations and discussion group visits to all active evaluation sites
- interviews with the key stakeholder in the implementation process.

The basic assumption underpinning the funding of the AI applications to learning programme was that the acceleration of the use of the media could be brought about by funding its development and facilitating its access to other similar organisations. Indeed there was a mistaken belief that AIT products would sell the concept themselves (Goodman, 1992).

Two groups of institutions were initially identified for the field testing. The first group consisted of the Yorkshire and Humberside BTEC consortium colleges:

- Bradford and Ilkley Community College
- Dewsbury College

- East Yorkshire College of Further Education
- Harrogate College of Arts and Technology
- Huddersfield Technical College
- Percival Whitley College of Further Education
- Scarborough Technical College
- Grimsby College of Technology
- Barnsley College
- Doncaster Metropolitan Institution.

The second group comprised four colleges and three businesses. The businesses were not included as part of this study. Thus, the four colleges in this category were:

- South Warwickshire College
- High Peak College of Further Education
- Carlisle College
- Lancaster and Morecambe College of Further Education.

At the outset, all colleges in both groups were contacted by post. The response from the letter was overwhelming and all but one of the colleges (Doncaster Metropolitan Institution) agreed to participate. The responses received were enthusiastic about the prospect of being involved in the field testing.

At installation, three colleges found that they did not have the appropriate machines. At the start, another college involved in the evaluation were still awaiting the arrival of an IBM computer on which CUSTOM could run. However, according to the college this never materialised. It was later found out that this college had a great many machines on which CUSTOM **could** have been installed but there was some rivalry between the Catering and Computer Department. As the computers were the responsibility of the Computer Department, CUSTOM was never installed.

Alongside the colleges above, another three withdrew their support after installation:

- college X was not able to run groups of students through the system because of organisational problems. A new kitchen had been constructed and a reduction in student numbers and course hours meant that students did not have access to the computers

- at college Y, the memory size of CUSTOM prohibited its use on their restrictive network system. In order for CUSTOM to work in this context it needed to split into separate modules
- memory requirements also prevented CUSTOM from being installed at a further college Z. CUSTOM was found to be too large to be installed by their computer services staff. They stated that they could not allow such an amount of computer memory for software that was only useful to one particular group of students. In a letter withdrawing their support, two more comments were made to substantiate the withdrawal. It was felt that students needed *to spend a disproportionate amount of time on it* and that the college did *not have enough colour monitors.*

With all the problems outlined, seven college sites remained. Each of these sites was used as a mini-case study. Data for the field trials was collected through self-completion questionnaires and analysis of the student printouts. Two interview/ observation visits were scheduled at each of the remaining sites. Within the visit, the lecturer in charge of CUSTOM was interviewed and student interviews, observation and group discussions were conducted wherever possible.

College A

At college A, the system was installed in a computer room which was continuously booked throughout the year making access by Catering students difficult. Any student wishing to use CUSTOM had to give up their lunch time or return after college to work through the system.

When an observation visit was made, it was clear that students had only been working through the original version of CUSTOM. It was stated that the new version had never worked. Castle had installed a dedicated help-line to help with such difficulties but no one had passed on the number to the person installing and running the new system. Therefore, Castle had not been informed of the problem.

Only a limited number BTEC 2nd year Catering students worked through the original version of CUSTOM at this site.

College B

This college intended to use CUSTOM with BTEC Catering students but, over the first six month of the evaluation, nothing happened.

Although the college had a large open access area containing a myriad of differing machines, CUSTOM was only allowed to be installed on the Amstrad 1512 machines because of its memory requirements. The memory capacity of the Amstrad 1512 machines meant that some of the larger modules in the earlier versions of CUSTOM could not run. Also, the machines were painfully slow in carrying out any operations. Again the project manager from Castle was not informed of difficulties.

Finally, one group of 1st year reception students did work through CUSTOM. Unfortunately only half the group at a time had access to the computers for a one hour period over six weeks. This meant that they only had three weeks exposure to CUSTOM. Also, the role play part of the program would not work. Again the project manager was not informed.

College C

At this college, only one machine was available for students. Originally the Catering department had no colour monitors and one advantage of being involved with the CUSTOM evaluation was that they *got a colour screen.*

Two groups of students were asked to work through CUSTOM at this college. However, because of the siting of the one computer, it was impossible to impose usage requirements on the students. The groups used were Hotel Management and 2nd year Hotel Reception students.

The computer was installed in the Head of Department's office and was used on an ad hoc *drop in* basis. The Head of Department who was responsible for administering CUSTOM stated that using CUSTOM this way *was good, but getting students to drop in* was a problem. In hindsight, the Head of Department stated that, if he was to do the year again, he would have incorporated CUSTOM into one of the BTEC assessed assignments, as this would have ensured systematic use of CUSTOM by all students.

A related problem highlighted within this Catering department was that they had only two machines and were reliant on *computer people* who were *a law unto themselves* to provide support.

A comment made by the Head of Department was that:

> *although the computer people could be helpful when asked, they would not go out of their way to help Catering lecturers or students.*

The Catering Department also found that the computer tutor couldn't relate the BTEC computer awareness option to the students so they had to move the responsibility for the computer option to a Business Studies tutor.

College D

At this college, it was envisaged that CUSTOM would be used with all students who required tuition on reception area skills and knowledge. This included BTEC National, General and Craft students in an in-house work experience environment. The work experience environment was a restaurant reception area where CUSTOM was being used by students when they were not occupied with other work based tasks. In this role it was to be used every day.

In the first three months of the project (academic year 1988/89), several groups of students worked through the package. However, in the 1989/90 autumn term, they had problems with their hard disk. They were unable to repair the computer themselves and had no departmental technician support. Therefore, they were at the mercy of other departmental technicians and had to wait several months before it was supposedly mended.

Although assured that the computer had been repaired, when an observation visit was conducted the computer was still faulty. This meant that after approximately one minute into CUSTOM the program *crashed.* Therefore, the observation visit was taken up by the Castle College project manager identifying the problem and proposing solution for the college computer technicians.

At the end of the field trials, this college requested an up-dated version of CUSTOM for use in the college.

College E

This college used CUSTOM in the college reception area with two differing groups of students. These groups were both BTEC Diploma students: the first year students used CUSTOM whilst completing the reception option of the BTEC Diploma, and second year students used it as the basis of an assignment. All students in the Catering Department of this college used CUSTOM.

As only one computer was available, CUSTOM had been placed in the reception area of the training restaurant and students worked through the system when they had no other reception duties to perform. The system was used on a stand-alone basis and each student worked through CUSTOM however they wished.

This college requested a further copy of the system for an industrial setting. They also asked for an updated version following the field trials.

College F

This college gave total support to the evaluation. The Head of Department and the lecturer using CUSTOM were both committed to *doing the evaluation properly*. Lessons were arranged to ensure that a comprehensive evaluation was made of CUSTOM. The students who worked through the system included 2nd year Hotel Reception students who had already been out on work placements and 1st year Hotel

Reception students who had to come in on their afternoon off to take an extra lesson to evaluate CUSTOM. They were both set the task of working through each section of the system and completing the appropriate section of the questionnaire. Therefore, from this group of students, all sections of the program were evaluated.

At one of the final visits, it was agreed that a one day paid evaluation should be scheduled to see if the reactions of the general caterers differed from those of the receptionists. Tutors felt that this might be the case because the Hotel Receptionists were continuously trained in customer care but Caterers were not.

Two three hours courses were arranged to run over a one day period with two groups of Catering students. Two tutors were available and the training programme included tuition and role play as well as the use of CUSTOM. It was not possible in the three hour period to cover all the CUSTOM content so a selection of appropriate and priority modules were compiled by the tutors. The courses were run as an external course, with a break in the middle and tea and biscuits provided in a separate room. This college requested an up-dated version of CUSTOM following the field trials. At this college they were hoping to develop some external courses around CUSTOM.

College G

The Computer Department at this college would only put CUSTOM on the network because of its large memory requirements. Unfortunately, CUSTOM did not have a network version so it had to be installed on a computer in the Travel and Tourism room. As this computer had restricted access little use was made of CUSTOM because students had to leave the room to work unattended through the program.

Conclusions from the implementation case study

From the implementation case study the conclusions grouped into three main areas: general observations, driving forces for implementation and restraining forces for implementation.

1. **General observations** from the implementation case study showed that:
   - the maximum learning period for CUSTOM was said (and confirmed) by students to be about half an hour. At this time, some other activity needed to be included. It was not useful to use CUSTOM for a whole lesson. This was a problem for the case study sites that had to schedule an entire lesson in an open access computer area
   - however useful the system was, tutors felt that it must be based around an assessed assignment to motivate students to use CUSTOM effectively
   - the system was seen to have a value to those trialling it. For example, at Lancaster and Morecambe, tutors and the Head of Department felt that short industrial courses could be based around the system. At Carlisle, the tutor intended to use CUSTOM to cover the whole module of a new City and Guilds Catering course.
2. The **driving forces for the implementation** of CUSTOM were:
   - one or two committed staff (lecturers and Heads of Department) who were prepared to trial the system effectively. Where this was a lecturer, senior departmental support was essential
   - direct contact channels with the project manager by the staff involved
   - Catering Department lecturers and students having easy access to computers or the department itself having its own computer(s)
   - computers that were suitable for the installation and use of CUSTOM
   - effective technician support that was available and easily accessible
   - students who were compelled or felt they ought to work through CUSTOM.
3. The **restraining forces for the implementation** of CUSTOM were:
   - computer personnel who, in many cases, taught the Catering students. At several field testing establishments, computer staff prohibited the use of CUSTOM even though, at other sites, the reaction of the Catering professionals to CUSTOM was found to be favourable. Even where tutors

were found to be anti-computers for teaching this subject area, positive reactions were found after CUSTOM had been used in its correct context.

- access to computers. Although Further Education establishments have a great many computers, it does not mean that equal access will be given, especially in a vocational area where computers are not thought to be a major part of the students' and trainees' curricular activities
- the divide which still existed in some establishments between the computer and other vocational departments
- disk space which was precious and prohibited the use of CUSTOM at some sites, especially as the package was seen as being of restricted use, that is, only for Catering courses.

The success case studies

The success case studies were identified from research (desk and fieldwork) that was being undertaken at a national level. Two were highlighted by FEU personnel and one by DoE staff.

Although not central to the study, they served as critical cases in that they demonstrated sites where information technology/AIT had been embedded in the Further Education vocational education and training curriculum or was being developed and used by Further Education in some innovative way (that is, positive case study sites). These cases also helped to identify other areas of possible influence which might not otherwise have been uncovered by the other elements of this investigation. As the colleges in question had already used or embedded information technology/AIT into the Further Education vocational education and training curriculum, the data collected was historical and therefore might well have been influenced by the present state. As Kanter (1985) stated: reality changes when it is documented.

Success case study H

This college was identified as successful in the implementation of CAL across Further Education vocational education and training by a development officer at the FEU. Three visits were made to this college. The evaluation of the International Conference for information technology allowed a three day study of the college and its conference. Although not externally published, a report was compiled for this College.

Interviews were conducted with the key stakeholders who at this college were found to be the Principal, the Vice Principal (at that time), the Head of Department of Computer Studies, a senior lecturer involved in the development of some computer based training (CBT) packages and the ex-senior lecturer (working at ICL at that time) who had been responsible for attracting the funding for the CBT work in the first instance.

At this college, an innovative senior lecturer who had just left the navy was involved in the procurement of funding for a two-year research project from the European Social fund. This project was concerned with the development of CBT lessons covering topics such as car mechanics, remedial English and basic electronics. Before the project commenced, the lecturer involved left the college to join ICL.

Following this initiative, funding was granted by the DTI for the development of some introductory lessons on the use of Computer Aided Design/Computer Aided Manufacture (CAD/CAM).

The college had strong connections with IBM and some development work was completed in conjunction with them as one of the major employers in their locality. This work was ESG funded.

The Principal was very supportive of all of these initiatives and believed that:

> *support from the hierarchy of the college was essential.*

He saw open access to computers as the way forward for Further Education. Therefore, he placed his Vice Principal in charge. The Vice Principal, from an engineering background, took charge and implemented this. To this end, a large open plan computer area was created in the college and access to all Further Education vocational education and training students was available at all times.

The development of the specific CBT courseware, the external funding, the support of the Principalship and the importance of IBM as a recipient of the college students all played a part in the successful implementation of information technology across the curriculum of this college.

Success case study I

This college was identified by a senior DoE officer. This college had set up the North West AI Applications Group through Local Collaborative Project (LCP) funding. The funding was administered at civil service regional level and its purpose was to bring together industry and education to address a particular need of industry or of the geographical area (in this case the North West).

Thus, the college was visited as an illustration of the successful development and provision of training in leading edge technology for both industry and education.

For this case study, interviews were held with the North West Regional officer responsible for LCP and with the lecturer administering the funding.

The funding had been sought by the Head of the Technology Centre at the college. They had formed a collaboration with various industries in their area. One important industrial contributor was the recipient of a great many of the college's student population.

The lecturer administering the funding had a personal involvement in AI as he had been studying for a higher degree using AI techniques for an engineering development. The funding led to the development of several courses about and using AI techniques and the programming languages which underpinned them. His Head of Department was fully supportive of the initiative and ensured that sufficient time and resources were allocated to the project.

Success case study J

Although designated a college case study, the driving force for this intervention came both from the college and the LEA. A combination of FEU/ESG money was used to develop a core of ten exemplar modules that would then be used for staff development and use with students.

Unfortunately, it was not possible to interview the Principal and the LEA contact (who at the time of the investigation had moved to another LEA). The Principal was not available at the scheduled time. Therefore, an interview was conducted with the college contact and the person who was responsible for evaluating the initiative. A thorough analysis of the documents and an interview with the FEU Development Officer was used as supporting evidence.

The Principal of the college had developed a model for embedding information technology into the Further Education curriculum. This Principal, together with the Assistant Education Officer, were the champions of this case. They used an LEA wide approach which would lead to all Further Education staff and students across the LEA area being familiar and having access to information technology. The approach had three components:

- the development of a set of CAL packages which had been designed and developed by Further Education lecturers for specific areas of study
- training a team of Further Education lecturers in the use and methodology of the CAL materials
- staff development for all 800 LEA staff. This would be done by the training team outlined above.

