THE ROLE OF THE PRINTING INDUSTRY OF THE FUTURE WITHIN THE COMMUNICATIONS INFRASTRUCTURE OF THE UNITED KINGDOM

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SUMMARY

The role of the printing industry of the future within the communications infrastructure of the United Kingdom.

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This thesis examines the effect of new technology on printing and publishing now and the likely changes by 1995. Computer-driven technology (and particularly micro-electronic computers) are having an effect on most major industries but the greatest effect is in the field of information processing and distribution.

Since the situation is complex an information transfer model is proposed and used where possible in the thesis as a means to identify and clarify the issues involved.

The thesis examines both the direct and indirect effects of new technology on printing. The direct effect is seen in the new electronic equipment (electronic composition and page-make up systems, scanners and laser plate-makers) which are causing major changes in production methods. The indirect effect occurs in two ways. First in the emergence of new substitutes for printing such as high speed copiers, ink jet and laser printers and new electronic media such as view-data and teletext. Second in the emergence of industries using these technologies and the development of publishing potential of established industries such as the telecommunications and computer supply industries.

All these effects are dependent on socio-economic conditions and are in turn causing major socio-economic changes such as job loss and creation, retraining, company closures and the creation of new companies.

To ensure that full consideration is given to all these factors background information is given on: structure of the printing, publishing and alternative industries, new technology in printing, print substitution technologies and alternative media. The implications of the new technologies for manpower and consumer are then explored using the information transfer model. A forecast is then made of the situation in printing and publishing to 1995.

Keywords: printing, publishing, information transfer, modelling, forecasting.

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C H A P T E R 1

OUTLINE AND DEVELOPMENT OF THESIS

1.1 Introduction

Since its inception, printing has adapted to changes in technology and gradually absorbed the best developments. Recently, and particularly in the past decade, the pace of introduction of technology has increased rapidly. Moreover the nature of these technological innovations has also changed, affecting methods of publishing as well as printing.

Therefore decision makers in printing and publishing now require information and assessment of the latest technological innovations and future developments. This has led to expansion of research in this area.

Pira, the research association for the paper and board, printing and packaging industries, is one research centre that has provided additional services to members to help them in their assessment of technological developments. This was one of the reasons for the formation of the Techno-economics Group (see Section 1.2).

The Techno-economics Group relied mainly on outside consultancy for the major part of research on technical projects. The IHD (Interdisciplinary Higher Degree) scheme was therefore seen as a potential source of in-house expertise and the following IHD project was proposed:-

The objective of the project would be to study the role of the printing industry of the future within the communications infrastructure of the United Kingdom. The intention would be to study technologies which can become substitution technologies within the printing industry and those technologies which will become a substitution for printing but operate as an alternative medium - for example, teletext. The forecasting period of the study would be 15 years, and it would be necessary not only to generate in-depth scenarios of the technology available but also to assess the technological implications, the economic and sociological implications and industrial impact which the changing pattern of printing technology would produce. The central theme of the project would be technology forecasting but with the inter-related discipline of economic and sociological assessment. The technology would tend primarily to be in the area of computer sciences, electronics, opto-electronics and telecommunications. In addition, it would involve a requirement for systems analysis at the macro level in determining cross over points at which the technical feasibility and economic break-even points could be achieved for transference of communication from conventional printing into alternative media. The resultant information coming from the study would be fed into various Pira projects over the three year period during which the work would be undertaken.

The general theme of this proposal has been followed but such a broad concept is open to a number of differing interpretations and this thesis is only one of them. There are differences of detail between this thesis and the proposal particularly concerning the methodology used.

The selection of appropriate methodologies for this research project was a difficult task and this is described in Chapter 2. References to the proposal are also made in Sections 1.2, 1.3 and 1.4.

The remainder of this chapter describes the research project and its development. Section 1.2 provides background information on Pira and the Techno-economics Group. Section 1.3 examines the use of industrial research reports as research instruments. Section 1.4 describes the Pira research projects which were co-ordinated with this research project.

The development of this research project is described in Section 1.5.

Section 1.6 concludes this chapter with a description of the remaining chapters in this thesis.

1.2 Techno-economics Group at Pira

The Printing Industry Research Association, was founded in 1929 as a one man information bureau. This association slowly grew until 1936 when the provision of a Government grant from the Department of Scientific and Industrial Research enabled considerable expansion in research activities. The association was re-named Printing and Allied Trades Research Association, PATRA. When a move was made to new premises in London in 1937 the staff had risen to 18. A further move was made in 1948 to the present site at Leatherhead, Surrey.

Close relations were developed in the sixties between PATRA and the British Paper and Board Industry Research Association which was located at Kenley. In 1967 these two associations merged as Pira, the research association for the paper and board, printing and packaging industries. The number of employees reached a peak of just under 200 in 1976.

At the commencement of this research project in 1978 Pira was organised as five Divisions; Paper and Board, Printing, Packaging, Information and Training, Administration. The original role of Information and Training Division was to provide services to both members of the association and to researchers in the Paper and Board, Printing and Packaging Divisions. The services provided include those centred around a well equipped library, production of self-instruction training kits and provision of seminars, conferences

and courses. The Library services include the provision of Selective Dissemination of Information profiles (SDI), abstracts journals, bibliographies and translations. Extensive use is made of a computerised information system and Pira has a bibliographic database held at the Lockheed Dialog computer centre in California, USA.

The formation of the Techno-economic Group in 1976 was a new venture which offered a different product to those offered by the existing services within Information and Training Division or by the three industry divisions. The Techno-economics Group published reports that differed from reports published by the three industry divisions in that the latter concerned results of 'hands-on' research. These reports were of three different types:

- statistical and economic reviews
- sector studies
- new and emerging technologies.

Techno-economics was a small group relying on outside consultancy for the bulk of the research carried out for each report. Most of the studies were carried out on a multi-client basis.

By 1978 the Techno-economics Group had become firmly established and the reports published had become well-known both within the UK and abroad. It was hoped to expand the group and add more 'in-house' expertise. The IHD scheme was seen as a method for achieving these ends and participation commenced in October 1978.

The research outline proposal has been stated in Section 1.1. From the Pira viewpoint the objectives for their participation in the I.H.D. were to obtain:-

(i) extra personnel within the Techno-economics Group working as researcher, author and manager of projects

(ii) 'in-house' expertise within the group on computing, electronics and other technological subjects.

(iii) a non-printing viewpoint for assessment of new technology.

Curwen (1981) using the term 'publishing' in its widest sense to include printing comments in the Preface to his book:-

"The publishing industry is excessively defensive about its trade practices ....".

Therefore objective (iii) is important at a time when there are many potential threats to the printing industry.

The student would participate in projects associated with printing rather than paper and board or packaging. These projects would be of a technology assessment or technology forecasting nature rather than statistical. Three projects were scheduled which would include participation by the student. These were:-

- Technology forecast for the printing industry 1978/88
- The impact of speech input and recognition systems on the communications industries.
- Survey of integrated text-tone publishing/printing systems.

These are described in detail in Section 1.4.

1.3 The use of industrial reports as research instruments

One major difference between the research proposal given in Section 1.1 and this research project is that Pira projects have been fed into this research project rather than vice versa as indicated in the last sentence of the proposal. This was due to the pressure exerted by the industrial sponsor.

The Pira reports were used as research instruments for this thesis and they offered a number of advantages compared to academic channels of research:

- there was access to Pira's confidential information on printing and publishing.

- There was the opportunity to obtain expert opinion from Pira's staff.

- Contacts with suppliers and users of the most up-to-date equipment and other research workers could be most easily made under Pira's auspices.

- Pira provided established research procedures.

There were also disadvantages, the two most important being that the methodologies and emphasis of the Pira reports were unsuitable for direct inclusion in a thesis. The reports were designed with a particular readership in mind (printing and publishing executives) and the methodology and emphasis were tailored accordingly.

Although the reports touched on some socio-economic aspects of the introduction of technology innovation in printing and publishing the emphasis was on technology assessment. Important manpower implications of the introduction of new technology were not tackled in detail and the subject of industrial relations was avoided completely.

On balance the advantages outweighed the disadvantages and the use of industrial research reports as academic research instruments is recommended.

1.4 Pira reports used as input to this thesis

Various Pira projects were considered for input in this thesis. In addition to the three reports mentioned in Section 1.2 two possible projects comparing methods of publishing were investigated almost to a final proposal stage, but were not implemented. The final Pira project with which the student was associated was an investigation of document delivery systems. A description and project history of these reports follows together with an indication of the work contributed by the student.