Close monitoring of the packages in use was undertaken and changes made in the light of experience.

Within the ESG funding allocation, it was expected that all LEAs receiving money would have an information technology policy. The policy statement for this LEA was developed by the college Principals (Director of Education Report, Computer Sub Committee, 6th January, 1986). It revealed a wide ranging policy.

The policy covered:

- information technology literacy
- information technology applications
- computer based learning
- use of the computer
- college administration
- staff development
- purchase of equipment
- evaluation and assessment
- policy for individual colleges.

In response to the final of these directives, the college set up their policy which involved the move over to a student centred approach with easy access for lecturers and students.

All lecturers had to complete 20 hours of the *Further Education staff development in the use of Micro-computers* course. A series of in-house courses on specific applications was offered together with appropriate advice throughout the college year. Senior staff also had to incorporate computer applications into Further Education syllabuses.

These components resulted in the spread of the use of information technology across the college. All students completed 30 hours information technology work. At that time 50% of the staff had been trained and 50% were working on their own or adapting commercial packages.

Conclusions from the success case studies

The three success case studies had certain factors in common. They all:

- were driven by an influentially positive person (see Figure 40, the Tricycle model, page 281), who was really the project champion, with a vision about embedding information technology and/or AIT into the Further Education vocational education and training curriculum

- had positive support from the Principalship, including Heads of Departments
- had leaders who were committed to the use of information technology across all Further Education vocational education and training curriculum areas
- had received and utilised direct and indirect government funding to promote the development and use of information technology/AIT in Further Education
- had procured funds from the same or other government departments or bodies for the development and use of information technology/AIT.

The AI applications to learning programme

The final part of the research was undertaken by the author when working at Sheffield Hallam University as an evaluator of the impact on the Further and Higher Education sector of the DoE's AI applications to learning programme. This programme was a £3.2 million initiative funded under the Learning Technology Unit (formerly the New Training Technology Section of the MSC).

The purpose of the programme was to stimulate and disseminate AI applications to learning in education (Further and Higher) and industry. At the outset the AI programme was to last three years.

The historical perspective of the AI applications to learning programme

DoE interest in AI technology (synonymous for this study with AIT) started early in 1985 when the then Chairman of the MSC:

> *identified AI as a technological innovation with the potential to effectively and efficiently aid the training and learning process.*
>
> SCP (1991b)

At this time, the Chairman also visited Kingston College to see for himself the use of AI technologies in practice. This visit highlighted Further Education as a potential source for the development of AI when applied to an education/training problem.

In April 1986, a paper was submitted to the Chairman's Management Committee requesting approval for funding the programme. The funds were to be divided:

- 25% to Further Education
- 25% to Higher Education
- 50% to industry.

10% of the overall budget was to be set aside for external evaluation and 10% of each of the projects funded was committed to internal evaluation.

The external evaluation was funded as two separate exercises: one for industry projects and one for the Further and Higher Education projects.

The aims of the programme were to:

- *explore the use of AI techniques in developing more effective training methods*
- *accelerate the appropriate application of AI applications to learning*
- *encourage UK industry to become more competent and more competitive by providing evidence and demonstrations of more cost-effective means of training.*

SCP (1991b)

The FEU were commissioned to carry out the Further and Higher Education evaluation. This was conducted for the FEU by Communication Information Research Group (CIRG) of the then Sheffield City Polytechnic (SCP, now SheffieldHallam University). The author was appointed as project researcher/evaluator.

Part of the evaluation included the development of suitable tools for the evaluation. The tools devised by the author have been described in Chapter 4. Further to this, in order to provide base case evidence for the AI programme a census and follow-up survey of Further Education establishments was conducted using self-completion questionnaires. The idea was that this would allow comparative impact to be measured (see Figure 35, the Total Growth of Impact Graph, page 198). These two parts of the AI programme evaluation provided some valuable data which was particularly relevant to this study in terms of the introduction and use of AIT in Further Education institutions. The AI programme evaluation also allowed the scope of this study to be widened to a national level. The DoE agreed that the data collected could be used for this study.

The AI applications to learning programme evaluation census

The author's involvement in the AI applications to learning programme evaluation census was in the development, execution, analysis and reporting stages. The statistical analysis, through SPSSX, was supervised by the author but completed by another researcher working on the project.

The main results from the census are documented below and have been extracted from two reports prepared as part of the AI applications to learning programme evaluation [Sources: FE Census Report (SCP, 1989a) & Final Evaluation Report (SCP, 1991b)].

1. The response rate for the Further Education census conducted at institutional level for all Further Education institutions in England, Wales and Scotland was 61.84% (342 responses).
2. The best response rates were achieved from the South East region where 113 colleges (33% of respondent colleges) responded and from Further Education colleges where 154 colleges (45% of respondent colleges) responded.
3. 244 (72%) of the responding colleges were not currently using AI.
4. The general use of AI was found to be consistent across all the regions.
5. In all, apart from the Northern region, colleges with no use of AI greatly outnumbered those using AI.
6. Colleges using CAL were more likely to be using AI.
7. Colleges not using CAL were unlikely to be using AI.

8. Colleges who already used CAL materials were more likely to be planning to use AI than those who did not use CAL materials.

9. From a profile made of the characteristics of colleges using AI, the following qualities were shown to be typical of a respondent sample. A college using AI would:

   - be from any part of the UK
   - be large with some AFE and will also offer NAFE and vocational qualifications
   - be a Technology college
   - have departments of Business Studies, Technology and Production Engineering
   - use CAL materials particularly in science based subjects
   - develop CAL internally as well as buying in from outside
   - use AI mainly for teaching, again in science based subjects
   - receive its single most important funding source from internal revenue and resources across all contexts of use.

10. The main area of use of AI techniques was in teaching followed by staff development. For both of these, the major area of work being undertaken was in expert systems.

11. Teaching was also envisaged as the main area of future work in this field. However, no one area of work for planned AI use was paramount.

12. The major single source of funding for both present and planned use of AI was specified as being internal (or college) funding.

The follow-up survey

For the follow-up survey, the author was mainly involved in the development of the sampling procedures and in the composition of the questionnaire. From this survey (SCP, 1991a), the following results were found to be relevant to this study.

1. There had been a *significant decrease* in the use and development of AI since the time of the census, particularly in the Further Education sector. Of the colleges still using AI, most applications were being funded by the DoE.

2. Concerning, planned use of AI at the time of the survey:

   - 21 respondents indicated at the census that they were planning to introduce AI. By the follow-up survey, only two had introduced the techniques. Five were still planning to introduce AI but the remaining fourteen were neither using nor planning to use AI
   - seven institutions currently using the techniques were planning to introduce a further thirteen projects in the near future
   - eight of the eighteen planned applications had acquired external funding.

3. The reasons elicited for the decreasing use of AI were:

   - lack of funding. Of the respondents who were currently using or planning to use AI, 71% indicated lack of funding as the major problem when introducing AI techniques into Further Education
   - lack of expertise within institutions was cited as the major problem by 59% of respondents using AI or planning AI projects at the time of the survey
   - turnover of staff. Several factors indicated that knowledge of AI necessary for the introduction and dissemination of the techniques was restricted to a few key staff members within a college. For example, over 50% of all the applications mentioned were supported by only one member of staff or student.

Follow-up telephone calls to non-respondents indicated that 52% of the contact people had left for other jobs leaving no one with any knowledge of AI to fill in the questionnaire.

4. 26 respondents indicated in their census return that they were neither using nor planning to introduce AI. 25 were still in the same position. The remaining institution was at the time of the survey planning to introduce the techniques in the near future

   The main reasons given for non introduction were:

   - lack of expertise (9 responses)
   - lack of curriculum and staff time (9 responses)
   - lack of funding (7 responses).

Overall conclusions from the census and follow up study

From the AI programme evaluation and related studies, the following conclusions are useful to this investigation.

1. Government funding for the development and implementation of AIT is crucial for its introduction into Further Education vocational education and training courses.
2. Software has to be sufficiently developed and relevant to the subject area before it is likely to be purchased by Further Education vocational education and training lecturers.
3. Developing software for Further Education vocational education and training is not seen as a lucrative enough market for software houses.
4. At the time of the investigation, AI technology was not sufficiently developed to make an impact.
5. There was a lack of expertise in the development of AI software at the time of the study. This was particularly so in Further Education.
6. When a high level government official believes that Further Education is important in the introduction and development process, funding into colleges can follow.

7. Further Education is not seen as a developmental environment for AI techniques.

8. Committed lecturers can be instrumental in the development of AI software related to Further Education vocational education and training courses. However, these people, when leaving a college, usually take their expertise with them.

9. The availability of:
   - appropriate equipment to run the software
   - suitably qualified and experienced staff to develop and support the use of AIT in Further Education are important to its implementation.

10. Positive attitudes and support from the Principalship or Head of Department is needed, particularly to allow developments to proceed.

11. Computer departments might enable the introduction of AI but they can create barriers, both perceptual and real, to its embedding.

12. Often Further Education vocational education and training staff, who do not teach in computer related disciplines, lack confidence in the use of computer to aid with their teaching.

13. Initial funding and the impetus that this creates is soon forgotten. Funding for embedding is essential for the Further Education vocational education and training sector.

14. Marketing of developed AIT products should be an essential element for information technology/AIT initiatives funded by government.

15 Information technology/AIT development and use is not seen as prestigious by Further Education college staff

16. When lecturers become experienced in leading edge technological developments, they are often lost to industry where they move away from Further Education related developments.

Overall conclusions and findings from the fieldwork

The main conclusions from the fieldwork directly relate to the development of the models devised throughout the research period. These are discussed in detail in the following two chapters. However summary conclusions drawn from the various components of this study are documented below. The conclusions can be discussed in two sections:

- terms and descriptions of the various activities involved in the curriculum change process
- the driving and restraining forces within this curriculum change context.

The various activities identified in the curriculum change context

In carrying out the research, it became clear not only was the Further Education sector a complex system, the curriculum change process itself comprised a set of inter-related activities which, if not carefully balanced, could lead to resistance and ultimate failure. In attempting to identify the various activities in the curriculum change process, it is important to define the areas and the stages involved in the curriculum change context being studied. This study identified several aspects which need to be thoroughly understood and evaluated to enable successful and lasting change to take place.

The curriculum change context

Firstly, the curriculum change context, where it is important to take a holistic view of the situation within which the curriculum change will occur. This includes investigating and evaluating the:

- type of organisation within which the curriculum change is to be implemented
- political and other implications that are present within the environment
- stakeholders both within and outside the organisation
- the type of change to be implemented.

The change strategy

The change strategy includes the development of the processes, procedures, practices and policy to be adopted, investigated, operationalised and, where necessary, adapted to ensure the successful implementation of change. The change strategy highlights the approaches to be used and the people who will drive the change adoption process.

The change intervention media

The change intervention media relates to the media, materials and items which are core to the change adoption process, for example, in this case information technology is the media but it could include other items such as the introduction of NVQs.

The change adoption process

The change adoption process refers to those processes which are important to successful change. They include consideration of:

- **change entry processes**, that is, those processes necessary to ensure that the change is introduced into the organisation, including an investigation of the gatekeepers, potential resistors, readiness of the stakeholders and tensions between the stakeholders. This would be similar to processes involved in Lewin's (1958) unfreezing stage (see Figure 17, page 109)
- **change activities,** that is, activities which have been selected by those seeking the change to maximise the potential of success. This would be equivalent to Lewin's (1958) movement stage (see Figure 17, page 109)
- **change embedding processes**, that is, those processes which will facilitate embedding of the change into the culture of the organisation. These processes would be equivalent to Lewin's (1958) refreezing stage (see Figure 17, page 109). They would also facilitate the institutionalisation (Crandall et al 1982, Miles, 1983 and Holly, 1986) of the change adoption process.

Threshold of readiness

In addition for this study, the concept of the **threshold of readiness** was important. This covers two aspects in the change adoption process:

- the readiness of the stakeholders within the organisation to introduce and adopt the change
- the readiness of the change intervention media to be introduced and embedded, for example, for AIT to be introduced and embedded the technology itself has to have reached a certain developmental stage to become accessible to Further Education institutions.

The driving and restraining forces

The focus of this research was to identify those forces which drive and restrain the change embedding processes.

The **driving forces identified** from the various components of this study include the need for:

- an influentially positive person (see Tricycle model, Figure 40, page 281), who is a project champion with a vision about embedding information technology and/or AIT into the Further Education vocational education and training curriculum
- positive support from the Principalship, preferably the Principal, but others in senior resource holding positions who have the authority to ensure action can be as effective
- leaders who are committed to the use of information technology across all Further Education vocational education and training curriculum areas
- inclusion in examination syllabuses or designation as a compulsory assignment
- lecturers and students in non computerate vocational areas having easy access to computers or the department itself having its own computers
- effective technician support that is available and easily accessible

- external funding (felt to be critical to the successful development and embedding of AIT within a Further Education environment) to:
  - enhance the awareness of all Further and Higher Education personnel not already involved in developmental work in AIT
  - allow for the remission of teaching hours for lecturers (subject and computer specialists should be working in collaboration to develop software) who wish to developing AIT software and/or attend courses / conferences on AIT.
- committed and enthusiastic lecturers who will develop software related to Further Education vocational education and training courses needs. However, these people, when leaving a college, usually take their expertise with them.

The **restraining forces** identified include:

- inter-departmental conflict and rivalry between the computer and vocational departments
- lack of staff development and training in information technology and AIT that is not exclusively designed for computer studies staff
- lack of access to computers. Although Further Education establishments have a great many computers, it does not mean that equal access will be given, especially in a vocational area where computers are not thought to be a major part of the students' and trainees' curricular activities
- lack of technical and teaching support at an institutional level
- lack of lecturers and support staff with *relevant expertise*
- lack of confidence by lecturers in the use of computer to aid with their teaching
- cost of relevant software
- lack of appropriate hardware and software including the need to ensure that the equipment is updated
- software being insufficiently developed and relevant to the subject area
- negative perceptions about the value of software
- the reluctance of industry to recognise that a Further Education college has the expertise to help in the area of information technology and particularly AIT

- resistance to information technology in vocational areas that do not see it as important to their occupational area, for example, in Hairdressing
- the image of Further Education as a customer for software.
- information technology/AIT development and use not being seen as prestigious by Further Education college staff and more importantly the Principalship
- experienced lecturers in leading edge technological developments being lost to industry.

CHAPTER 6

DEVELOPMENT AND ANALYSIS OF THE MODELS OF CHANGE

One of the main aims of this study was to develop a final model which would identify the critical factors for the successful embedding of information technology / AIT into the Further Education vocational education and training curriculum.

The development of the model did not happen in isolation. It was an evolutionary development which involved three periods of investigation and thought:

- the early period where two initial models were constructed from the Sheffield survey and the literature search
- a transition period where the two initial models of change were examined and refined
- a final period which culminated in the development of EMBED, a model of changing.

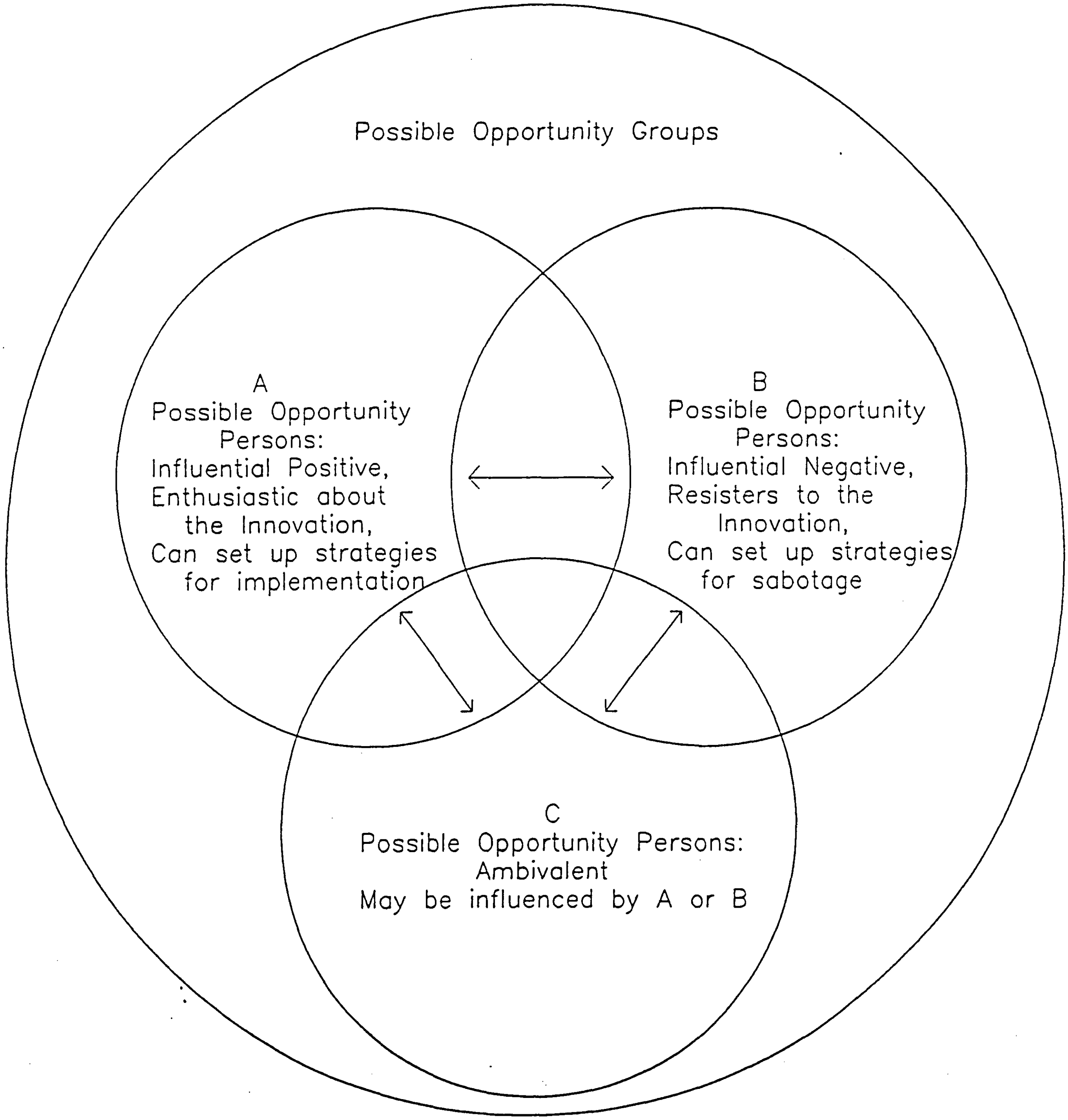
This chapter documents and explains sequentially the processes which led to the development of EMBED.

The initial models of change

The early period

At the end of the initial period of study, two models of change were developed. The Tricycle model shown in Figure 40, used a group dynamics/social interaction approach based on the findings from the literature search. The second model, the Factors Affecting the Introduction of Information Technology (FAIIT) Model (see Figure 41, page 286) emerged from the casing exercise and the Sheffield survey.

FIGURE 40 THE TRICYCLE MODEL



The Tricycle model

According to Havelock's (1982) social interaction perspective to the adoption of innovation (see Figure 24, page 138), individuals within any organisation belong to a specific network when using or adopting change. These network groups will affect the rate and type of adoption for an innovation. Equally, Elliott-Kemp (1982) believes that the ability to establish the power and concern of individuals who are likely to be involved in the change process is a crucial aspect in being a successful change agent (see Figure 22, page 134). Lewin (1958) also considers organisations to be based on a set of subsystems which comprise groups with specific sets of behaviour that can pressurise individuals to resist change if contrary to group norms. Resistance, as illustrated in Chapter 2, is an endemic problem with change, however, resistance does not always have a negative effect on the change adoption process. The Tricycle model (so called because of its appearance) in Figure 40 offers a simple representation which accommodates the three major groups who can affect, and be affected by, the change adoption process and strategies. Although the inner circles have been drawn equivalent in size, in reality such equivalence would be unlikely. The model is based on the assumption that, within each organisation, there are opportunity groups upon which the change agent can focus to develop the best change strategy. Similarly, the groups and their members have the opportunity to accept all, some or none of the change activities. The model can be viewed globally, representing the whole organisation as an opportunity group, or fragmentedly, examining the differing sets of groups within an organisation that can be analysed to ascertain the affiliations and likely reactions to the change strategy.

The model offers a *general perspective of change* (Mercer, 1985) but can be adapted to suit any particular change activity by identifying the three categories of people included in the venn circles within the outer ring.

Figure 40 identifies the three groups of people that have an opportunity to promote or resist change. Alternatively, they can reserve their judgement remaining ambivalent to the change activities and the change adoption process. The broad groupings of people have been named Possible Opportunity Groups (POGs). The people existing within the POG are Possible Opportunity Persons (POPs). It is the people (the POPs) within the groups (the POGs) who can be influential positive, influential negative or ambivalent. The three POGs circles can grow or diminish dependent the movement of the POPs between groups and ultimately this movement can indicate the success of the change adoption process.

The POPs include:

- those who are positive (**influential positive**) and enthusiastic and who often initiate the change. This group usually includes the *project champion* (Twiss, 1986) and others who will set up strategies to help the introduction and implementation of the change adoption process
- those who are negative (**influential negative**), who resist the change and who, in extreme cases, can set up strategies for *sabotage* (Schein, 1965) if the change adoption process is forced upon them
- those who are **ambivalent**, who feel neither positively or negatively towards the change, or may at different times feel positively **and** negatively to the change. These people may become enthusiastic if the change appears to benefit them or resistant if the change is seen as a threat dependent on the change strategies used and the influence of the people in the former two groups.

The strength of feeling of an individual POP can vary within the circles. They can, as described by Havelock (1982), be central to it, in isolation or on the periphery. The centrality of the person is a likely indicator that that person will remain within that POG. However, should they change their stance, they may well be a key influencer in the acceptance or the rejection of the change, dependent on the original position. For example, an initial resistor might in the end be an:

> *essential part in making sure that the innovations are implemented.*
>
> Mercer (1985)

The scope of the Tricycle model

The Tricycle model was developed from the literature review.

Its use lay in identifying the three general groups of people found by other change theorists to affect the success of the change adoption process. The strength of each group will be something that a change agent will need to consider within any curriculum change context. Identifying such groups should help the change agent:

- develop a more effective change strategy
- highlight the readiness of the organisation for the change adoption process
- identify areas of resistance.

The model was not intended to be specific but to have a general applicability whatever the change intervention media.

The limitations of the model are that it does not offer the change agent:

- any indication of the level at which the POGs should be identified, for example, at organisational level, departmental level or group levels
- any indication of how one can or should identify the POPs
- the parameters by which a POP should be allocated to a positive, negative or ambivalent POG
- any indication of the centrality of an individual POP to their respective POG
- strategies for utilising influential positive POPs to facilitate transfer from the ambivalent and the negative POPs
- a framework which outlines how the information about the POGs and POPs should be used to ensure a successful change adoption process
- any timescales or stages required for implementation of the change adoption process.

The FAIIT model

The FAIIT model was created from the casing exercise and Sheffield survey. It highlights the organisations, factors, agencies, and people (*stakeholding audiences* according to Stake, 1975) who have been found from this study to influence (thus becoming change agents) the introduction of information technology into Further Education vocational education and training. Figure 41 illustrates this model of change.

The initial fieldwork identifies two specific groups of possible *change agents* (Havelock, 1982):

- external change agents, residing outside the Further Education organisation
- internal change agents, from within the organisation.

External change agents

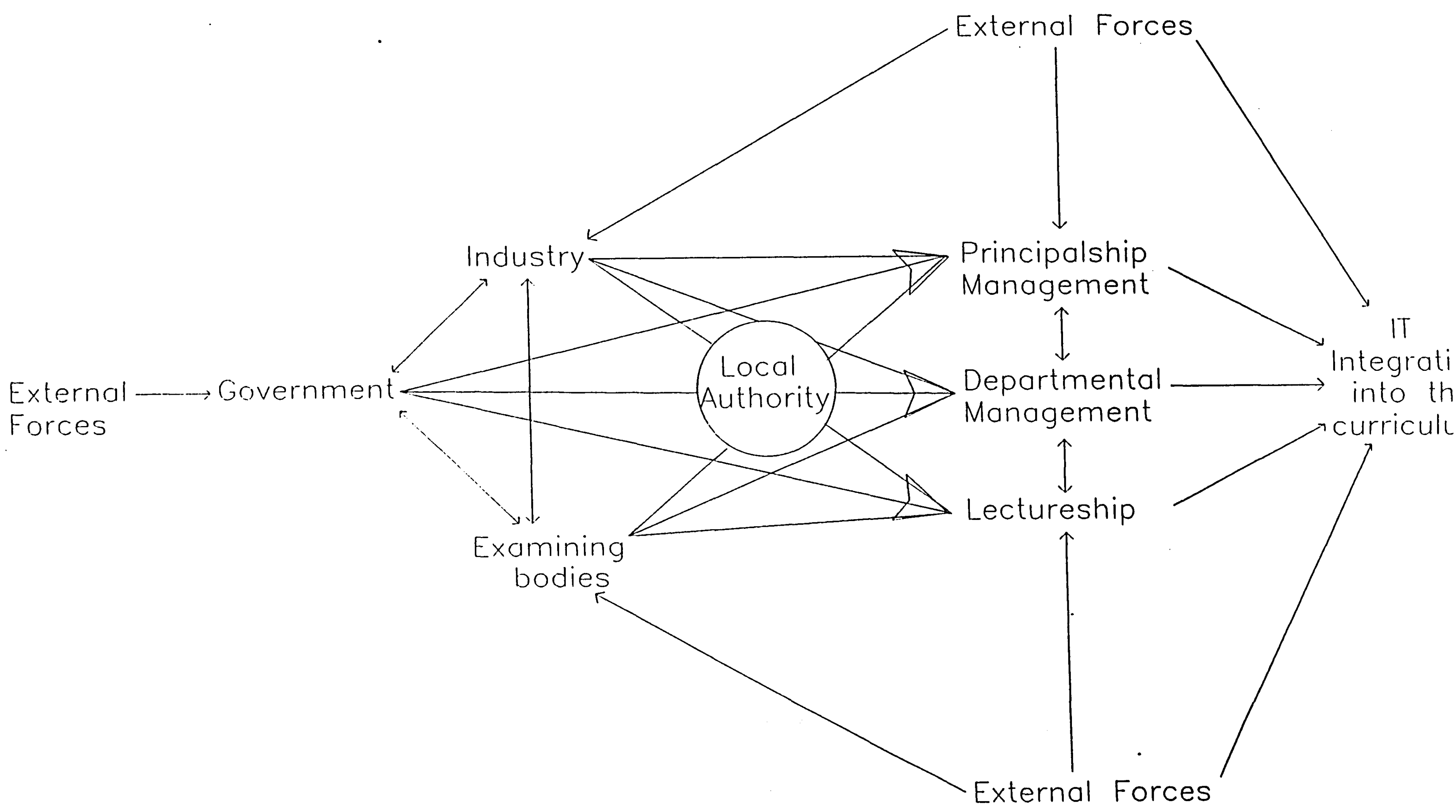
Government

The main change agent in the Sheffield area in terms of funding for information technology was found to be the government. According to the lecturers responsible for the dispersal of the funds, ESG funding through the LEA had allowed the purchase of hardware and software and the introduction (albeit in differing forms) of staff development (a critical factor in the management of educational change according to Fullan, 1986).

Examining bodies

Examining bodies had a critical role in the introduction of information technology into Further Education vocational education and training courses. The most commonly cited instrument for ensuring the introduction and teaching of information technology was its incorporation into examination syllabuses. This also facilitated the purchase of the necessary hardware.