Report A

"Printing Technology Forecast a 10-year forecast for the Printing and Publishing Industry Training Board" (PPITB) (See Appendix 1)

Work had already commenced on this project in summer 1978. The study purpose, scope and methodology had been agreed with the PPITB and following this a team from Pira had visited the United States of America on a fact finding tour in September 1978. Five technical headings had been determined for investigating trends in printing. These were:-

- Composition
- Graphic Reproduction and Platemaking
- Printing
- Binding and Finishing
- Alternative Technologies and Competitive Industries

In each case data was collected in two ways. First by a literature study and second directly from industry suppliers and users. In each chapter these data collections were organised so that each topic heading gave:

- An introduction setting out the context and boundaries of each topic,
- A technology status report
- A technology assessment of limitations/problems of existing technology.
- A formal statement of hypotheses describing likely future events and the implications of these hypotheses for the printing and publishing industries.

The student contributed to the first two topic headings writing most of the chapter on composition and all of the chapter on graphic reproduction and platemaking.

The report also included an overview chapter on economic, social and technological factors. The student wrote the whole of part II of this chapter, Technological aspects.

Fieldwork for this project entailed visits to 28 companies including five in West Germany.

The report was published in September 1979.

Report B

"The impact of speech input and recognition systems on the communications industries." (See Appendix 2)

This was a multi-client study produced in conjunction with the Numerical Analysis and Computer Science Division of the National Physical Laboratory (NPL). NPL were responsible for research into the technological aspects of speech input systems. Pira was concerned with the implications of technology trends, particularly for the printing and publishing industries and ensuring the final report satisfied sponsors' requirements. The student become involved in the project Spring 1979 at the time of the inaugural sponsor meeting assisting in managing the project, liasing between Pira, NPL and the Sponsors. He contributed Chapter 6 of the report, "Implications for the Communications Industries", and also edited the final report. In an effort to ensure that the final report met the sponsors requirements he also designed a questionnaire which was circulated to the sponsors.

Fieldwork included visits to five companies, one supplier and four potential users.

The final report was published in May 1980.

Report C

"Survey of text/tone integrated publishing/printing systems".
(See Appendix 3)

The student commenced work on this project in the Autumn 1979. He was to be responsible for all aspects of the project including providing promotion copy.

The objectives of the study were stated in the original proposal to the Chief Scientist's Requirements Board requesting Government funding:-

(a) To describe developments in text/tone integrated publishing/printing document reproduction systems.

(b) To survey current equipmment and available technology.

(c) To identify companies involved: their major business interests, product range and R & D effort.

(d) To describe likely future developments and their potential applications and opportunities for UK manufacturing.

The report was to provide a management brief which would overview developments in digital handling of information that speed up the integration of text and tone material and the increasing demands for information management that is leading to the need for automated document handling systems.

The project which was published in March 1981.
There were some editorial, communication and production difficulties. The final report differed in outline and detail from the original conception of the project.

There were difficulties relating to the content of the report. The title appeared unsuitable in view of the lack of available integrated text/tone publishing/printing systems. There were also

widely differing interpretations of the term integrated text/tone publishing/printing system. Therefore the title of the report was changed to 'The electronic merging of text and tone'.

The field work comprised 18 visits (9 suppliers, 6 users, 3 research centres) in the UK and France, Belgium, West Germany and Finland.

Report D

"Comparison of Methods of News Publishing: Traditional and Electronic"

The student proposed a six-month project at the end of 1979 to compare traditional and electronic methods of publishing news. This was expanded to a 12 -month or longer project to be launched as a multi-client study. An outline proposal was produced by February 1980 and agreement had been reached with a well known publishing consultant to act as project advisor. The recession increased the difficulty of attracting sponsors, however, and the project was abandoned through lack of funds.

Report E

"Pilot project for an occasional series"

A further project for student involvement was sought with the termination of Report D, Comparison of Methods of News Publishing. In the summer of 1980 a project was suggested that would provide a methodology for a series of Pira projects. Each project would examine an aspect of new technology that would effect publishing and printing. Again this project was abandoned through lack of funding.

Report F

"Document Delivery Services"

In the absence of other suitable projects work commenced September 1980 and ended early in 1981 on a Pira project conducted on behalf of the Publishers Association. The objective of this project was to

ascertain the effect on the UK market of a document delivery service. There were two separate tasks. Firstly to compile a literature review of the status of available technology together with its acceptance by users. Secondly to provide a computer analysis of the results of a Pira questionnaire. The literature survey was modified so that in the final form only abstracts of articles were published.

Reports A and C were the most important in obtaining an accurate assessment of technological innovations in printing. Report F provided useful information on new developments in publishing and the computer-aided analysis of the questionnaire was a valuable learning experience. Although they were abandoned Reports D and E were useful exercises in project planning. Report D also provided the opportunity to study methods of publishing news.

Reports B and C provided excellent experience in project management.

1.5 Development of Thesis

Pira policy for training its research workers is that they should learn while carrying out their jobs. This is reasonable since new staff are usually recruited from within the industries that Pira serves. The student was therefore expected to acquire a detailed knowledge of printing while conducting research for Pira projects. The only practical training given was that at a five day course given by Monotype and involving many aspects of composition and graphic reproduction. 1 day was also spent examining the role of photography in graphic reproduction at a course provided by Kodak. Both of these courses were attended in January 1979. In retrospect this policy can be seen to be detrimental to the student's progress. At the end of three years the student had acquired a detailed knowledge of printing technology developments which would be difficult to improve upon. The initial learning phase, however, could have been smoother had a more formal and practical introduction to printing been provided. The abundance and diversity of the new material confronting the student increased the difficulty of the learning process. The normal Pira policy on training was therefore inadequate in this case.

In the first year most time was devoted to acquiring an appreciation of printing technology and writing for the ten year forecast. Time at Aston University was mainly concerned with coursework. This coursework consisted of sections of the M.Sc. OR/SA stream and covered econometrics and simulation. This work had been chosen early in the academic year when a first assessment of the research proposal (see Section 1.1) had indicated that statistical forecasting techniques or computer modelling would be appropriate.

The completion of writing for the ten-year forecast in the summer of 1979 allowed time for deeper thought. The lack of adequate, detailed data suitable for mathematical forecasting or of an adequate framework as a basis for a computer model meant that statistical forecasting or simulation were unlikely to be suitable analytical tools. Therefore an outline of an information transfer model was produced in Autumn 1979 as a basis for the required analytical framework for the thesis. These developments are described more fully in Chapter 2.

Since that time there has been no major deviation in the structure of the thesis although changes to the Pira projects as described in Section 1.4 have caused some modification of details. The main difference between the original research proposal given in Section 1.1 and the present thesis has been the selection of a methodology incorporating the information transfer model and greater consideration of the role played by people in technological change.

1.6 Thesis outline

A major part of the development of this thesis was to select appropriate methodologies and apply them. The selection procedure is described in Chapter 2 Methodology, particular attention being given to modelling.

Chapter 3 introduces a new model of information transfer. A review of the literature on information transfer is first given with particular attention to the modelling approaches which have been suggested. The new model is then described and possible applications suggested.

Chapters 4 to 8 are then concerned with applications of this model although Chapters 4, 5, 6 also provide necessary background information on technology, trends and industry structure relating to the whole of the publishing and printing industries. However, close attention is given to two market sectors in this thesis, news media and learned publishing, since these sectors are at the forefront of technology development.

Chapters 4 and 5 provide an overview of the printing industry and its potential competitors. In each case information is given on industry structure and technology status. First, potential competitors to the printing industry are reviewed in Chapter 4 because alternative methods of printing and alternative media are likely to produce the greatest long term changes in the printing industry. Chapter 5 then examines the printing industry and also the publishing industry because of its long association with printing.

Chapter 6 examines in closer detail the various ways of reproducing paper by conventional printing, alternative methods of printing and electronic media.

In each of Chapters 4, 5 and 6 a summary of the relevance of the information transfer model is given. Chapter 7 builds on the information given in these chapters and analyses publishing using the informationtransfer model.

Chapter 8 provides a forecast for the printing and communication industries in the 1990s. After an examination of historical trend evidence using an original approach other forecasts are examined. The chapter is concluded with a forecast for the 1990s. This takes economic and sociological as well as technological factors into consideration.

Chapter 9 concludes this thesis providing a summary of results, appraisal of achievements and suggestions for further research. Appendices 1, 2 and 3 contain synopses of Pira reports A, B and C (See pp 15-17).

C H A P T E R 2

METHODOLOGY

2.1 Introduction

A major part of the early work was the review and selection of appropriate methodologies for this thesis. There were two main aspects to this problem. Firstly there was the diverse and complex nature of the information accumulated during the research of this thesis. Secondly, there was the shift in emphasis from mainly technology assessment to greater consideration of socio-economic factors. The purpose of this chapter is to describe the methodologies considered and the reasons for the selection of those used and for the rejection of others.