FIGURE 41 **THE FAIIT MODEL**



Industry

From this study, industry has had both a positive and negative effect on the introduction of information technology into the Further Education vocational education and training curriculum. In computer specific courses such as Electronic Engineering, Computing and Engineering, industry has had a direct and positive effect. However, where there was little or no use of information technology in the industrial setting, there was little or no use of information technology in the Further Education vocational education and training related courses. For example, in Carpentry and Joinery, because computer technology was only used in the mass production of windows, the introduction of information technology was mainly dependent on two factors: committed lecturers and the introduction of information technology into the examination syllabus.

However, the **secondary** influence of industry was profound. Industrialists and their organisations, for example, the Confederation of British Industry (CBI), have had a major influence on the development of government reports relating to information technology (Butcher, 1984; ALVEY, 1982 and Bide, 1986). From these reports, many government initiatives for information technology in Further Education vocational education and training course emerged.

External forces

It was difficult to attribute specific weightings to the external forces at work within this study but they certainly included:

- foreign competition, particularly Japanese developments (ALVEY, 1982)
- the reorganisation of the Sheffield college system. In the first reorganisation, computers were one of the items in demand by all colleges. In the new reorganisation, the move to a place all the computers and computing within a central department has been counter productive in some areas, for example, Signwriting.

Other external forces were developments in the European Economic Community (EEC), demographic trends and changes and ecological factors.

Internal change agents

College Principals

The college Principal, although postulated as important in many studies conducted outside the UK (for example, Crandall et al, 1982 and Fullan, 1985), was found in this study to have a significant influence in only one college in the Sheffield survey. At this college several years before, the Principal had invested much of the college budget to purchase computers for each staff room. When interviewed in 1987 he said that this was *paying dividends*. This was confirmed by lecturers. Indeed, this was the college with the best computer equipment (some of which was in novel areas, for example, Signwriting) and the largest number of computer courses.

Heads of Departments

Influence by departmental heads on the introduction of information technology in the Sheffield survey was different across the differing colleges (now Centres). In areas where there was need for expensive equipment, for example, in Engineering, the Head of Department was instrumental in procuring resources to expand and update the existing technology. Another Business Studies departmental head did affect staff training as he was insistent that all lecturers underwent staff development for information technology. However, according to the person running the courses, this was counter productive for some not wishing to attend as the course only confirmed their original dislike and distrust of computers. In Castle College, each Head of Department ran their department autonomously; when the AI project was undertaken it was his support that enabled the project to be completed.

Inter-departmental rivalry

Inter-departmental rivalry was one of the restraining forces in the change adoption process for information technology. Much mutual mistrust existed between the vocational and computing departments and often between lecturers within the differing departments. Many computing lecturers did not like teaching students from other disciplines and this was evident from the classroom observation. The most effective teaching of information technology was delivered by a vocational subject specialist.

Lecturers

Lecturers in this study did influence, both positively and negatively, the introduction of information technology. Many instances of good practice were found with lecturers (mainly self-taught in their own time) who had developed some interesting assignments using information technology. The problem was that there was no incentive for lecturers to learn about information technology as it was not considered to be an area which would aid one's promotional prospects.

Students

Students, except those who were customers for the information technology-related courses, had little influence on the introduction of information technology. Only in Mechanical Engineering did the students beneficially affect the information technology content of the curriculum. In this case, new students were so proficient in computing that the lecturers had to upgrade their own skills and their syllabuses. Conversely, the lack of computer skills and experience in subjects like Catering necessarily kept the computer level of the course at a low level.

The scope of the FAIIT model

The FAIIT model (see page 286) was developed mainly from the Sheffield survey and the initial research of the two longitudinal case studies.

The FAIIT model was constructed to highlight:

- the factors and people found to be instrumental in the introduction of information technology in the colleges and courses studied
- the inter-relationships between the factors and people identified.

During the initial the period of study, the data collected was not of the type that would allow the magnitude of influence of the factors identified to be validly attributed. Also, the investigation focused mainly on the introduction of information technology rather than its embedding across the rest of the vocational education and training curriculum.

Certainly no comparison was made between the factors identified to ascertain their worth in the change adoption process. Indeed the exploratory phase of the research identified the need for the development stage of the study to:

- ascertain the worth of the factors identified
- examine further the factors required to ensure that information technology was embedded across the Further Education vocational education and training curriculum
- explore the factors which would drive and restrain the embedding of information technology across the Further Education vocational education and training curriculum so that government could more closely focus their funding on those factors that would facilitate successful and lasting change.

Thus, the limitations of the FAIIT model for the change agent is that it:

- is complex, especially in the inter-relational links that exist prior to the integration of information technology into the curriculum

- shows eight interlinking factors but does not indicate the strength and criticality of the links, that is, whether any factors could succeed in isolation or whether there are critical links that need to be established in order for the change to succeed
- does not indicate the most productive intervention point
- does not indicate the most important lever or factor for successful change.

Appraising the Tricycle and FAIIT models

Following the initial period in which the Tricycle and FAIIT models were developed there was a need to appraise the models to assess their generic applicability across any Further Education vocational education and training context and establishment.
Also, although the models and research had identified a myriad of factors affecting the introduction of information technology and AIT into Further Education vocational education and training courses, they raised further issues about the value of introducing information technology and AIT without establishing the factors and processes to ensure their continuance.

Generalising from the initial models

One of the problems with a study that is exploratory is that at the beginning it is likely to be limited in scope. This causes difficulties for generalising the outcomes to other similar change environments, that is, although the study might be strong on internal validity, the external validity could be questioned.
Wherever possible in this research, sampling was carefully selected and compared with other data across other sampling contexts. Also concurrent validity measures were incorporated. However, typicality within the Further Education sector was difficult.
Indeed a further casing study would have been required across a sample of LEAs to ascertain whether it was possible and/or feasible to find a set of typical and comparative colleges across the country.

Also, when the research began, colleges were at differing stages in the introduction and embedding of information technology across the Further Education vocational education and training curriculum. An alternative would have been to randomly select colleges and *see what happened*. The problem with this approach was that, given the time and resources available for the research, one might have selected all negative cases. This would then have made it difficult to extrapolate positive features and processes for the change adoption process.

Thus, the models developed were based on the collection of data that, because of the resource constraints, might shed doubt on their external validity. Further work in this area would need to be done to ensure that the acceptability of the models across other Further Education establishments. This was partially achieved in the transition and final periods, and through a review of the outcomes of surveys conducted by other organisations such as the FEU (1984a) and NCET (1991). However, this is still an area that could be open to further research.

The value of the models

The Tricycle and FAIIT models represent outcomes of what Fullan (1985) would call research on change, that is, *what factors affect change*. Although providing a useful framework, the models did not address all the issues required by government or other funding agencies when endeavouring to focus funding that would be successful in the change adoption process.

The models identified the critical factors but could not answer the more detailed questions concerned with:

- How much funding would need to be placed on each factor to ensure the embedding of information technology?
- Does funding need to be given to any factors that may work better in co-ordination?
- To whom and on what should initial and subsequent funding be based?
- How long does the funding need to be given for the factors to yield success?

- For what type of activities should the funding be given?

To be really useful, these questions needed addressing and their outcomes accommodated within the structure of the model. Indeed the model needed to move to the type of research that Fullan (1985) postulated, that is, research which goes:

> *beyond theories of change to theories of changing (how change occurs and how to use this new knowledge).*
>
> Fullan (1985)

The need for the final model to include factors which would accommodate Fullan's notion of changing emerged from two of the early findings.

Firstly, in the exploratory phase, ESG funding was identified as the primary external change agent within Sheffield in relation to the introduction of information technology into the Further Education vocation and training curriculum. However, the DES, who funded the activities, had little research evidence on which to base decisions about the specific foci for funding categories (even though prior to this initiative millions of pounds had been spent on various information technology programmes in education). Secondly, evaluation of government intervention in practice (that is, the evaluation of the impact on the Further and Higher Education curriculum of the AI applications to learning programme, see Chapter 5) revealed the need not only to identify the factors affecting change adoption process but to find some way of indicating their worth to the change adoption process.

Also following the exploratory phase further research was necessary to ensure the external validity of the model which had primarily been based on the Sheffield survey. Therefore, the main aim of the development phase of this research was to establish the **sphere of influence** of the various factors highlighted in the FAIIT model (see Figure 41, page 286) and to encapsulate it in a refined model of change. This model would then allow government agencies to more accurately prioritise and focus their funding on those elements which were more likely to succeed when using what Argyris (1973) called an *interventionist approach* to introduce and embed information technology and AIT into Further Education vocational education and training.

The transition period: from change to changing

During the transition period, the initial models were examined to establish if they could be developed to accommodate features which facilitate the theory of changing, as postulated by Fullan (1986), that is, a theory which:

> *concerns itself with how to influence, manage and otherwise alter those factors known to affect change.*
>
> Fullan (1986)

Thus, the pre-requisite for any model of changing is the inclusion of those factors which can influence and/or facilitate the management of change.

To change the balance of agents / factors known to influence the introduction of information technology into Further Education, there was a need to outline the sphere of influence (that is, the type, speed, penetration and criticality of the agent / factors in bringing about the implementation of information technology into Further Education).

Sphere of influence, for this study, comprised four elements:

- **speed** which included the notion of how quickly (or not) the differing agents / factors could bring about change (either singly or as multiple factors)
- **scope** involved the penetration value of the factor or agent, that is, how widely the agent / factor could influence the change adoption process
- **type of influence** within this study varied between the factors. It included whether the influence was positive or negative and the power structure (hierarchical or influential) of the factor
- **worth** was defined within this study as the value, whether critical or sufficient to the change adoption process.

One area of study in the transition period was to review techniques postulated by various change theorists to establish which could be applied to develop the refined model of change. Lewin's (1958) force field analysis was found to be a useful tool that could be applied to the two initial models developed within the research. Using force field analysis, the author could differentiate and prioritise the factors identified in the FAIIT model. Also, the outcomes of the force field analysis would allow a more accurate identification of the forces that might affect the movement between the POGs within the Tricycle model.

Furthermore, by using the sphere of influence parameters, one could focus more precisely on those factors found to be the influentially positive (driving forces) and influentially negative (restraining forces) in their affect on the introduction and implementation of information technology / AIT into the Further Education vocational education and training curriculum.

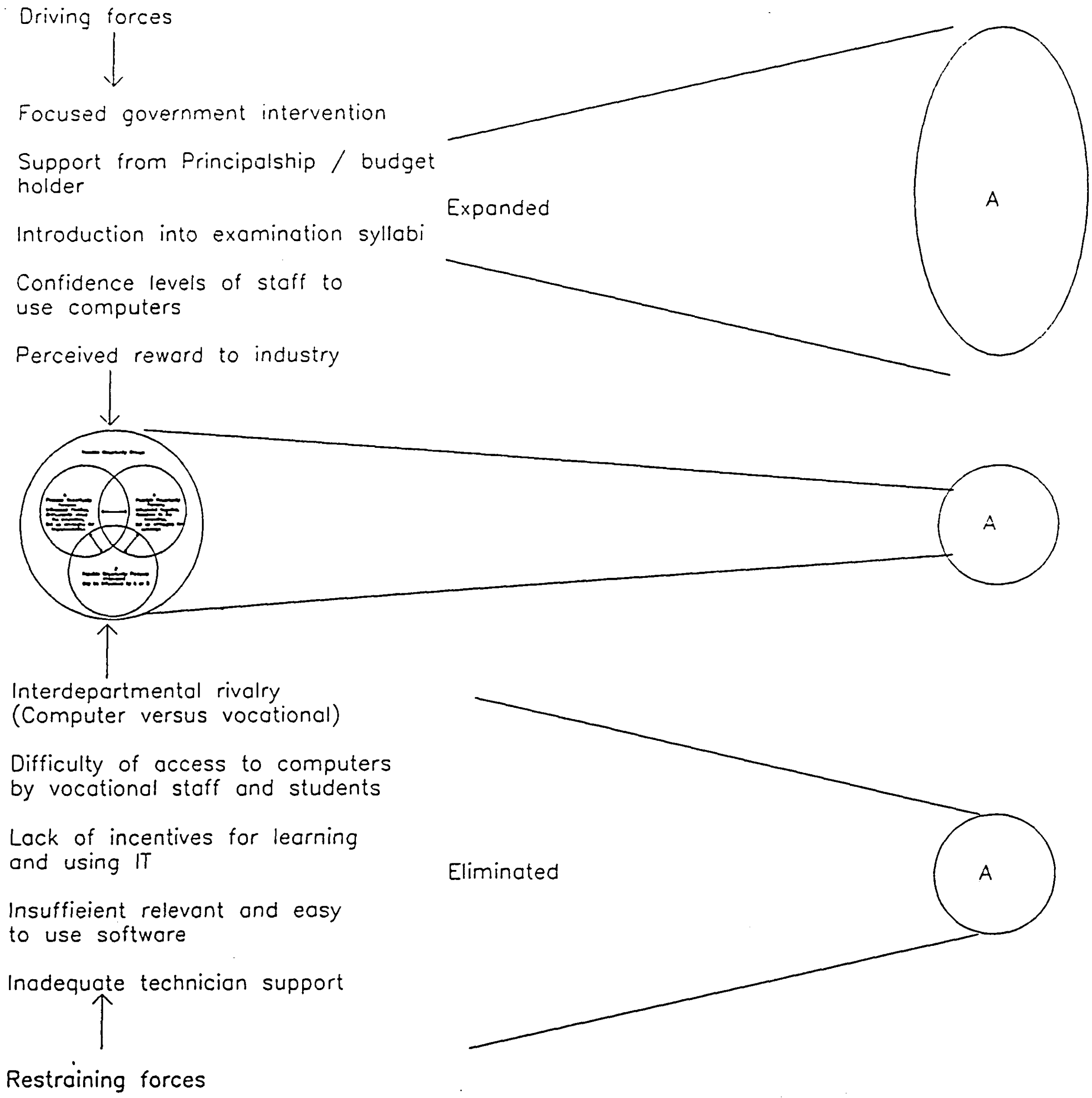
The impossible dream

Figure 42, the Perfect Integration model, highlights the main driving and restraining forces which, if it was possible, would lead to the perfect integration of information technology across the Further Education vocational education and training curriculum. The model uses the Tricycle model as its starting point. In order to reach perfect integration, every POP would need to be positioned within the influentially positive POG, that is, inner circle A of the Tricycle model (see Figure 40, page 281) where everyone supports and is enthusiastic about the innovation.

Unfortunately, in the real Further Education environment, it is almost impossible to envisage a situation where **all** the stakeholders would be fully committed and influential in the promotion and embedding of information technology across the vocational education and training curriculum. Thus, this model is felt to represent the **impossible dream**.

The horizontal dimension in Figure 42 represents time take to achieve perfect integration from perfect equilibrium between POGs in the first instance. The driving and restraining forces are level with the initial Tricycle model to indicate what needs to happen over time for perfect integration to be achieved, that is, the driving forces need to be expanded and the restraining force eliminated.

FIGURE 42 THE PERFECT INTEGRATION MODEL



EMBED the model from the final period

When identifying the forces itemised in Figure 42, it became clear that other factors were important to the development of a comprehensive model of changing which would accommodate the embedding of information technology into the Further Education vocational education and training curriculum. This was also substantiated by the field study, in particular, the AI applications to learning programme.

Stages to complete implementation

Firstly, from the AI applications to learning programme evaluation, three important stages of impact emerged. Each stage has its own driving and restraining forces. Some of these are exclusive to the stage and some are important, albeit in a differing format (for example, government funding), across more than one stage.
The three stages identified included:

1. The developmental stage

From the AI applications to learning programme evaluation, it was found that the technology (hardware and software) needed to be sufficiently developed to be introduced into the Further Education vocational education and training curriculum. For the technology to be acceptable, particularly in vocational areas that have little perceived need for or use of computers, the technology needs to be well established as a viable tool for learning and / or within the industry into which the student will be going. Also the technology will need to be cheap enough to be purchased by Further Education colleges who, from the findings of the AI programme, were not seen as a lucrative market to software houses.
In order to reach this stage, especially in education, government funding was needed to pump-prime this type of development work.

2. The introductory stage

The introductory stage involved those forces found to be important (either positively or negatively) for the introduction of information technology / AIT into Further Education organisations at any level. Introduction often happened without embedding, that is, a Further Education institution may have introduced information technology but it would be primarily focused on computer and other information technology related departments, for example Electronic Engineering departments.

3. The embedding stage

The introduction of information technology is not sufficient to ensure its use or integration across all vocational education and training courses. Indeed, if the introduction and power lay in the hands of the Computer Department, it could be counterproductive to integration across the vocational education and training curriculum. The embedding stage (often referred to as the implementation stage, Fullan, 1991) was identified mainly from the literature review and case study work. For embedding to take place, information technology needs to be integrated throughout **all** Further Education vocational education and training courses offered within an Further Education establishment as, for example at Kingston. Information technology / AIT at this college has become an accepted organisation norm, and can be used as a teaching aid by most vocational lecturers.

Transfer between stages

The transfer between and within these three stages is not clear cut.
New technology, in the main, needs to reach a point at which it is accessible in terms of the hardware requirements, the software availability and the skills of lecturers to use the technology for Further Education colleges to introduce the technology. This is problematic because commercial software houses do not see Further Education as a lucrative market, and so little is developed in the educational field, especially the technology that is at the leading edge.

Introduction is often a simple exercise, especially with small scale introduction into the Computer, Science and Mathematics Departments who realise and value the potential of the technology. However introduction into these departments does not ensure embedding. Embedding can only be said to occur when the use of information technology and AIT becomes a norm within and across the vocational areas of the Further Education establishment.

Types of forces

From the derivation of the driving and restraining forces for the three stages outlined above, various forces were found to be prevalent within and between the stages. These were classified as follows.

Economic forces

Economic forces include market related forces found to affect (positively and negatively) the implementation of information technology into the Further Education curriculum.

Financial forces

Financial forces included those forces which were related to the funding of information technology at all levels within the information technology implementation process.

Educational forces

Educational forces were allied to the delivery of the Further Education vocational education and training curriculum.

Industrial / commercial forces

Industrial / commercial forces included those forces which were found to be driven or delayed by the needs / wants of industry and / or commerce.

Organisational forces

Organisational forces included those forces which referred to the organisational / policy implications for the embedding of information technology into the Further Education vocational education and training curriculum.

Personal forces

Personal forces involved those which drove stakeholders to use, or prohibited them from using, information technology at any stage within the implementation process.

Interaction between forces

An interaction between forces was found. This had three forms.

Firstly, there was the problem in allocating forces. In many cases the forces could have been placed as a positive *driving* force if phased positively, or as a *restraining* force when a converse statement was made. For example, interdepartmental rivalry could have been rephrased to interdepartmental cohesion and placed as a driving force.

The second type of interaction was a positive correlation which changed when the needs of individuals differed. For example, there was a positive correlation between technician support and lecturer confidence. The greater the lecturer confidence, the less need there was for extensive technician support. However, in this interaction, technician support was **always** required, albeit in different forms, dependent on expertise of the lecturer.

The final interaction to be identified involved an interaction across forces. For example, even if sufficient easy-to-use software was made available and lecturer confidence was quite high, many lecturers would revert to traditional teaching practices if access to the computer facilities was difficult and bureaucratic.

Motivation

From the fieldwork, motivation was identified as another important factor to the embedding of information technology into Further Education vocational education and training curriculum.

Motivation was found to be significant at three levels:

- level 1: macro, that is, economic level
- level 2: organisational level
- level 3: micro, that is, at an individual level.

At the **economic level**, there was a need for the government to:

- retain its supremacy in leading edge technology
- compete with other countries in the production of goods and the provision of services
- produce a highly skilled and technologically capable workforce.

These factors led the government to increase and focus funds to enable colleges to introduce information technology / AIT into Further Education vocational education and training courses.

At the **organisational level**, the motivation to use and embed information technology was most effective when driven by the Principalship. If information technology needs were important to the local industrial and commercial environment, they were seen as a priority. If not, growth in the use of information technology was much slower.

Motivation at an **individual level** could be intrinsically or extrinsically driven and was dependent on the importance of information technology to the vocational area and/or within the college. Several factors were found to enhance the extrinsic motivation of the lecturers to learn about and use information technology. These included:

- the image of information technology being high
- a college policy which gave easy access for vocational education and training lecturer to computer facilities
- staff development being provided and the college giving support to lecturers whilst they were using information technology applications.

Intrinsic motivation was found at all levels where lecturers were attending information technology courses which spanned awareness through to sophisticated programming courses. Also many vocational lecturers who were developing software for their students were doing so from their own interest and enthusiasm. These lecturers were mainly self-taught.

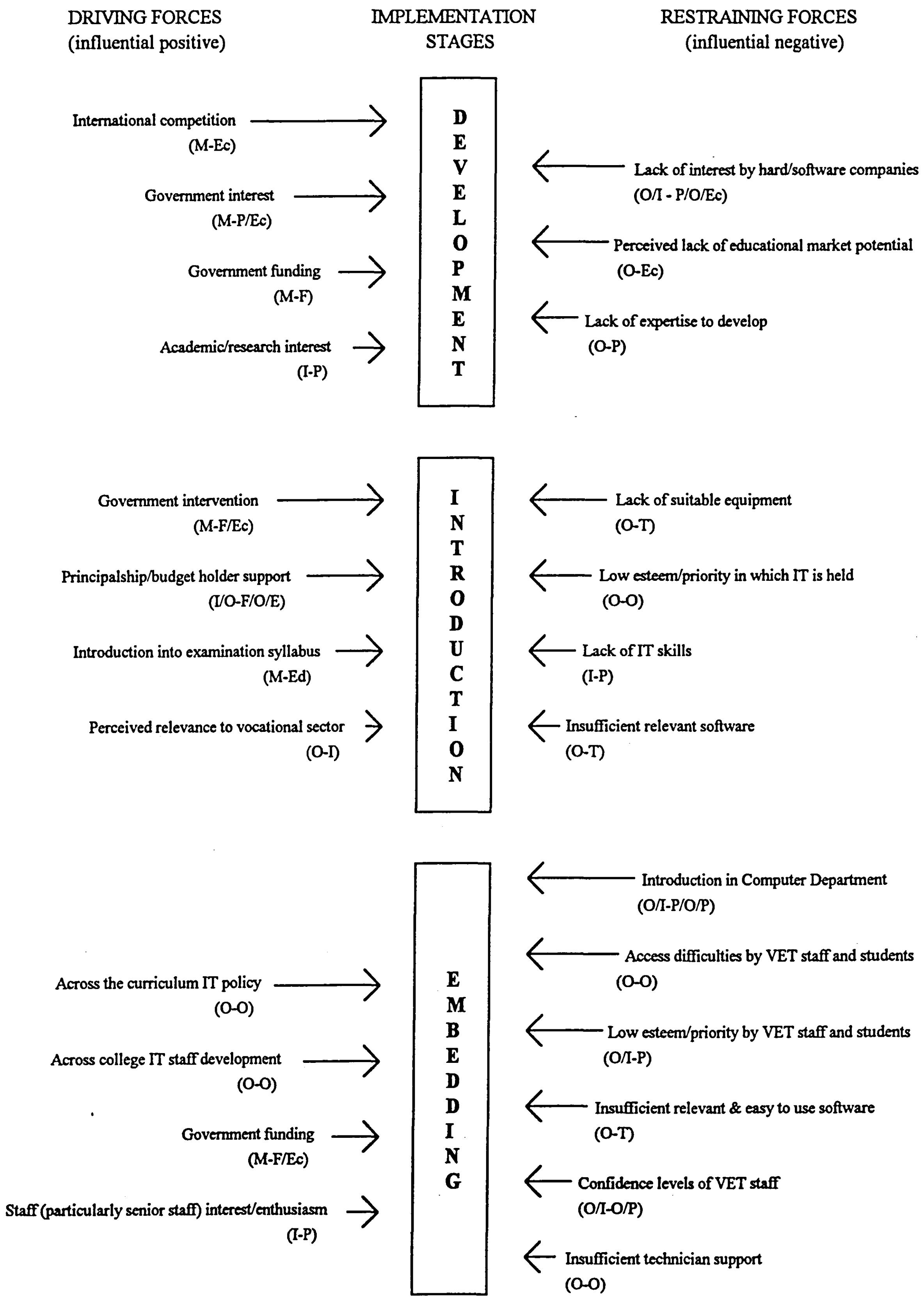
The final components of the EMBED model

The final model accounted for the three major components that were found within the study to affect the change adoption process. These have been included in the EMBED model (see Figure 43), and comprise:

Implementation stages	Development Introduction Embedding
Motivation factors	Macro Organisational Individual
Types of forces	Economic Financial Educational Industrial/commercial Technological Organisational Personal

The interactions between forces and their sphere of influence illustrate the dynamic and multi-faceted components that need to be considered when developing and funding any change strategy involved with the embedding of information technology into the Further Education vocational and training curriculum. All of these are greatly influenced by organisational differences both in structure and operations.

FIGURE 43 EMBED - THE FINAL MODEL OF CHANGE



Key: The first parenthesised letters indicate the motivational levels the letters following indicate the type of force

Motivation: M = macro O = organisational I = individual

Type of Forces: Ec = economic F = financial Ed = educational P = personal I = industrial/commercial T = technological O = organisational

The scope of EMBED

Based on the findings from the literature review and the fieldwork, Figure 43 diagrammatically illustrates the driving and restraining forces involved in the embedding of information technology and AIT into the Further Education vocational education and training curriculum. The arrows provide an indication of the relative strength of the various forces. Those with the *longest* arrows are the *least* important for that type of force and implementation stage. The idea underpinning the model is to maximise all the forces that drive change and obliterate all the forces that restrain the change adoption process.

For funding agencies, the importance of the model lie in the exposure of forces that should be funded at each implementation stage to aid the change adoption process. The model also indicates the focus of funding that would be required, for example, at a macro, organisational and individual level centred on the type of force, that is educational, technological, personal and industrial / commercial.

However, the model fails to indicate:

- the magnitude of any funding for a particular force, that is, how much funding should be given to support a driving force or to eradicate a restraining force
- whether a combination of forces within or at differing stages of implementation would provide a more effective funding strategy
- the actual change strategies to be used to ensure effective use of funding at each of the implementation stages
- the implementation stages of the participants within and between stages, that is, although the driving and restraining forces of stakeholders are indicated within the stages, the structure of the model is on the development of the technology, its introduction and continued use by the stakeholders rather that the perceptions, fears, needs and actions of the stakeholders themselves.

This leaves unresolved some of the questions that were not answered by the Tricycle model (see page 281) and the FAIIT models (see page 286), notably (see page 292) the questions:

- How much funding would need to be placed on each factor to ensure the embedding of information technology?
- Does funding need to be given to any factors that may work better in co-ordination?
- How long does the funding need to be given for the factors to yield success?

Did EMBED achieve its purpose?

The purpose of developing EMBED, as indicated earlier in this chapter, was to address some of the issues that the initial models of change failed to highlight. It was further envisaged that the final model would move from a model of change to one of changing as described by Fullan (1985), that is, a model that:

> *beyond theories of change to theories of changing (how change occurs and how to use this new knowledge).*
>
> Fullan (1985)

It was not possible to address all the issues outstanding from the initial work. Nor was it possible to present a comprehensive theory of changing as described by Fullan (1985).

EMBED does address two of the questions (see page 292) from the initial period of research:

1. To whom and on what should initial and subsequent funding be based?
2. For what type of activities should the funding be given?

Both of these questions are addressed at a global (force level) rather than a specific (within force) level.

In response to the first question, EMBED does indicate to whom and on what the funding should be based, for example, the need for the technology to be sufficiently developed and strategically introduced with support from the Principalship/budget holder is indicated in the model. The relative strength of the forces within the implementation stages also highlight what and on whom the funding should initially and subsequently be placed.

The level at which EMBED does not fully address the issue about initial and subsequent funding is within the forces. For example, the driving force across college information technology staff development does highlight the force but does not indicate what type of staff development should be implemented and to whom first. Similarly, the second question is addressed at a global level through the implementation stages and the forces outlined. However, again the model does not indicate the type of activities that need to be included for funding within the forces for an effective and successful change adoption process.