Section 2.2 describes the selection of methodologies as a historical narrative. Section 2.3 is devoted to models describing both their application in general and in this thesis.

2.2 Selection of methodologies

It would be relatively easy to organise the material of the Pira reports described in Chapter 1 into a technology assessment report using a similar approach to that used in the Pira techno-economic reports. However, the intention was to produce an original, well-structured document which would go beyond the usual technology

assessment reports, whether industrially - or academically - based. The introduction of technological innovation is a complex process which does not proceed smoothly. Response from different markets, change in consumer habits, manpower training requirements, the national and world economic situation are factors that need to be considered as well as technology push. The process of methodology selection will be described in chronological order.

A mathematical forecasting or a simulation approach was first considered. A severe limitation on these approaches, however, is the absence of detailed and coordinated statistics in the printing and publishing industries particularly in the UK. Christopher Cross, a colleague in the Techno-economics Group responsible for economic and statistical aspects of the reports, stated in the 10 year forecast (Blunden et al 1979 p2.4):-

"Attempts to predict when specific technology is likely to become significant has been determined principally from consensus judgement of industry experts but where appropriate from extrapolation of statistical data. In most cases however insufficient runs of statistics have been available for regression analysis. In any event, simple projection using statistical data does not take into account the changing external environment. Thus a consensus judgement technique based on a simple questionnaire approach has been used".

UK statistics on printing and publishing presently available are compiled from a variety of sources; British Printing Industry Federation (BPIF), Printing and Publishing Industry Training Board (PPITB), Newspaper Publisher's Association, Newspaper Society, Publisher's Association, Pira, Trade Press and the Government Census of Production. None of these sources, even the Census of Production, provide complete coverage of the UK printing and publishing industries. Each non-Government source obtains information by a survey of its members and in most cases only a sample of the membership is surveyed. Therefore there are a number of gaps in the available statistics.

Moreover it is impossible to combine accurately statistics from different sources since none of the associations will release complete details of their statistics. Since most companies are members of several different associations there would be duplication of statistics where an overlap of membership occurred. This would only be avoided if the names of the surveyed companies were known but this information is regarded as strictly confidential by every association and is not released.

There is also a lack of refinement in the available statistics. For example, the printing processes used by companies are usually broken down only into the categories letterpress, lithography and gravure. Letterpress includes any equipment from hand set metal letterpress to flexography to contemporary polymer newspaper letterpress. Lithography and gravure are treated in a similar crude fashion. There is no indication of the type of technology employed. Similarly reprography includes any method of producing an image on paper other than by the three printing processes mentioned.

While there is general agreement in the printing and publishing industries that there is a need for improved statistics on printing and publishing it is unlikely that these will become available in the near future. A Pira study (Blunden et al, 1980 (2)) showed that a project to compile a computer data base containing a breakdown of important sector statistics of the UK printing industry was feasible. However, the required number of sponsors to implement the project could not be obtained. While most companies agree that such a statistical data base would be useful few, if any, are prepared to pay for it.

While some estimates can be made to fill the gaps in the available statistics or to add refinement to the crude statistics available (and this method is employed in research carried out by consultants) the procedure is unsatisfactory and error-prone. Chambers et al (1974, p. 287) comment on disaggregation of data and the use of "educated guesses". They state: "We have found instances where such estimates are significantly in error (in situations where we had access to confidential industry data)".

Therefore little reliance can be placed on statistics obtained by modifying the available information by an estimating process. The uncertainties introduced would invalidate any predictions made. Therefore the mathematical forecasting and simulation methods were abandoned and a new approach sought.

Experience at Pira provided new insight into appropriate methodologies. The Techno-economics Group had developed a pragmatic methodology for their technology assessment and forecasting reports. There was a heavy reliance upon a consensus of expert opinion. This appears justified and is certainly supported by this author's own experience. The structured interview allows researchers the opportunity not only of obtaining an expert's opinion but also evaluating the value of this opinion. In obtaining a consensus opinion the value of different opinions can be weighted either objectively or subjectively. Chambers et al (1974, p. 90) state: - "The eliciting of expert opinion is often the only approach possible to obtain technological forecasts for 10 to 20 years or more into the future".

A more rigorous application of the Techno-economics Group's methodology was therefore, an attractive proposition. This approach will be returned to later in this section.

During the period of work on the ten-year forecast other methodology options were explored. Coursework attended at Aston University comprised the Econometrics, Simulation and Survey Methods coursework for the OR/SA M.Sc. streams of the Faculty of Management Studies. Also during this period a survey was made of literature relating to Manpower Studies. In most of these studies use was made of either qualitative or quantitative models. Where quantitative applications were made there was always a detailed and well-structured statistical data base available. This was in contrast to the deficiencies of statistical data in relation to the UK Printing Industry which have been referred to above.

By summer 1979 it appeared that neither a statistical forecast nor a simulation approach would be possible within the time period available. In summary the reasons for this can be stated:

- No detailed and centralised statistics for the UK Printing Industry relating to technology status were available.

- No qualitative model or well-structured overview of the technology status of the Printing Industry was available which could be used as the basis of a simulation exercise.

In addition there are considerable doubts as to the successful application of these methods to the complex situation regarding technology change in printing. Turner (1974) makes the following statement concerning mathematical trend projection in long-range forecasting:-

"Unfortunately however, trend projection has a number of drawbacks. In particular, it is frequently asserted that the technique is a relatively naive method of forecasting insofar as it does not take causation into account, that is to say, no analysis is made of the factors which have caused demand to grow or decline in a certain way. It simply continues the trend of the historical time series, assuming that the growth pattern experienced in the past will contunue into the future. As a consequence, the general valid application of trend projection is considerably restricted."

Chambers et al (1974, p. 55) comment on the same subject: - "Trend projections are usually not very accurate for long-term forecasts since they are too easily influenced by changes in market share and advertising, for example".

A number of sophisticated mathematical techniques are available for analysis of time-series data such as Box-Jenkins analysis and notably the Catastrophe Theory of Rene Thom. The application of the latter theory in the Social Sciences has been described by Isnard and Zeeman (1976). Both of these techniques, however, require the type of detailed statistics which are not available on printing and publishing.

It has already been mentioned that consideration was given to a more rigorous implementation of the Techno-economics Group's methodology. It appeared that this would require the design of a questionnaire or

a Delphi study. A questionnaire designed for Report C (see Section 1.4) showed a potential source of error in using either of these approaches. This questionnaire was used in a number of interviews but was discarded when the replies were found to be error prone. Informed answers to the questionnaire could only be given if the respondent had a wide range of expertise. Experts in computing science, however, made elementary errors on aspects of printing technology while experts in printing technology did not possess the required knowledge of computing. These errors could be reduced by a careful selection of the experts although few people are likely to possess expertise in all the disciplines needed to assess the changes in the printing and publishing over the next 15 years, eg computers and microelectronics, printing and publishing, consumer attitudes and other sociological factors. Moreover, Armstrong (1978) is critical of the performance of experts in forecasting including Delphi studies. He cites (ibid, pp 109-110) a number of tests that compared the performance of expert and non-expert Delphi panels and found no significant difference in performance. He concludes (ibid, p. 111) his review of Delphi with the comment:- "The primary advantage of Delphi is that it is a gimmick that is acceptable to organisations".

Delphi originated at the Rand Corporation in 1948. It is significant, therefore, that the greatest criticism of Delphi comes from that organisation. Sackman (1975) reviews Delphi principles and methodology as practised in some 150 Delphi reports conducted both within and outside Rand. He concludes "that the massive liabilities of Delphi.... outweigh its highly doubtful assets". He recommends that the use of conventional Delphi be discontinued.

Returning to the subject of simulation, an opportunity occurred early in 1980 to examine a successful application of this technique. Cowie and Probert (1979) describe a statistical predictive model designed for use in planning telecommunications business over a time horizon of 30 years. The model operates interactively on a computer with graphics, numerics and text displayed on a VDU. Four key areas are incorporated in the model; demand/supply, equipment, manpower and finance. A visit was made to the Intelligence Division of the British Post Office (now British Telecom) to discuss the model. It was immediately apparent that it was easier to construct

a simulation model for telecommunications business than one for the printing industry. This was because:

- Detailed statistics were available and updated regularly.

- Procedures and algorithms were already in existence within the four key areas referred to above.

- While the situation was complex and account was taken of technical and economic developments the situation regarding the printing industry is of a greater order of complexity. While the UK printing industry has a multiplicity of products, product sectors and technology options and fierce competition from abroad, British Telecom has a monopoly of the UK market with restrictions on foreign competition and only two market segments, business and home. It has a small range of products and its technology options are few in number.

Moreover the model was formulated within an operational forecasting group that had been in existence for a number of years.

This confirmed that a simulation model of printing was not feasible within the time frame of the thesis, particularly since there were additional constraints due to working for a commercially viable research organisation.

This thesis utilises two main methodologies. Forecasting is based on the techniques used in the Techno-economics Group described above. The forecast made in Chapter 8 is based on the work conducted for reports A, B and C (pp 15–18) summarised in Appendices 1-3, together with the accumulation of pertinent data given in Chapters 4-7. In addition a model of information transfer pertinent to publishing is proposed in Chapter 3. This model is used to:-

(i) Provide a framework for a discussion of the technology trends in communications

(ii) To provide an analytical tool for an examination of the particular technology innovations that can or will be utilised either by the printing industry or its rivals.

2.3 Models

As a preliminary to a discussion on models and their use the following definitions are taken from Bullock and Stallybrass (1977).

A model is "a reproduction of something else, designed for a specific purpose". This purpose could be to "recall to our minds what the original looks like, to predict behaviour in the real world, to explain the nature and working of an esoteric theory e.g. Atomic Theory".

All models, of whatever purpose have one common characteristic which is the mapping of elements in the system modelled onto the model. This mapping may be isomorphic but in most cases is many-to-few so that models lose in complexity when compared with the original. Most models utilised in science are theoretical models e.g. a system of gravitational equations may model the behaviour of planets as they move around the sun. Compared to models used in the physical sciences economic and social models tend to be mathematically more naive and to lack experimental verification.

Models play a vital role in the problem solving approach used in Operational Research and Systems Analysis (OR/SA). After defining the problem a number of solutions are generated and models are used to test the possible results of applying these solutions to the system being considered. In this context models may be categorised:

- Mental models
- Verbal models
- Diagram models
- Symbolic/mathematical models (Luck G M, 1980)

Mental models are the personal representations of reality of each individual. These models are implicit and the difficulty of interpreting and communicating their content often leads to disagreement between individuals. All other models are explicit.

Verbal models are often used by management either in spoken or written form. Examples of the latter are job descriptions and manuals. They may be used to provide training or reference material. They also serve as a vehicle for focussing the thoughts of the model makers leading to improved precision in the explicit statements made.

Diagram models such as flow charts and decision trees are available in OR/SA work. They offer the following advantages over verbal models:

- They are clearer and easier to memorise.

- Sequences of activities, including loops and repetitions are easier to follow.

- Simultaneous relationships are clearer than in verbal models where sequences which may not be relevant are introduced due to the sequential nature of speech.

Both verbal and diagram models are limited. They are essentially static and it is difficult to use them to compare a number of different situations. When a system is translated into mathematical or symbolic form then a number of advantages become apparent. Measurements can be utilised, complicated sequences can be followed and a number of different situations can be easily compared.

The information transfer model proposed in this thesis and described in Chapter 3 embodies aspects of all three of the explicit models described above. Its use in Chapter 7 and elsewhere in this thesis also points to its potential for rigorous quantitative application if an appropriate data base for the UK Printing Industry becomes available.

C H A P T E R 3

A MODEL OF INFORMATION TRANSFER FOR COMPARING METHODS OF PUBLISHING

3.1 Introduction

Chapter 2 described how a modelling approach was chosen as the most appropriate methodology for this thesis. This chapter describes a model of information transfer which is examined as an evaluation instrument and then used as an analytical framework throughout the remaining chapters of the thesis.

Section 3.2 defines some of the terms used in information transfer in order to avoid ambiguity in their use in this thesis.

Section 3.3 consists of two surveys of modelling as applied to information transfer. In section 3.4 it is suggested that there is a gap in the literature, namely, a suitable model of information transfer relevant to publishing.

Section 3.5 describes a new model of information transfer and the prospective application of the model is discussed in 3.6.

Suggestions for the use of the model are made in section 3.7, which is followed by a summary.

3.2 Definitions

The terms 'information' and 'knowledge' are used in a variety of ways in relevant literature. Sometimes they are used as synonyms and sometimes interpreted differently. Brookes (1980) regards " ... knowledge as a structure of concepts linked by their relations and information as a small part of such a structure". Another view is that information denotes the removal of uncertainty, an interpretation used in the mathematical theory of communication. Kochen (1975, p.2) interprets knowledge as going beyond this, preparing the recipient for appropriate actions. Farradane (1980, p.77) suggests that "knowledge is defined as a memorable record of a process in the brain, available only in the mind ..... Information is defined as a physical surrogate of knowledge (eg language) used for communication".

The definition of information used in this thesis is that given by Murdock and Liston (1967) "that an item of knowledge becomes an item of information when it is "set in motion" - when it enters the active process of being communicated or transferred from one or more persons, groups or organisations (sender) to one or more other persons, groups or organisations (receiver)".

This statement also serves to define information transfer. Murdock and Liston consider information transfer to be important since "value is dependent upon transfer", (value referring to value of information). In a discussion of their general model of information transfer (see figure 6) they then classify a variety of channels of communication:-

- The Direct Channel; face to face discussion. Advantages are that gesticulations and inflections can be used as well as words, interruptions and feedback are possible with no delay. Disadvantages are that there is little chance for detailed study and memory faults may lead to erroneous conclusions and acceptability of vague generalisations.

- The Primary Recorded Media Channel; examples of this are letters, newspapers, conference notes, monographs, texts, patents and tapes.

- The Archival Channel; Document depots, libraries, special libraries, corporate files.

- The Secondary Recorded Media Channel; This is fed from both primary sources and archives and its purpose is to assist in the search of the increasing information base. Examples are abstracts journals, accessions bulletins, indexes and bibliographies.

- The Information Centre Channels; These provide a service to a known group of users and the main functions are acquisition, storage/retrieval and special reports in response to customers requests.

Printing and publishing do not utilise the Direct Channel and therefore it is the other four channels that are of most importance with respect to this thesis. The primary and secondary recorded media channels are particularly important since publishing accounts for a major proportion of information transferred via these two channels as indicated by the examples of media given by Murdock and Liston.

3.3 Review of information transfer models

3.3.1 Initial review

Telecommunications developed rapidly in the 1920s and a mathematical information theory was formulated in association with this work. The most important concept to emerge at that time was the mathematical demonstration (Hartley, 1928) that in order to transmit a given quantity of information a definite product (bandwidth x time) is required. It was not until the late 1940s, however, that information theory was to become widely known and used outside the field of telecommunications. This was prompted by the work of

Shannon and Weaver. They proposed a model of a communication system as shown in Figure 1 (Shannon and Weaver 1949). The information source selects a desired message from a set of possible messages. The desired message is then changed to a signal and transmitted over a communication channel to a receiver where it is changed back to the original message. In the transmission process the signal can be modified by interference or noise. The importance of the work of Shannon and Weaver is embodied in two mathematical statements that they give. The first is that the information, H, in a message can be measured. The value of H is given by:

$$H = -\sum Pi \times \log Pi$$

The message consists of a number of terms each of which is a symbol e.g. a number or letter and Pi is the probability of the ith term. Note that when Pi = 1 the ith term is certain to occur and the amount of information becomes 0.

The second statement relates to the capacity (C) of a noisy channel:

$C = \text{Max} [H(x) - Hy(x)]$ where $H(x)$ is the input information and $Hy(x)$ is the conditional entropy or equivocation of input x given output y. This is a measure of the ambiguity of the signal.

It is necessary to emphasise that the work of Shannon and Weaver was concerned with the technical problems of communication and how to attain accuracy of transmission. The semantic content of a message is not dealt with in their work. Thus two messages, one meaningful and one complete nonsense can have the same measure of information content. Therefore, their model, in its original form, is not applicable to information transfer as propounded in this thesis (see Section 3.2). Nevertheless their work was a major contribution to the development of information theory, and despite its limitation the Shannon-Weaver model has been used as a basis for many models of information transfer.

Information theory itself has found application in a wide range of disciplines. The influence of cybernetics and systems theory has helped to disseminate information theory. One can therefore discern the influence of Shannon and Weaver in other models. For example Figure 2 shows the model of the information transmission process used by Wersig in 1971 and described by Belkin (1978, p.75). He examines six categories as possible types of information definition. These are:

- Material world
- Source
- Message
- Characteristics
- Effect
- Process

Wersig concentrates on 'effect' -type definitions having decided that only such definitions can be relevant to information science. The point is made (Belkin, 1978, p. 76) that Wersig "has failed to develop an adequate information concept because he has concentrated exclusively upon the recipient in the communication system, without considering how the recipient can be related to the rest of the system through an information concept". This model is therefore unsuitable for application to information transfer, particularly in the publishing sphere.