The move from a model of change to changing was partially successful in that EMBED offers a partial solution to *how change occurs* through the indication of the driving and restraining forces and the three implementation stages. It does not fully address the need for a model of changing to describe *how to use the new knowledge* because of its focus at the global level of activity.

In order to resolve the issues raised above, a series of models based at a specific level would need to be produced. For these to be produced, further research would be required at the specific, force level. Unfortunately, this type of research is likely to require extensive and extended research activities that would need to be specifically focused and comprehensively evaluated to ensure that the interactions between forces were clearly established.

CHAPTER 7

CONCLUSIONS AND IMPLICATIONS

Throughout the study, consistent themes and factors have emerged that indicate where and how government should structure their funding to best facilitate embedding (called *institutionalisation* by Crandall et al 1982 and *continuation* in Fullan, 1991). This chapter attempts to bring together all the strands of the work undertaken in this study and take the results one step further by providing a general (Mercer, 1985) and descriptive (Legge, 1984) model of change that can be used as a framework which will allow government funding to be staged, focused and evaluated to assess the actual impact achieved by the funding.

Critical success factors

A useful way of drawing together the conclusions is to establish those factors throughout all strands of the study that were consistently found to be critical to the success of the embedding of information technology / AIT into Further Education vocational education and training courses.
The driving and restraining forces (Lewin 1947) that affect the change adoption process at the three implementation stages have been highlighted in the EMBED model shown in Figure 43 (see page 303). Basically the critical success factors necessary and sufficient for such embedding indicate the need for:

1. External funding of some sort, for example,
    - through government:
        - directly through project funding for example, Kingston, Castle and the success case studies
        - indirectly, for example, through the LEA as with the ESG
    - through industry, as for example, with Kingston.

2. The need for a clearly articulated policy (HMI, 1987; HM Treasury, 1988; Davis et al, 1988 and NCET, 1991) which is not directed at, or through, traditional Computing departments but that focuses on implementation across all curriculum areas and teaching by the vocational as opposed to computer staff.
3. A project champion (Twiss, 1986) committed to embedding and who has the necessary power, influence and resources, either in his/her own position or via direct access through someone who can procure such resources. Whatever the change strategy the change adoption process is likely to be much more effective if it has positive Principalship support.
4. The need for staff development (NCET, 1991) which is developmental and addresses the individual needs (Hall and Loucks, 1978; Havelock, 1982 and Bolam, 1986) of the staff member and their individual and collective *subjective reality* (Fullan, 1991).
5. The need for suitably developed, easy to use and relevant software.
6. Accessible hardware, preferably owned by the specific vocational departments. (A consistent problem in the fieldwork, especially with the implementation case study sites, was access to appropriate hardware to run the CUSTOM).
7. The need for technician support.
8. The introduction of information technology into the curriculum as an essential element rather that as an adjunct (HMI, 1987).
9. Improved status of information technology / AIT within the college and its departments.

Implications of the study for funding agencies

Having conducted such a study and highlighted the critical success factors, it is important to consider the usefulness of the outcomes to society in terms of the future implications of information technology and AIT for the UK economy and to ascertain the role for Further Education in this.

Why information technology is important to the UK's future development

One of the four main challenges for Britain in the 1990s has been highlighted as the *introduction of new technologies* (DoE, 1991 and 1993). Of these, three enabling technologies have been identified as:

- information technology
- biotechnology
- new materials.

It is presumed by the DoE that the use of information technology will continue to spread during the 1990s with leading edge technologies penetrating through to companies that in the past have not used these techniques. In particular, the impact is seen as being in the service industries and in manufacturing through integrated and advanced manufacturing systems. Expert systems and AI will be further developed to aid increased production for managerial and professional occupations.

The DoE (1993), in describing the labour market and skill trends for 1994/1995 believe that the challenge of new technology will be on its:

- effective application
- efficient utilisation.

According to DoE the efficient use of the new technologies will not only require:

> *specific technical skills but also managers who appreciate the potential of technology and its implications for human resources.*
>
> DoE (1993)

The two areas where managers will need to have better awareness of the scope of new technology will be to:

- *improve products and processes*
- *implement the organisational changes that may be needed to get the full benefit.*

DoE (1993)

As the new technologies permeate the organisation DoE (1993) believe that all employees will require *at least the basic skills* in the use of the new technologies. The Engineering Council with the FEU (1988) believe that what they call the key technologies will be of significant importance to industry and to the vocational education and training curriculum.

Equally Maclure (1991) states that international demands on Further Education will *force* the UK to respond to the need of information technology and produce a workforce competent in information technology.

Thus the DoE believe that attention should be focused on the opportunities created for young people by the new technologies. In order to do this, there is a need for:

> *maximising the contribution of the vocational education and training system to local economic development.*
>
> DoE (1991)

The future need of Further Education vocational education and training

Predicting the labour market needs and skills trends for 1992/1993 (DoE, 1991) the DoE outline the important role of Further Education in post compulsory vocational education to the economic future of the UK.

The 1991 White Paper (Education and Training for the 21st Century) indicates the importance of the 16 - 19 years olds by promising opportunities and incentives for them. One of these is in the provision of vocational education.

According to the DoE (1991) the upturn in the economy started in the summer of 1991 with the *recovery gathering strength in 1992.* The challenges of this upturn will lead to the need for training. One of the main issues is:

> *how those involved with vocational education and training can best contribute to business, community and individual development in the expanding economy in 1992/1993 and beyond.*
>
> DoE (1991)

Each year one million young people aged 16 years to mid 20s (DoE, 1991) leave education and start work. The expansion of vocational Further Education is expected to rise from 2.2 million in 1989 to 2.9 million by year 2000.

In outlining the need for the UK to keep on a par with our competitors the government believes that vocational education needs to be treated as an essential commercial investment on a par with research and development.

The need to ensure that vocational education is designed to contribute to business success and economic growth is listed as the first priority for the government's new framework for Employment in 1990s.

The way forward

The NCET report (1991) states that colleges:

> *have a long way to go before embedding information technology applications are the norm across course areas.*
>
> NCET (1991)

This being the case, the implications of this study could be profound. With all the government funding that has been focused on Further Education within the period from the FEU (1984) to the NCET survey (1991), it is significant that embedding across the curriculum has not happened. Clearly, if the intention of the government was to ensure the use of information technology across the vocational education and training curriculum, it has failed.

How can this study help?

There are two essential factors to be considered when examining the way forward for the outcomes of this study:

- the emphasis placed by government on the predicted growth and use of information technology and AIT in the business and industrial environment
- the role of vocational education and training in addressing and providing for the growing information technology and AIT needs of the country.

Both of these indicate the continued importance for ensuring that information technology and AIT becomes embedded across all Further Education vocational education and training courses.

In examining EMBED (Figure 43, page 303) it is clear that there are five specific areas where government funding should facilitate the embedding of information technology and AIT across the vocational education and training curriculum.

Developmental work

This is necessary to:

- motivate:
  - those involved in fundamental and applied academic research
  - hardware and software companies
  - companies to use the technologies (i.e. development should be linked with industry/commerce needs which would, in turn, create demand from Further Education vocational education and training courses,

  to ensure that the technologies are sufficiently developed to be amenable to an educational market
- produce relevant, affordable, educationally focused and easy to use software specifically applicable, or that can be tailored to suit, the various vocational disciplines.

Method of introduction

The introduction of well developed AIT into Further Education establishments is not a great problem, in that, given funding most colleges will introduce information technology. However, this study has shown that the way in which information technology is introduced into the college is crucial to its expansion across the vocational education and training provision. Unstructured or even structured introduction led by Computer Departments has been found to be one of the most consistent themes leading to resistance and lack of take-up across other vocational areas. One way forward might be to base funding on measurable planned outcomes which focus on achievements across the vocational areas other than computing, engineering and business studies (NCET, 1991).

Staff development

Such planning should include the provision for staff development based on the raising of awareness and moving through to refocusing (Hall and Loucks, 1978). The plan should also provide incentives to increase the esteem with which information technology is held.

Technician support

To aid with staff development there is a need to include provision for technician support for lecturers at all stages in the development process. Part of the problem is that, as lecturers become more sophisticated users, their demands for technician support change as they move away from using simple software to that which is more complex. Observations from this study revealed three fundamental technician support types and levels which link with lecturer confidence in the use of information technology.

Level 1: The lecturer is aware of information technology and can use ready made software that does not require lecturer input. Often at this stage the processes followed are done so by rote. At this stage technicians are required to be close at hand because it is unlikely that the lecturer will experiment should anything go wrong. Technician help at this stage is crucial because, if the technology fails in any way, it may prohibit use by the lecturer in the future.

Please note: The levels and content are only observations and have not been validated or tested within the study. They do, however, highlight the need for technician support, which is always a problem because of the added cost without added income.

Level 2: The lecturer at this level understands more about the computer and is able to resolve common problems.

Technician support at this stage does not need to be as intense, especially if familiar software is being used. However, the technician will need to be available for hardware problems and uncommon software problems that inhibit the progress of students.

Level 3: The lecturer is confident and might wish to adapt or tailor software for their own and their students needs. A lecturer might be very skilled and able to complete such work themselves.

Technician support and the role required of the technician at this level can often be collaborative and facilitatory, working with the lecturer who may well be able to diagnose problems but not solve them. The technician needs to be available for this type of lecturer to provide advice and to resolve any major technology problems.

Inclusion of information technology as part of the vocational syllabi

Introduction into the curriculum through the inclusion in all syllabi. For example, information technology (Kenneth Baker, ACFHE speech 1989) could be introduced as part of the core curriculum which is being developed for vocational education and training students. Now that the government has a firm control over the vocational qualification system through NCVQ, this could be easily accommodated.
Although the EMBED model highlights the driving and restraining forces which allow funders to critically assess areas where funding should be focused, the emphasis is still on the funder's perception of Further Education vocational education and training curriculum needs. This study suggests that government should focus its funding and give only an indicative commitment (as with the ESG) to fund the provision further. Any future payment should be based on demonstrable, acceptable and evaluated outcomes.

One crucial element of such funding is that the provision should continue after funding has ceased, that is, it should be subjected to the institutionalisation test which examines whether the innovation has continued without its advocate and funding (Miles, 1983). This process is acceptable but can be very costly. Berman and McLaughlin (1978) found that most federally funded programmes ceased at the end of the funding period. Bearing this in mind, it is essential that embedding, internalisation and ownership takes place as part of the funded implementation strategy so that the innovation can continue with its own momentum following cessation of funding. For this study, the author believes that continued usage, internalisation and ownership **is** part of the innovation's **durability.**

Durability in this context relates to the:

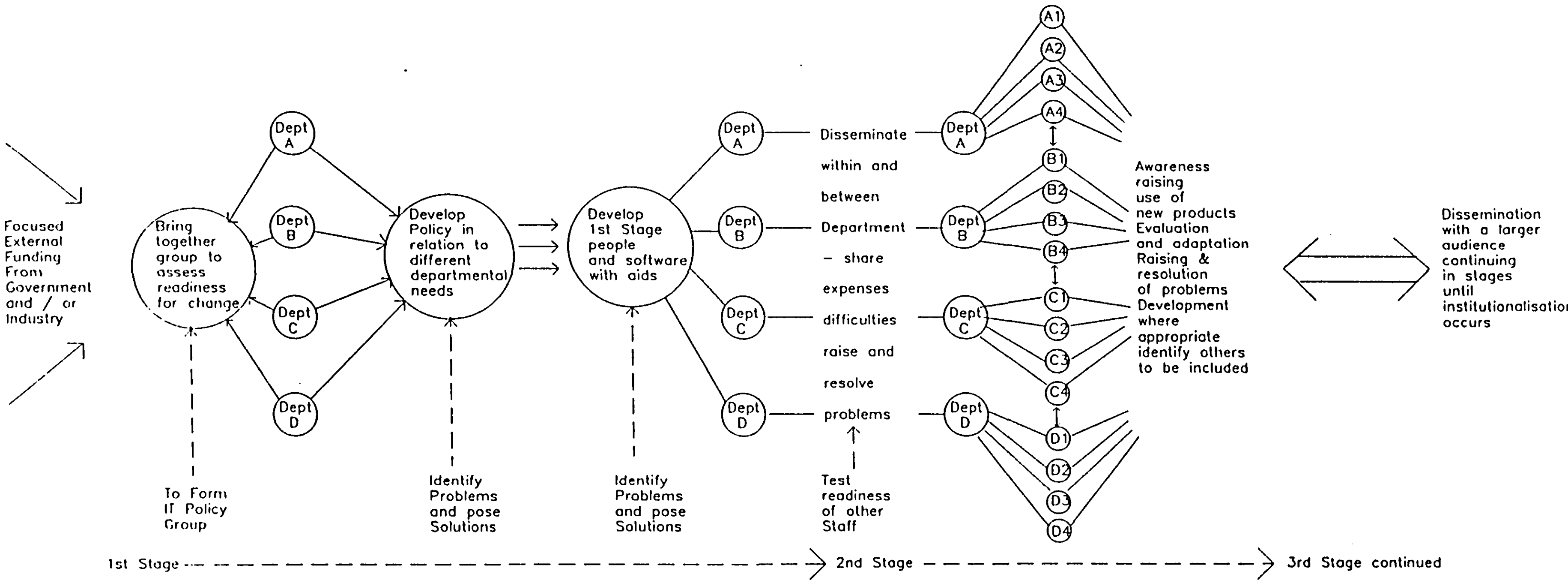
- innovation, whether it is relevant and acceptable to the organisation and the individuals to whom it is being introduced, that is, can it be introduced and will people use or implement it?
- strategy used to introduce and implement the innovation, that is, will it become a norm within the organisation and its staff ?

To this end a descriptive model has been devised which advocates a staged implementation process driven through shared policy making and development. An illustration of the processes involved are shown in Figure 44.

The basic assumption underpinning the model is that, given the diversity of Further Education establishments, there is a need for the funding, although focused, to be based on organisational, departmental and individual needs. The funding should be staged as indicated in the model. At each stage the actual benefits and outcomes should be demonstrated before the next stage is funded. The author accepts that this might appear threatening given the type of commitment required to implement information technology. However, this potential problem should be overcome by the funding provision being based on the individual organisation's needs. Thus, the products and outcomes will be useful to the organisation, its staff and students. This focus should facilitate the understanding or the phenomenology of the change (Fullan,

FIGURE 44

THE DURABILITY MODEL



1991) and hence help the change adoption process. Also, it allows the technology to be introduced in an evolutionary process (Naisbett, 1982 and Louis and Miles, 1990) which can enhance the chances of success by causing minimum disruption as it expands to other staff when their readiness has been established.