Figure 3 shows a generalised information system (Yovits and Ernst, 1968). The system comprises four essential functions:

- Information acquisition and dissemination
- Decision making
- Execution
- Transformation

While the model is a general one, the authors develop some consequences of the model and are concerned with some semantic considerations. The latter part of the paper develops a mathematical treatment of information transfer. A synopsis of this is as follows:

The transformation of information into observable actions can be shown by

$$T \times G = A$$

where T is a transformation relating to two matrices, G of the sources of information, A of the observable actions. G, A are functions of time, T a function of time and external environment. Where a small time interval passes then the change of information is equal to the inverse of T multiplied by the change in A. A smallest unit of information the Informon can be defined. This is the smallest amount of information that will cause a decision maker to change a course of action. This is, therefore, a measure of value as well as quantity of information.

Although the model was used in a later paper (Whittemore and Yovits, 1972) in an attempt to quantify information, the authors stress that their measure of information is relative.

Another model with a mathematical basis is that of Avramescu (1975). An attempt is made to adapt the physics of thermodynamics to information transfer. The information transfer process is regarded as analogous to heat diffusion. No practical applications or results are given for this model. It would suffer the same disadvantages as the Yovits and Ernst model namely the difficulty of quantifying information when information varies in value, particularly subjectively.

Most models encountered in this review emerge from research

into the role of libraries and information retrieval and concentrate particularly on the dissemination of scientific information. A further example from this background (Subramanyam, 1977) suggests that the process of communication consists of four elemental phases recurring in succession. These phases are:

- Generation
- Recording
- Surrogation and dissemination
- Utilisation

These phases overlap and a cycle of four phases is shown in Figure 4. A similar scheme for the information cycle contains seven elements and is shown in Figure 5 (King and Wood, 1975).

The theme paper for the 1968 Convention of the American Documentation Institute (Murdock and Liston, 1967) contained a general model of information transfer. This is an elaboration on the classic Shannon-Weaver sender/channel/receiver model. A diagram of the model is shown in Figure 6, the model providing a framework for discussing information transfer.

The Murdock/Liston model shows the influence of new information technology. Other models carry this a stage further. For example Libaw (1969) outlines an inbricated (overlapping) model of information transfer. A diagram of the model is shown in Figure 7. The core of this model is a machine-readable record, which can be accessed and processed by a variety of software packages.

Communication is a subject of vital importance in the Social Sciences. In an exploration of communication in these disciplines Kuhn (1974) proposes a model that is relevant to the subject of information transfer. He states:-

"For intrasystem analysis the model proposes that any controlled adaptive system, including the human being, must utilise information, preferences or values, and behavioural responses, which

are handled respectively by detector, selector and effector functions of the system".

A diagram of this model is shown in figure 8. Kuhn proposes communication, transaction and organisation respectively as intersystem parallels of detector, selector, effector.

Wilkins(1977) suggests three classes of information transfer models:-

(i) Technical
(ii) Semantic
(iii) General

Referring to Technical Models Wilkinssays:

"Psychology, sociology, cybernetics and telecommunications are only a few of the many fields from which models for examining information transfer have evolved. Although they have tended to be used more by information specialists than by librarians, these models are valuable to all professions concerned with linking users and sources of information".

Wilkins cites the Yovits and Ernst (1968) paper mentioned above as an example of a semantic model and the Murdock and Liston model as an example of a general model.

The literature reviewed above shows the intense interest in information and information transfer. Wersig and Neveling (1975) comment on the origins of information science:-

"'Information science', 'informatics' or whatever else it is called is a newly emerged field of study whose first consciousness of being a discipline dates back to the late fifties". They suggest that many disciplines contributed to the birth of information science some of these being;

- computer science
- library science

- philosophy and taxonomy
- linguistics
- information theory
- cybernetics
- mathematics

There is also an element of 'technology push' to the development of information science as Wersig and Neveling indicate:-

".... the introduction of new technologies, particularly electronic data processing, made the emergence of this discipline necessary, ...".

A modelling approach appears less popular in publishing. Perhaps this is because publishing is only part of the information transfer process, albeit a very important part. However, Engwal (1978) incorporates a modelling approach in an analysis of the organisation of newspaper publishers. Using case study material he discusses the roles of various personnel involved in newspaper production. These roles are mapped onto a diagram of the structure of the organisation (See fig.9).

The above review of models is based on a literature search initiated in 1980 assisted by a computer search of Pira and other databases. It can be seen that most of the references date from the mid-1970s or earlier. Moreover there is little evidence of the use of models other than as frameworks for discussion. The lack of any current or recent references is the most serious deficiency in the review since any successful application of a modelling technique in publishing would be well referenced. Fortunately a project funded by BLRDD made it possible to include the following update of the review.

3.3.2 Review update

This review update is based on an intensive manual search of relevant literature (Holloway, 1983).

A number of difficulties confront any reviewer of information transfer models. First, there is the sheer size of the body of relevant literature. The topic is of interest in a wide range of disciplines, the most obvious being Library and Information Science, Publishing and the Social Sciences. Second, different terminology may be used for the same or similar processes. Information transfer may be called knowledge transfer or communication and is also part of the process of diffusion of knowledge. Third, the term 'model' is ascribed a wide range of meanings and levels of abstraction. Perhaps because of this many authors prefer to substitute other terms in place of 'model' such as 'outline', 'theory' or 'systems view'. An additional difficulty occurs when the reviewer is looking for actual or potential application of the models, as in the present instance. Despite these difficulties the following review provides a useful cross-section of the varied approaches to information transfer modelling. Models are reviewed in three categories:

- Qualitative models
- Limited quantitative models
- Quantitative models of more general application.

Qualitative models

The diffusion of knowledge has attracted considerable attention since the late 1960s. Havelock, Rogers and Shoemaker are frequently cited on this topic. Havelock (1976) proposes a conceptual framework for examining the flow of new knowledge in society. This incorporates a series of models for four levels of the process of dissemination and utilisation of knowledge; the individual, the interpersonal, the organisation and the social system. Rogers and Shoemaker(1971) examine the innovation-decision process, isolating four stages in the decision process for accepting/rejecting innovation; knowledge, persuasion, decision and confirmation.

Mass media studies have incorporated a number of modelling approaches. Many of these are adaptations or extensions of models initiated in other disciplines such as library and information science, inter-personal communications and the study of organisations. The most well-known model emerging specifically from

a study of mass communication is the 'gatekeeper' concept. First proposed by White (1950) in an examination of the selection of wire service news items in newspapers it has been refined and used by a number of researchers e.g. Bass (1969), Tunstall (1972), Allen (1977).

Some indication of information flow is incorporated in most models and in many instances this is the sole purpose of the model. The influence of Shannon and Weaver has already been mentioned in 3.3.1, many models being either modifications of the Shannon-Weaver model or showing a similar approach, one of the most well-known being the Lasswell formula:-

"Who says what in which channel to whom with what effect". (McQuail and Windahl, 1981, p10).

The most serious defect of early information flow models was that they were uni-directional. Defleur (1966) incorporated two-way flow by using two sender-receiver models, one in each direction. The continuous cycling of information is now incorporated in most communication models as indicated by the models of Subramanyam, King and Wood, Murdock and Liston, and Libaw outlined in 3.3.1.

Levitan (1982) suggests that 'channel' and 'systems' models of information transfer do not take sufficient account of the dynamic nature of information transfer. Major weaknesses of these models lie in the lack of a time dimension in which to view activities and the absence of a fixed unit of information to observe. Levitan suggests these weaknesses can be overcome by refining a life cycle model of information production. The phases of this model consist of generation, institutionalisation, maintenance, enhancement and distribution.

Schramm (1954) suggests that interpersonal communication can be analysed in terms of the functions encoding, interpreting and decoding. For example, in conversation the speech mechanism encodes the message and the hearing mechanism decodes the message which is then interpreted. This model may be compared with the Kuhn model of

3.3.1. Both Schramm and Kuhn extend their models; Schramm for mass communication studies while Kuhn is concerned with all social interactions.

Rogers and Awarla-Rogers (1976) use a network analysis approach to examine communications in organisations. They identify different group structures e.g. circle, wheel, chain, all-channel. They also suggest that individuals can take one of four roles in communicating within organisations; gatekeeper, liaison, opinion leader or cosmopolite. Another type of organisational model is that of Engwal (1978) reviewed in 3.3.1.

Limited quantitative models

A large number of communication models incorporate an attempt at quantifying some aspect of information transfer. In most cases these models are of limited application. This may be because the models examine a restricted subject area e.g. inter-library loans. At the other end of the scale are a number of models which attempt to describe mathematically information transfer but at too high a level of abstraction. The diffusion model of Avramescu mentioned in 3.3.1 is an example of this type of model. Fedanzo (1980) adopts a finite matrix approach to depict information as a causal agency in systems, both natural and artificial.

Citation analysis is widely used to assess the use of primary publications. It is also used, together with analysis of other parameters such as co-authorship and co-referencing to discern informal communication channels. The informal ties in science communication are usually referred to as an invisible college (Crane, 1972). Krauze and McGinnis note that the large body of literature on citations does not include a general formal treatment and outline their own matrix approach (Krauze and McGinnis 1979).

Inter-library loan and request statistics are also popular subjects for analysis. In this research field 'model' is usually interpreted as a mathematical equation which fits a distribution curve. For example, Burell (1982) discusses four mathematical formulae in a

curve-fitting exercise on library circulation data. Wolper and Trudell (1978) describe a model of more practical application. This provides a computer simulation of inter-library lending.

Oswitch (1980) reviews modelling and simulation in library and information systems and suggests that most effort has been directed towards information retrieval and specific operating problems. The large number of models for evaluating information retrieval systems can be divided into those that examine costs (for a review see Hawkins (1981)) and those that examine search techniques (for a review see Bates (1981)).

A number of studies apply systems analysis techniques to library problems. For example, MacKenzie (1970) describes a simple model of consecutive technical processes in a library; input rate, labour, processing rate, backlog, processing capacity, delay and output rate. He suggests that the model is suitable for ordering, bookselling, accessioning and cataloguing. Leimkuhler (1978) reviews other systems approaches to library management in the areas: library studies, document usage, storage problems, availability, reference scattering, total system models and human factors. Rouse (1979) reviews mathematical modelling of library systems.

Networks and tree structures of different origins possess similar topologies and are subject to similar methods of analysis. Graph analysis techniques have been applied to citation networks. For example, Pritchard (1980) adopts the shortest path algorithm of transportation to citation indexing. Graph analysis techniques have been applied in studies of computer networks and, therefore, to information retrieval systems. Fialkowski and Jastrzebski (1978) outline a model of the routing process for the flow of information in information retrieval networks.

Considering the size and nature of the publishing industry there are relatively few examples of the application of modelling techniques. The demand for publications can be modelled in

various ways. For example, equations representing the demand for journals can be derived mathematically (Rosenbluth, 1979) or empirically (McDonough, 1982). Cozenza and Davis (1982) outline an interactive model for the demand for newspapers in the tertiary market.

Econometric models of publishing have been available for some time. For example, Bailey (1970) describes several mathematical models on the economics of book publishing. More recently, Machlup and Leeson (1978) make use of econometric modelling techniques with reference to journal publishing.

The structure of publishing organisations has been analysed. For example, Dubick (1978) examines a sample of 72 US newspapers, relating structural differences of the organisations to their metropolitan environments. Dubick uses the following parameters for measuring the environment:- competition, social class, heterogeneity of population, leisure services, national and metropolitan dominance.

Quantitative models of more general application

The quantitative models reviewed above examine specific aspects of information transfer. Because of the limited area of interest, often with detailed statistics e.g. citations, loan and request data etc, relatively simple techniques can be applied. Generally, these specific models cannot be applied in a wider context, although it may be possible to incorporate similar models as parts of a more general model.

A project at University College (Oswitch, 1980) adopts this approach. This attempts to model the impact of online bibliographic data bases on traditional information services. A conceptual model of the complex of systems interacting in the information chain is built around the five elements; generate, publish, distribute, mediate, use. A number of exploratory system dynamics models for particular aspects of the information chain

examine the growth of online access points assuming constant growth rates and epidemic theory postulates. The major model, PROTO2 DYNAMO integrates:-

Growth of online access points

The resulting proliferation of information queries, references, document requests, interlibrary loans

The levels of satisfaction with parts of the system.

The Strategic Modelling Group of British Telecom has already been mentioned in Chapter 2. This group has been developing system dynamics models of telecommunication since 1976. Probert (1982) describes two models that are currently in use; a Long Range Planning Model (LRPM) and an Integrated Communications Demand Model (ICDM).

The LRPM has been operational since 1978. It provides a corporate model of British Telecom and simulates the results of policy decisions under a variety of business conditions. The model is composed of four modules: Marketing (Demand/Supply), Technology (Equipment), Personnel and Finance. There are around 200 output variables which can be plotted over a planning horizon of 30 years. The model can be interfaced with other dynamic models such as the ICDM.

The ICDM integrates the demand for all communications media, with emphasis on competition for telecommunications services. The model takes account of policy options (Marketing Strategy, Development Strategy, Tariff-setting) and environmental assumptions (User Characteristics, Economy and Society, Political and Market Environments). Both the LRPM and ICDM display results on an intelligent colour graphics terminal.

Computer modelling methods are also applied in publishing. Hall 1976) describes a systems dynamics model to simulate magazine publishing based on operational data covering a 20-year period at the Saturday Evening Post. Gomez (1982) applies the General Systems Problem Solver (GSPS) to the problems of the Journals

Division of Switzerland's leading publisher and printer.
King et al (1979 pp 142-149) describe an econometric model of publishing which groups costs under three headings; prerun, runoff and miscellaneous. Prerun costs include editing, graphics preparation, typesetting and proofreading. Runoff costs relate to the cost of reproducing and distributing copies e.g. printing, binding, wrapping and mailing. Miscellaneous costs are those incidental to the publication process e.g. promotion, advertising and conversion to microform. The model does not account for writing and rewriting costs. The model incorporates over 100 parameters although these parameters are not specified. King and Roderer (1978) use a framework for analysing scientific and technical journal communication which defines five functions; origination, transmission, recording, preservation and end-use.

Considerable interest has been shown in electronic methods of publishing, particularly since Senders (1977) described an electronic journal. Turoff and Hiltz (1982) outline progress on this and other forms of electronic journal. They discuss four forms of journal operating on the Electronic Information Exchange System (EIES); an informal newsletter 'Chimo', an unrefereed public conference 'Paper Fair', an electronic journal replicating a print-based journal similar to that proposed by Senders and a highly structured inquiry-response system 'Legitech'. Evaluation of these and similar prototypes appears to be the established research procedure in this area. The Birmingham and Loughborough Electronic Network Development (BLEND) is a study programme designed to assess the cost, efficiency and subjective impact of electronic journals (Shackel, 1982). Different types of electronic journal are being explored; refereed papers, annotated abstracts, co-operative writing of papers. Cost, performance, objective patterns of behaviour and subjective experience of users are four aspects of the system which are being assessed.

A number of projects have been initiated which may lead to the development of information transfer models. In the USA, for

example, NSF grants have been awarded to Princeton University to examine the nature of feedback between R and D and its dissemination and rate of growth elsewhere in the economy and to New York University for behavioural research on broadcast teletext (Anon, 1982, 1). In addition, an extensive programme of research into library and information science is planned (Anon, 1982, 2). Precise details of the modelling techniques to be used are not given although the main thrust of the research programmes appears to be the economics of information.

3.4. The need for a new model of information transfer

The above review shows that although modelling techniques of many different kinds have been proposed with reference to information transfer there are few general models. Nor are there any models that are universally accepted, although as previously mentioned, the Shannon-Weaver model or its derivatives are widely used. Havelock, Rogers and Shoemaker are also cited in information transfer. Dammers (1974) suggests an adaptation of the Havelock linkage model to machine-readable data bases. Landau et el (1982) adapt the Rogers and Shoemaker model to define information users and outputs. However, these adaptations are at a conceptual level. This is not to deride conceptual modelling which is an essential stage in all model building, but models have to be developed beyond a conceptual stage if they are to be used for prediction or comparison. For these purposes models have to be detailed and at least partly quantitative.

Where models have been developed to this stage, details of the techniques used are usually concealed, perhaps for commercial secrecy. For example, the publishing model (King et al, 1979) reveals few details apart from the use of over 100 parameters. However, it appears that this and other quantitative models are econometric or based on demand/supply statistical relationships. Another model of this type for economic forecasting in printing and publishing was developed internally at

PPITB prior to cessation of its activities in 1982. Perrin (1983) indicates that Pira is interested in developing the model and has launched a Printing and Publishing Economic Statistics Group to attract funding for this purpose. The Pira/PPITB model was developed due to the availability of a large body of useful data. The publishing model (King et al 1979) was developed from established publishing accounting/forecasting procedures. The BT LRPM was based on both established procedures and a detailed data base. While these methods of model building may be adequate for their designated purpose e.g. demand forecasting, there appears to be a need for a different type of information transfer model. Authors such as Libaw (1969) and Levitan (1982) also point to deficiences in the models presently available but do not themselves offer better answers. Indeed, one of Levitan's suggestions for improving models, the introduction of a fixed unit of information, appears to be questionable. The efforts to define a unit of information, the Informon, by Yovits and Ernst (1968) have been described in 3.3.1. Further attempts to define and quantify information, based on value are described in Yovits et al (1977) and Griffiths (1982). Kantor (1982) also proposes an evaluation of information retrieval systems by measuring the value of the actions taken. He points out that there are philosophical problems in measuring the value of an action. Certainly information is a phenomenon that is difficult to measure meaningfully (see Shannon and Weaver, 3.3.1) except by its effect. This appears to be accepted by Yovits et al since they treat information only as data of value in decision making. Value of information is certainly an important topic and as Murdock and Liston point out (see 3.2) value is dependent on transfer. However, value is subjective and so the philosophical discussion of the measurement of value of information will not be pursued here.