The durability model in Figure 44 shows the need for some type of external funding which must be focused, staged and not directed or driven by the Computer department. This is not to say that the Computer department should not be involved at all. Wherever possible, their expertise should be channelled into helping others, at least in the initial stages of development. However, this help should be directed towards the individual and departmental needs of the non-computer vocational departments.

A requirement for the funding should include the need for an acceptable information technology policy across the college which is:

- flexible enough to respond to changing need
- assured of allowing for change in practice
- appropriate to the varying needs of all departments
- developed by an appropriate group from across the college curriculum.

Indeed, it should address the three R's postulated by Fullan (1991): readiness; relevance and resources. It is also important at this stage to ensure that the organisational climate is receptive to change, and if not, set in place strategies that will facilitate a change in the climate (Bennis, 1969; Burke, 1987; Berkhard and Harris, 1987 and Gerstein, 1987).

The policy should include milestones which will allow for the monitoring and evaluation of any changes either by consensus or through reinterpretation of policy by the various stakeholders (Saunders, 1986). The latter should not be allowed to take over the policy or its credibility will be placed in jeopardy, leading to a garbage can (Cohen et al, 1972) or disjointed incrementalism approach (Braybrooke and Lindbolm, 1963). From studies conducted thus far these approaches are the type which have been most commonly used to bring about across curriculum implementation (or not) of information technology to date (for example, FEU, 1984a; HMI, 1987; Davis et al, 1988 and NCET, 1991).

Following the development of the policy (which although being relevant to the structure and operations of a particular college should be based on staged implementation), the first stage of individual staff development should take place. This needs be driven by the requirements of the participants whose ultimate goal should be to be able to develop or adapt software for their own and their colleagues vocational needs.

At the end, or more beneficially within this stage, other individuals should be invited to contribute. The outcomes can then be disseminated and further members of staff involved in the second stage development. At the end of each stage the progress and outcomes need to be evaluated to illustrate the benefits and uses within a Further Education vocational education and training environment. This should be completed at a departmental and interdepartmental level so that experiences can be shared, problems raised and solutions offered. The next stage of the policy will then be able to be reviewed in terms of its applicability to the organisational environment and climate at the time.

This process needs to continue until information technology and AIT has become a cultural norm across all departments of the Further Education establishment.

Future work

The Durability model, together with the EMBED model and the conclusions from the study, offer a sound foundation that could be built upon to ensure a comprehensive and validated model of change. The models need to be piloted and validated by funding bodies and tested in Further Education establishments. This work would inevitably lead to refinements and changes which may allow for a more comprehensive and valid model of changing (Fullan, 1985) to be developed. This would, in turn provide a better framework for government departments and agencies to better focus funds and intervention to ensure success.

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GLOSSARY

OF ACRONYMS AND TECHNICAL TERMS

(Page numbers are indicated following the glossary item)

ACFHE Association of Colleges for Further and Higher Education 28, 86, 314

AFE Advanced Further Education (includes education which lead to post 'A' level qualifications) 27, 35, 38, 39

AI Artificial Intelligence (computing programs that attempt to emulate human cognition) 16, 19, 54, 185, 202, 245, 248, 250-255, 268-274, 309

AI programme the DoE's Artificial applications to learning programme 185-201, 268-274

AIT Advanced Information Technology (more commonly called leading edge technology and usually related to 4th and 5th generation computer technology that can process knowledge rather than data) 9, 11, 16-17, 19-20, 23, 33-34, 53, 57, 65, 70-71, 84, 91, 172-173, 232-235, 246, 248, 253, 263, 268-274, 277-279, 295, 298, 304, 307-309, 312

ALVEY Committee, chaired by John Alvey, its purpose was to meet international competition and contribute towards international co-operation regarding the fifth generation computing projects. It reported in 1982 12, 54, 57-59, 63-64, 172, 235-236, 287

Awareness index, an evaluation tool developed to indicate the awareness levels of individuals who have been exposed to AIT 20, 185, 194-196, 201

Base case what would have happened if a policy had not been implemented 168-169, 197-199

BASIC one of the original computing languages 72, 222-223, 227, 230

BTEC Business and Technician Education Council 19, 39, 47, 61, 116-118, 206, 208-209, 217, 224, 246, 247, 250, 254, 258-260

CAD Computer Aided Design 71, 74, 264

CAL Computer Assisted Learning 83, 266, 270-271

CAM Computer Aided Manufacture 71, 74, 264

CBAM Concerns-Based Adoption Model 129-130, 174

CBI Confederation of British Industry 47, 287

CBT Computer Based Training 83, 264-265

CERI Council for Educational Research and Innovation 121

Change adoption process, those processes which are important to successful change. They include consideration of:

- **change entry processes**, that is, those processes necessary to ensure that the change is introduced into the organisation, including an investigation of the gatekeepers, potential resistors, readiness of the stakeholders and tensions between the stakeholders
- **change activities,** that is, activities which have been selected by those seeking the change to maximise the potential of success
- **change embedding processes**, that is, those processes which will facilitate embedding of the change into the culture of the organisation 276, 293

Change agent, a person who facilitates change or planned innovation, they can be from within the organisation (internal change agents) or from outside the organisation (external change agents) 132-135, 285, 290

Change intervention media,the media, materials and items which are core to the change adoption process 276

Change strategy, the processes, procedures, practices and policy to be adopted, investigated, operationalised and, where necessary, adapted to ensure the successful implementation of change. The change strategy highlights the approaches to be used and the people who will drive the change adoption process 276

CIRG Communications and Information Research Group of Sheffield City Polytechnic, now Sheffield Hallam University 269

CNC Computer numerically controlled machines 71

Contextual analysis, an analysis of the context for organisational change which is conducted at vertical, hierarchical levels within an organisation and at horizontal longitudinal study levels, ie, the study of past, present and future perspectives 145-146, 174, 181

Continuation, Fullan's term which equates with embedding in this study 125, 175, 307

Cost effectiveness bars, a specific tool developed by the author to allow the cost effectiveness of project/programme variables to be plotted in terms of % increase and % decrease against the base case 20, 176, 185, 197, 199-201

CPVE Certificate of Pre-vocational Education 38, 43

CSE Certificate of Secondary Education 231

CSF Critical Success Factors, those things that have to go right in order for an organisation to succeed in bringing about change. There are two types of CSFs: *critical* ie those CSFs that are critical for an organisation to achieve its mission and *sufficient* ie those CSFs that are important tot the organisation achieving its mission 112-113, 175, 307-308

Curriculum change context, the holistic view of the situation within which the curriculum change will occur. It includes investigating and evaluating the type of organisation within which the curriculum change is to be implemented; the political and other implications that are present within the environment; stakeholders both within and outside the organisation and the type of change to be implemented 275

CUSTOM, the name of the Expert System developed at Castle College in a college catering environment 18, 23, 182, 202, 246-263, 308

DES Department for Education and Science (now split into the DFE and DFS) 12, 27, 32, 34, 44, 54, 71, 78-82, 204, 209, 293

DESSI Dissemination Efforts Supporting School Improvements 126

DFE Department for Education 12, 27, 32, 71

DFS Department for Science 27

Disjointed incrementalism, a descriptive account of what decision makers actually do, ie, they do not evaluate alternatives but make successive limited comparisons and a series of disjointed and incremental decisions that they muddle through 102, 246, 253, 317

DoE Department of Employment 13, 19, 34, 38, 78, 111, 185, 197, 204, 205, 207, 235-241, 246, 248-250, 309-310

Driving and restraining forces, linked with force field analysis, they are those forces which drive and restrain the change adoption process 110-112, 149-151, 176, 277, 296, 300, 303, 307

DTI Department of Trade and Industry 13, 71, 73, 204

Durability mode, focusing on the Further Education institution, provides a strategic framework to assist government and other funding agencies and departments embed information technology courses 8, 20, 315-318

EMBED, a three staged model which highlights the driving and restraining forces influencing the introduction of information technology /AIT FE VET curriculum 8, 20, 280, 297-307, 312, 314, 318

Embedding, the term used in this study to indicate that the change adoption process has been embedded into the culture of the organisation and is still continuing when any funding has ceased or its advocates removed (see also change embedding process) 232, 245, 276, 295, 292, 298-299, 305, 307

INSET In-service education and training 81

InTER Information Technology in Education Research programme 85-86

Institutionalisation, the built-in-ness or the embedding of the innovation into the culture of the organisation 126, 175, 232, 276, 307

Institutionalisation test, a test linked with whether the innovation continues after the funding has ceased and without it advocate 126, 245, 315

Intervention theory/method/approach, when someone enters an ongoing system of relationships to come between or among persons, groups or objects for the purpose of helping them 132, 232, 293

IT Information Technology (used by Davis et al to indicate *aspects of technology*, 84-85) 54, 62-63, 84-85, 90, 111, 139, 212, 251, 296

ITDU Information Technology Development Unit 173, 233-245

ITITO Information Technology Industry Training Organisation 207

IT86 committee chaired by Sir Austin Bide that set out the Plan for Concerted Action (The Bide Report) in 1986 63-64

LAA Local Authority Association 77

LCP Local Collaborative Project 265

LEA Local Education Authority 29, 32-34, 42, 69, 73, 77-82, 182, 202, 207-215, 246, 266, 307

LEATGS Local Education Authority Training Grants Scheme (now integrated into GEST) 81-82, 205

LPA Local Priority Areas 81

LSIC Large Scale Integrated Circuits 54

LTU Learning Technology Unit 11, 268

MEP Microelectronics Education Programme 13, 53

MMI Man-machine interface (now usually referred to as HCI) 58

Motivational levels, the three motivational levels found within EMBED; macro, economic level; organisational level and micro, individual level 301-303

MSC Manpower Services Commission (now part of the DoE) 11, 22, 38, 41, 42, 44, 77, 172, 197, 235, 238, 240-241, 268

POPs Possible Opportunity Persons (groups of people located within a POG of the Tricycle model, they can be influential positive, ie enthusiastic about the innovation and can set up strategies for implementation; they can be influential negative, ie resisters to the innovation and can set up strategies for sabotage or they can be ambivalent and may be influenced by either of the other two POPs) 280-284, 281-293, 295-296

Procultural approach the top-down imposition of an innovation 135, 233

Project champion, a highly motivated person and dedicated leader to push the change adoption process forward 113, 175, 232, 245, 267, 277, 308

Pyramid model, an evaluation tool based on Saunders implementation staircase. It has been used to the indicate stakeholders on whom their could be an impact, the flow of communication between them and, following the intervention, the actual impact 20, 185, 192-194, 201

RDC Regional Development Centre created as part of the ESG 208-210

RD&D Research, Development and Diffusion orientation 140-141

RSA Royal Society of Arts 61, 206

SCP Sheffield City Polytechnic, now Sheffield Hallam University 269-274

SEAC Schools Examination and Assessment Council 86

Sphere of influence, represents the need to outline the influence the various factors, people and agencies (outlined in the FAIIT model) had on the change adoption process. Sphere of influence had four elements speed, scope, type of influence and worth 293-294

SoC Stages of Concern that form part of CBAM 129-130

Stakeholding audiences (more usually referred to as Stakeholders), the differing interest groups who can affect (detrimentally or beneficially) the introduction of a programme, they can be external to the establishment (external stakeholders) and internal to it (internal stakeholders) 29-30

Stakeholders same as stakeholding audiences 29-30, 33, 35, 295, 317

Taxonomy of variable determinants and analysis matrices, focusing and analysis instruments developed by the author to help any researcher or evaluator make explicit all the variables that need researching within a research activity and to allow the documentation of the outcomes 20, 176, 185, 186-192, 201, Appendices A and B

TEC Training and Enterprise Councils 33, 78, 185

TEC Technician Education Council (now BTEC) 95, 117-118

Threshold of readiness, covers two aspects in the change adoption process, the readiness of the stakeholders within the organisation to introduce and adopt the change and the readiness of the change intervention media to be introduced and embedded 277

Total growth of impact graphs, graphical representations developed by the author that can allow the cumulative impact to be measured over time against the base case in units of impact 20, 176, 185, 197-199, 201, 269

Tricycle model, a model which identifies three groups of people who may influence, positively or negatively, the change strategy, these people are located in Possible Opportunity Groups (POGs) and comprise Possible Opportunity Persons (POPs) who are influential positive, ie are enthusiastic about the innovation and can set up strategies for implementation, those who are influential negative, ie those who are the resisters to the innovation and can set up strategies for sabotage and those who are ambivalent and may be influenced by either of the other two POPs 8, 20, 280-284, 291-293, 295-296

TVEI Technical and Vocational Education Initiative 43, 87

Types of forces, found to exist for the EMBED model included:

- **Economic forces** include market related forces found to affect (positively and negatively) the implementation of information technology into the Further Education curriculum
- **Financial forces** included those forces which were related to the funding of information technology at all levels within the information technology implementation process
- **Educational forces** were allied to the delivery of the FE VET curriculum
- **Industrial / commercial forces** included those forces which were found to be driven or delayed by the needs / wants of industry and / or commerce
- **Organisational forces** included those forces which referred to the organisational / policy implications for the embedding of information technology into the FE VET curriculum
- **Personal forces** involved those which drove stakeholders to use, or prohibited them from using, information technology at any stage within the implementation process 296-297, 302-303

Verbatim counting technique, a data driven process developed by the author which allows for the quantification of qualitative data. The process involves the analyser taking each verbatim comment (that is, each individual comment and not the whole response, as there might be several comments in an individual's response) made by one respondent and counting how many other comments reflect the same idea, thought etc. This technique, although used for qualitative questionnaire data analysis at a micro level, is similar to the idea of *grounded categories* used by Saunders (1986) for the *interpretative analysis* of tape transcripts from the TVEI interviews 225

VLSI Very Large Scale Integration 58, 60

WRFEDF Work related Further Education Development Fund 88

Appendix A

The Taxonomy of Variable Determinants

Taken from:

Evaluation of Impact on Further and Higher Education

Summative Report
for the Employment Department's Learning Technology Unit
by the Sheffield Polytechnic Evaluation Team

May 1991

Appendix C

The Taxonomy of Variable Determinants

Classification Variables	General Areas	Component Variables
Exploration	**Knowledge**	What knowledge did the development team have at the outset of the project in: • conventional computing? • intelligent computing? How much knowledge is there in this area of work in other educational institutions?
	Uniqueness	How unique was the project: • to the Training Agency? • for personnel involved in developing/using the product/process? • to the institution developing the innovation? • to outside educational and industrial organisations? • as an application to learning? • in the use of different teaching methods?
	Learning	What did the development team believe they had learned from each stage of the project? i.e. • the design stage • tool availability and acquisition • knowledge elicitation • building the system/developing the process • evaluation procedures for the system/project.
	Success	Was the product/process successful: • to the project team? • to the Training Agency? • to the institution?