The reviews of 3.3 have shown that there are relatively few models relevant to publishing. Perhaps this is because in-house operational methods used by publishing companies have evolved

over a number of years rather than being developed from scratch. Furthermore the publishing industry is both introspective and entrepreneurial. This often leads to the pursuit of an individual house style of operation. Note that the systems approach to publishing suggested by Gomez (1982) is an in-house project by a Swiss publisher. In effect, most publishers have conducted action-research by following the course of action of evolving their own production methods and modifying these as technology develops. This is not to say that introduction of new technology has not been planned but this planning has for the most part been tactical rather than strategic. Action-research is very expensive. This expense may be justified in one-off pilot schemes such as BLEND, but generally an alternative method of planning and evaluating technology is needed. If a suitable model could be developed it would be useful, particularly at the initial stages of planning changes in production methods.

To be effective, such a model would have to be both flexible and practical: Flexible to allow for different publishing sectors, house policies, and technologies; practical to enable its use for comparison or prediction. In order to be of practical use it would have to go beyond the conceptual level and allow for some quantitative measurement. A new model of information transfer pertinent to publishing is proposed in the next section which, it is hoped, will meet these criteria.

3.5 A new model of information transfer pertinent to publishing.

It has been indicated in 1.5 that the new model was initially formulated in 1979. The author, adopting a systems approach, divided the publishing process into a number of stages. Although a number of divisions and sub-divisions may be possible, the clearest demarcation occurs between five stages; origination, processing, conversion, distribution and reception. The model was initially formulated without examination of any published models, but the review 3.3.1 was then made. Other authors have

divided information transfer into different stages e.g. Subramanyam (1977) suggests generation, recording, surrogation and dissemination, utilisation. Oswitch and Vickery (1979) adopt the terminology; generate, publish distribute, mediate and use. King and Roderer (1978) use the terms; origination, transmission, recording, preservation and end-use. In summary, neither the stages of information transfer nor the terminology referring to these stages are standardised in the literature. Therefore the model was reassessed. Origination, distribution and reception are terms with generally accepted meanings similar to those intended in the model and so are retained. While editing is considered to be part of processing, processing is retained since it is intended to entail more than editing. Reproduction is substituted for conversion because it has a generally accepted meaning.

The transfer of information is divided into five stages:

1 - Origination
2 - Processing
3 - Reproduction
4 - Distribution
5 - Reception

Origination refers to the capture of ideas in the form of words/symbols/diagrams.

Processing is the modification of material into a suitable form for reproduction. This incorporates both editing and conversion functions. Editing involves the manipulation of material with attention to legibility, appearance, style, emphasis, readability and impact. Conversion entails the creation of an image in a form suitable for reproduction e.g. printing plate.

Reproduction is the process of producing single or multiple

images of the processed information.

Distribution is the delivery of the information package to a suitable access point of the recipient. This may involve the physical transport of a book, magazine, or newspaper to a retail outlet or even directly to the home or office of the recipient. Alternatively, it is the transmission and reception devices in a telecommunications system.

Reception is the physical reception of the information package.

Origination is considered to be the capture of concepts in graphic form rather than the mental process of creating them. The origination stage ends with the receipt by the publisher of a draft manuscript. When publishing is viewed as a system, origination can be considered to be a data capture function. In the case of a journalist entering a news story directly into the computer-driven composition system of a newspaper, origination is truly a data capture function. Origination also incorporates ancillary activities e.g. a journalist seeking out news items or a publisher commissioning an author.

The processing stage commences as soon as a draft manuscript is received by the publisher. This stage can be subdivided into two separate sub-stages which it is logical to link together. Both editing and conversion are concerned with manipulation of originated material. Moreover, editorial control usually extends to the conversion stage in, for example, newspaper publishing.

Reproduction can also be subdivided into two sub-stages; replication and collation. Replication is the production of images of the processed information e.g. printed pages. Before the information can be distributed, however, further steps may be necessary. Printed pages may need to be placed in order, fastened together by glueing, stitching or stapling and bound. Fastening and binding are only necessary for some publications but all documents require pages to be in order. As a compromise collation is the term adopted for any or all of these processes in this sub-stage of the model.

Distribution has been defined clearly. It should be added that distribution includes any necessary functions prior to dispatch and after delivery such as bundling, wrapping and unwrapping.

Other definitions of reception were considered. Ideally, one would like to determine when the information has been read or preferably when it has been read and understood. There would be considerable difficulty in determining either of these, particularly in the latter case where some form of pre-test, post-test analysis would be required. It appears unncessary to introduce these complications and so reception is defined as the physical reception of the information package.

A block diagram of the model (printing/publishing) is shown in Figure 10. In this case, the stages origination, processing, distribution and reception are all sequential. There are feedback loops, particularly between origination/processing, and between processing/reproduction. Thus a sequence could begin:- origination, initial editing, secondary origination, secondary editing, initial conversion, tertiary editing, secondary conversion, replication .....

The effective transfer of information requires a controller. This may be a person, persons, a corporate entity or a machine. The person(s) fulfilling the role of controller may either participate in one or more of the five stages (e.g. editor, production manager) or be a separate entity external to these five stages (e.g. director of a publishing company).

While reproduction also follows sequentially after processing in, for example, the production of a book it may occur at other points in the sequence in electronic publishing.

A modified version of the model as applied to electronic publishing is shown in figure 11. There are major differences in the stage sequence, conversion can now be considered to follow immediately after origination. Replication, distribution and reception can be considered to occur simultaneously.

There is a change in the nature of the controller which is now a diverse entity being shared by the directing authority and the recipient. Partial control is also built into the system functions. This provides the potential for various automatic control options. Some of these are:-

(i) Counting the number of times an item of information is accessed.

(ii) Direct debiting of recipient.

(iii) Restriction of access.

Option (i) would be useful to the publisher in assessing the success of its publications.

The model operates in several modes. The mode described so far is a general descriptive one and is useful for describing different product sectors, technologies and operating methods. The model can also be used to describe the roles played in each of the five stages, ie originators, processors, reproducers, distributors, recipients or corporate entities, eg agencies, publishers, printers, wholesale distributors and consumers.

Quantification of the model

The model described so far is qualitative but there are various options for including numerical data.

Depending on the application of the model, there are a number of sources of data; time, costs (manpower, capital and material), resources (equipment, personnel) Any of these can be used to provide a quintuple of numbers, one for each of the five stages origination, processing, reproduction , distribution and reception. In each case the quintuple is entered as elements of a row matrix.

A discussion follows and in each case and throughout the remaining chapters of this thesis the following abbreviations will be used:-

origination (o)
processing (p)

reproduction (r)
distribution (d)
reception (R)

Personnel

Each element of the matrix is simply the number of persons involved in that stage of the information transfer process. For example the printing of invitation cards to a party may be handled by a one man printing business. Origination is performed by the individual giving the party (1), processing (1) and printing (1) are carried out by the owner of one-man business and distribution (1) is carried out by the party giver. The number of recipients is simply the number of people invited to the party. If this is 100 then the matrix is:

o	p	r	d	R
(1	1	1	1	100)

A small provincial newspaper with a circulation of 10,000 may have eight journalists, 14 editors and compositors, 12 workers involved in platemaking and press operation and 20 workers in distribution. The matrix in this case would be:

o	p	r	d	R
(8	14	12	20	10,000)

In some instances the measurement using personnel may be impossible or inappropriate. In this case the units used in the matrix could be man-hours.

Time constraints

The time taken to transfer information is an important consideration. In publishing there are deadlines that must be met. In newspaper publishing these deadlines are very tight. An important variation of the matrix has elements entered as periods of time. Where these times are known the matrix elements will simply be numbers of hours. In many cases the

times are not known accurately and/or vary widely in magnitude. In these cases the following coding will be used:

0 (less then 2 seconds), s (seconds), m (minutes), h (hours), d (days), w (weeks), M (months), y (years), x (not known or regarded as unimportant in the context of the particular point discussed).