Classification Variables	General Area	Component Variables
Exploration contd.,	**Changes in Institution**	Have there been any general changes in the institution's operation because of the innovation in terms of: • management procedures? • changes in the "core mission" of the institution? • changes in administrative procedures?
	Transfer and Change in Practice	Can any specific examples of changed practices be identified that have been brought about: • by the Training Agency funding generally? • by the department/institution involved in the innovation in terms of: - management procedures? - resources allocation and distribution? • on the departmental personnel involved in the innovation, in terms of: - teaching method? - learning environment? - involvement in techniques new to the individual? - content of lectures? • on other departmental staff within the institution in terms of the above? Have the techniques used been transferred to other subject areas either inside or outside the department conducting the project?
	New Applications	Have any new applications emerged from the execution of the project?

Classification Variables	General Area	Component Variables
Resister	**Internal Institutional Resistance**	Are there any persons within the institution that are opposed to the use of the product/process? Are the personnel resisting the innovation influential in terms of: • decision making? • personal influence? • gate-keeping? • allocation of resources?
	External Resistance	Is there resistance from outside to the acceptance of the innovation? If so, what? why? and whom?
	Reasons for Resistance	Why are these people resisting the innovation? Are there any people resisting the innovation who used to support it? If so, why?
	Stages in Resistance	Are there any identifiable stages through which the lecturers/management go to reject the innovation?
	Background Experiences	Are there any specific or general background experiences that may discourage lecturers/managers to use/be involved in the innovation?
	Support	Is staff development essential for making the process/product more acceptable to lecturers/managers?

Classification Variables	General Area	Component Variables
Resister contd.,	**Barriers**	What are the greatest barriers to the acceptance of the development? • personal (individual lecturers): - technology negative - needs negative - for self and students - incentive negative - personal conflicts • departmental: - management negative - needs negative - resource negative - incentive negative - intra-group conflict • institutional: - management negative - "core-intermission" conflicts - inter-departmental conflict
	Minimisation of resistance	Is there any one thing (or a series of things) that: a) initiated? b) resistance overcame? Are there any factors which indicate when and if resistance should be: a) quelled? b) re-channelled? c) ignored? Is there a critical stage whereby resistance should be: a) quelled? b) re-channelled? Is there a specific time span for lecturers / management to become: a) aware of the innovation b) responsive to it c) involved with it in order that resistance be minimised?

Classification Variables	General Area	Component Variables
Acceleration	**Compatibility**	How compatible is the product/project with existing practices?
	Transportability	Is the product/process transportable? (in terms of the shell for Expert System, the hardware, institutions, subjects matter etc.)
	Dissemination Structure	Are there structures set up within the project that will ensure dissemination? (e.g. staff training, inclusion in the curriculum, a saleable product, conferences etc.) Is there support for lecturers wishing to become involved in the innovation and what is the nature of that support?
	Acceptance Stages	Are there any identifiable stages through which the lecturers go to accept the innovation and can any strategies be introduced that will accelerate these?
	Background Experience	Are there any specific or general background experiences that may encourage lecturer/managers to use/be involved in the innovation?
	Motivation	Are there any incentives for the implementation of the project by other members of staff, other institutions?
	Marketing Strategies	Have any marketing strategies/funding have been incorporated for the dissemination of the process/product outside the institution? (see also Market Variable section)
	Original Ideas	What areas in the original proposal were specifically designated as accelerating the use of AI in learning?
	Generic/Specific Needs	Does the process/product answer or fulfil a particular/specific or general need? Are there other persons in the institution that are now enthusiastic about the terms of development in terms of : • strategies set in place that enabled this change of attitude? • personnel type? • personnel knowledge? • personnel involvement?

Classification Variables	General Area	Component Variables
Ergonomic	**Specific Environment**	Does the process/product require a special environment in which to function or is it environmentally robust?
	Access	Will the process/product require special access points and/or security?
	Cost	Is the cost of the product/process in any way prohibitive? (see Market Variable section)
Learning	**Effectiveness**	Has the process/product improved the effectiveness of the learning?
	Learning of Lecturers	For lecturers: • more time for the students? • a more effective tool for teaching the material? • a more motivating environment for student? • skill acquisition? • change of role e.g. lecturing/facilitator?
	Learning for Students	For students: • enhancement of the learning process? • motivational value? • individualised learning opportunities? • skill acquisition? • more information presented in an interesting way? • extra vocational competences achieved?
	Learning for the Training Agency	For the Training Agency: • in the identification of elements of AI applications to learning that will enrich and enhance the learning/training environment? • in identifying appropriate pointers for new funding? • in determining the advantages and disadvantages of external evaluation procedures?

Classification Variables	General Area	Component Variables
Industrial	**Liaison**	Are better collaborative links with industry likely to be forthcoming because of the project/process? Is liaison between industry and education likely to be improved because of the development/use of the project/process?
	Direct Industrial Involvement	Will the product/process involve lecturers more directly in the industrial process? Will the product/process affect or become part of the industrial process?
	Emulation of the Industrial / Commercial Process	To what extent will the product/process enable the: • students • lecturers • institutions to better emulate the industrial/commercial process?
	Understanding of the Industrial / Commercial Process	To what extent will the product/process enable the students to better understand the industrial/commercial process?
	Performance within an Industrial / Commercial Process	To what extent will the product/process enable the students to better perform in an industrial/commercial environment?

Classification Variables	General Area	Component Variables
Competence	**Knowledge, skills / abilities**	Will the innovation allow the students to access extra knowledge/skills/social and vocational abilities? If so, what are these?
	Industrial / Commercial	Will the extra abilities give them competences that will make them more acceptable in industry / commerce?
	Specific/Generic	Will the process/product give the students extra specific competences? Will the process/product give the students extra general competences?
	Transferability	Are the extra competences vocationally transferable: a) laterally? b) horizontally?
	Developmental	Will the lecturers acquire, by the use and/or involvement in the development of the process/product, any extra competences?
Effectiveness	**Throughput**	Does the innovation allow a larger throughput of students?
	Quantity of knowledge transfer	Are the students learning more for the same cost?
	Quality of Learning	Does the innovation add an extra dimension to the learning environment?
	Cost	Will the innovation, in the long term, lead to a reduction in the cost per head per hour of teaching time? Has the cost of innovation been of use to Training Agency personnel in their appraisal of AI applications to learning?
	Human Resources	Is the innovation most cost beneficial in terms of lesson preparation, marketing etc.? Does the innovation allow better use of human resource? Is the innovation able to be a "stand-alone" tutor? Will the innovation replace any human resource?

Classification Variables	General Area	Component Variables
Market	**Demand**	Is there a demand for this product/process: • within the institution developing the innovation? • outside the institution, in education and/or industry? How large is the market for which the product/process might be appropriate?
	Adaptability	Could the product/process be adapted for other markets? How large is the market for which the product/process might be appropriate?
	Marketing Strategies	Have strategies been incorporated within the project for marketing the process/product? (see Acceleration Variable section) Is the cost of the process/product prohibitive to educational and/or industrial establishment? How will this be dealt with? Who will deal with this?
	Individual Marketability	Have the skills/knowledge the students/lecturers have gained from the development/use of the innovation made these individuals more marketable in industry/commerce?
	Institutional Marketability	Will the developing institution receive any reward for the dissemination/marketing? Will the institution developing the innovation benefit and become more marketable because of the extra skills/knowledge/competencies of their personnel?

Classification Variables	General Area	Component Variables
Management	**Programme direction**	Was the programme as it was perceived? (Measurement of change of direction/practice) Was the use of the External Advisory Group (EAG) a good way to direct a programme? How was the programme directed? Was this effective direction?
	Decision making procedures	How effective were the decision making procedures for the projects? How effective were: • the design of the selection procedure? • the selection procedures as implemented? • the use of the Internal Advisory Group (IAG)? • the dissemination procedures within the Training Agency for the AI applications to learning programme?
	Leadership	Was the amount and type of senior management an efficient contribution to the programme? What were the programme leadership styles? Was the style of leadership effective for the successful implementation and completion of the programme? Were the project leadership styles effective? Did the leadership styles of the Steering Groups differ? Did these differences affect the direction the Steering Group, including its effectiveness?
	Steering Group Direction	Were the Steering Group helpful to the project direction of the project personnel? What was the composition of the Steering Group? How effective was the composition of the Steering Group to the completion of the project? Did the Steering Group members gain anything from their membership of the group?

Classification Variables	General Area	Component Variables
Evaluation	**Intervention (External General Area)**	How much effect did the evaluation team have in terms of: • the exploration? • the acceleration? • the evaluation of the cost effectiveness appraisal of the programme? Did the evaluation team affect the final outcomes of the projects? If so, in what ways? Did the project teams and/or the Training Agency see this as beneficial to the aims of the AI applications to learning programme?
	Methods	Did the methods employed constitute confounding variables to the evaluation? Did the evaluation methods yield valid data? Did the evaluation yield reliable data? Could the evaluation methods be improved? If so, how and why?
	Usefulness	Were the evaluation team seen as useful to: • the Training Agency? • the Project managers? • the Project teams? If so, how and why?

Classification Variables	General Area	Component Variables
Evaluation contd.,	**Exploration**	Did anything new come out of the evaluation projects? Were they useful to the Training Agency/Research community?
	Cost Effectiveness (External General Area)	In terms of the evaluation of venture capital did the evaluation team bring about changed practice in: • the Training Agency personnel and management? • the completion of the AI programme and projects?
	Evaluation Effectiveness	Were the methods used effective as measures of the Training Agency's programme? In terms of formative evaluation: What were the affects of this part of the evaluation on the success/failure of the programme? Were methods of quality assurance included in the evaluation procedures? How effective were these methods?

The Taxonomy was developed by Linda Goodman (April 1988)
with acknowledgements for the contributions and support from
Jenny Mundy and Murray Saunders.

Appendix B

Evaluation Matrices

Taken from:

Evaluation of Impact on Further and Higher Education

Summative Report
for the Employment Department's Learning Technology Unit
by the Sheffield Polytechnic Evaluation Team

May 1991

Appendix D

	KNOWLEDGE	UNIQUENESS	LEARNING	CHANGES FOUND	SUCCESS & NEW APPLICATIONS	E X P L O R E
THRESHOLD POINT						
AREAS OF IMPACT (INDIVIDUAL/ PROJECT/ ORGANISATION)						
CONSTRAINTS TO DEVELOPMENT/ IMPACT						
AREAS OF POTENTIAL GROWTH/ IMPACT						
METHODS USED FOR DATA COLLECTION						

	INTERNAL RESISTANCE		EXTERNAL RESUSTANCE		
	INDIVIDUAL/ GROUP	ORGANISATION	INDIVIDUAL/ GROUP	ORGANISATION	
THRESHOLD POINT -AREAS OF RESISTANCE FOUND					R E S I S T
AREAS OF IMPACT MADE AGAINST THE RESISTANCE (INDIVIDUAL/ PROJECT/ ORGANISATION)					
GROWTH OF RESISTANCE REASONS, BACKGROUND, BARRIERS ETC					
AREAS OF POTENTIAL IMPACT AGAINST RESISTANCE					
METHODS USED FOR DATA COLLECTION					

	LIAISON WITH INDUSTRY	DIRECT INDUSTRIAL INVOLVEMENT	INDUSTRIAL PROCESS ACCOMMODATION	
THRESHOLD POINT				
AREAS OF IMPACT (INDIVIDUAL/ PROJECT/ ORGANISATION)				I N D S T R I A L
CONSTRAINTS TO DEVELOPMENT/ IMPACT				
AREAS OF POTENTIAL GROWTH/ IMPACT				
METHODS USED FOR DATA COLLECTION				

	MARKETING / DISSEEMINATION		SOFTWARE COMPATIBILITY/ TRANSPORTABILITY	GENERIC APPLICBAILITY	ERGONOMICS	
	INTERNAL	EXTERNAL				
THRESHOLD POINT						
AREAS OF IMPACT (INDIVIDUAL/ PROJECT/ ORGANISATION)						A C C E L E R A T E
CONSTRAINTS TO DEVELOPMENT/ IMPACT						
AREAS OF POTENTIAL GROWTH/ IMPACT						
METHODS USED FOR DATA COLLECTION						

	LECTURERS	STUDENTS	TRAINING AGENCY	
THRESHOLD POINT				
AREAS OF IMPACT (INDIVIDUAL/ PROJECT/ ORGANISATION)				
CONSTRAINTS TO DEVELOPMENT/ IMPACT				EFFECTIVENESS
AREAS OF POTENTIAL GROWTH/ IMPACT				
METHODS USED FOR DATA COLLECTION				

	INDUSTRIAL/ COMMERCIAL COMPETENCES	GENERIC COMPETENCES	ADDITIONALITY IN TRAINING AND PERFORMANCE		
			LECTURERS	STUDENTS	
THRESHOLD POINT					
AREAS OF IMPACT (INDIVIDUAL/ PROJECT/ ORGANISATION)					
CONSTRAINTS TO DEVELOPMENT/ IMPACT					
AREAS OF POTENTIAL GROWTH/ IMPACT					COMPETENCE
METHODS USED FOR DATA COLLECTION					