Chazin (1976) describes one of the fastest productions of a paperback book, "90 minutes at Entebbe". Instead of months the whole book was conceived, written and published in a matter of days. Using his description as a basis and estimating where his figures are not precise the production time for the 224 page book (excluding covers, photographs and other material produced separately) was approximately 220 hours origination, 24 hours processing, 95 hours reproduction, 15 hours distribution. Assuming that most books of this type are bought by a casual purchaser, reception would possibly average at 10-12 minutes or 0.2 hours. The time duration matrix of the model in this case would be:-

o	p	r	d	R
(220	24	95	15	0.2)

The following are suggested as matrices for several different publications:-

	o	p	r	d	R
Text book	(y	M	w	w	m)
Periodical	(h	h	w	d	m)
Newspaper(National Daily)	(h	h	h	h	m)
Print on demand	(x	h	m	s	s)
Electronic journal	(x	h	0	0	0)

The above are the author's assessments of the average times for such publications. They have been verified as reasonable assessments in discussion with colleagues at Pira.

3.6 Discussion of prospective application of the model

The model, as described so far, was the initial form of the model. It was proposed as a framework for the thesis in order to coordinate and bring into perspective the many different forces and their effects on printing and publishing. (These will be described in Chapters 4, 5 and 6).

Section 3.5 has shown that the model may have potential for a more detailed role in examining printing and publishing. The brief comparison of traditional methods of publishing via printing and electronic publishing explored in the previous section with reference to figures 10 and 11 points to its potential for qualitative assessment. A degree of quantification has also been introduced by using various measures as elements of simple matrices. The following is a discussion of the further development of the model with a view to prospective application.

Publishing is a diverse industry. Therefore, for clarity this section will focus on one publishing sector, newspapers. This sector is chosen because it provides an example where printing and publishing are integrated within a single company. Furthermore, newspaper publishers have usually been in the forefront of the introduction of new technology.

Figure 12 shows an outline of the production and distribution of a newspaper, mapped onto the information transfer model. Newspapers are usually a mixture of text and graphics, the relative proportions depending on the nature of the publication. Quality national newspapers generally have less pictorial matter than the popular tabloids. Even so, the pages of 'The Times', 'The Guardian' and the 'Daily Telegraph' contain a generous number of photographs and other graphics. As everyone knows, not only is 'a picture worth a thousand words' but 'every picture tells a story' and editors are not

likely to forget these adages.

In most instances text prompts the origination of graphics. In the simplest case this may be achieved by dispatching a photographer to the location of a news event. In other cases maps and/or diagrams may be required as background to the story.

There are some instances where graphics may give rise to the origination of text e.g. a wire photograph of the winner of an international beauty contest.

Once originated, text and graphics pass through an editing cycle prior to page make-up. During assembly of text and graphics to form pages some re-sizing of galleys and photographs may be necessary and so a re-cycling of text and/or graphics may ensue. This shows once again that editing and conversion are closely linked and logically fall within the same processing stage of the model. While page make-up is firmly under editing control it is part of the conversion sub-stage of the model. The conversion sub-stage is completed with the production of the image-carrier, a litho plate or stereo. (In other publishing sectors the conversion sub-stage would be completed by proofing of the plate. In newspaper production this step is usually omitted to save time, proofing being carried out by visual inspection of the plate and proofing on-press).

In the reproduction stage of the model the plate is mounted on the press, printing takes place and the newspaper is completed by cutting and collating. In some special editions inserts may be added during collation e.g. colour supplements.

In the distribution stage the completed newspapers are bundled, wrapped and addressed. After delivery to their

destination e.g. retail outlet, the bundles must be unwrapped. Different methods of distribution are favoured by different publishers. Some use wholesale delivery companies to distribute their newspapers to retail outlets. Some use their own delivery fleet while some also own retail outlets. Some deliver directly to the recipient using news boys/girls or they may mail copies, particularly for overseas readers. While newspaper houses may concentrate on one of these approaches they usually use a mixture of several forms of distribution.

Where newspapers are delivered directly to the recipient, reception follows immediately after distribution. Most newspapers in UK, however, are sold through retail outlets. Reception may then occur in two ways; the pick-up of a copy previously ordered or the casual selection of a newspaper at point-of-sale.

It can be clearly seen from this account that the production and distribution of a newspaper is a complex operation. It is easy to understand that individual production methods have been evolved over a number of years and why publishers are reluctant to make major changes to their methods of operation. The smooth running of the business depends on each member of management and work force efficiently performing his/her appointed task. In addition to the basic skills associated with each job role, e.g. pressing correct keys when inputting text, there are many levels of decision making.

The hierarchy of levels of decision-making has at the top the Board. This will lay down editorial, marketing and technology policies. In some houses the editor, once selected, may be given almost complete freedom to pursue his/her own editorial style. In other instances certain editorial policy may be

laid down by the Board. In addition to constraints on editorial comment due to the political and sociological bias of the Board there are usually constraints on typography etc. The latter may only be changed after considerable discussion and the outcome of changes in typographical style may be quite startling e.g. 'The Times'. The editor is probably the most important decision-maker below Board-level. The editor's range of control extends directly to the origination stage of the model by selecting items and ordering a re-write. At this level in the hierarchy of decision-makers there is the production manager and at a slightly lower level circulation, marketing and technical managers. Reporting to the production manager there are supervisors of the composing room, machine room and the graphic reproduction and plate-making departments. These are all management positions and decision-making is naturally part of the function of management. At a much lower level, however, many decisions have to be taken by the work force. Compositors automatically perform part of the editing function, correcting words that are mispelt. It has been noted above that proofing is usually omitted. This could lead to expensive and time-consuming mistakes if the plate-makers did not inspect plates for faults. While these and other decisions may be mundane it is essential that they are correctly made for the smooth-running of newspaper production. The need to make important decisions even at the lowest skill level of the work force has probably been a factor in the emergence of very strong print unions.

While absolute power in respect to decisions may reside in the Board, there is no one person who has complete direct responsibility for the total operation. This responsibility must be delegated to the editor, production manager, accountant etc. This has in many instances led to an unsystematic procedure for decision-making within publishing companies. Usually decisions are taken after discussion

between departments and then reporting to the Board. This is at a tactical rather than strategic level of decision-making.

Changes effected in one department cause changes within other departments. Sometimes these can be predicted but this is not always the case. Consider a simple decision which requires no changes in production methods or introduction of new technology, an increase in number of copies. This would increase the amount of work and possibly some increase in the work force would be required. The extra copies would need to be sold so an extra effort by the sales force would presumably be necessary. Therefore production and distribution costs would be increased. The results would have to be monitored by the accounts department to ascertain the success of the increase in production by calculating the change in profitability.

This is a very simple example of tactical decision-making and yet it can be seen that the implications are far-reaching. Other decisions could have a more dramatic effect and the interactions very complicated and less predictable. For example, introducing a new item of equipment which has implications for manpower training and changes in production costs. Another example would be the suggestion by the marketing department that improved quality would increase sales. This would require a number of decisions, probably the introduction of new equipment and retraining of operators and maintenance personnel. Although sales might increase due to improved quality, profitability might not and the accounting department would have to monitor this.

When one considers the complexity which results from relatively simple decisions and the large number of variables to be taken into account in the decision-making process it is surprising that more systematic aids to decision-making are

not widely used. In the case of a newspaper publisher changing production methods such as to a different printing process or replacing hot metal composition by photocomposition a systems approach is essential.

The model described in the previous section requires further development before it can be used as an aid to decision making. The matrices need to incorporate a larger number of parameters. The obvious additional measures to use are related to costs. Since a publisher's costs end with the distribution of the newspaper, (sales costs are considered part of distribution costs) no figures are required for the reception stage of the model. The matrix is therefore reduced to four columns, one for each of the stages; origination, processing, reproduction and distribution.

Examination of the printing trade literature shows a number of cost parameters that are important, particular in relation to the assessment of new technology (see Appendix A3.3). These are the costs relating to labour, material, capital, maintenance and energy. There are additional costs that do not fall into any of these categories and these are allowed for by including an extra parameter, other. Cost parameters for the model can now be included in a 6 by 4 matrix as shown in Table A.

TABLE A COST MATRIX OF THE MODEL

	Origination	Processing	Reproduction	Distribution
Labour	x	x	x	x
Material	x	x	x	x
Capital	x	x	x	x
Maintenance	x	x	x	x
Energy	x	x	x	x
Other	x	x	x	x

In order to obtain figures for the model a visit was made to a provincial newspaper publisher. In a lengthy interview, the Chief Accountant obligingly provided information upon which to base the following development of the model.

The company, part of a publishing group of companies, is a provincial publisher of weekly and daily evening newspapers. The technology employed to produce the newspaper involves computer-driven photocomposition, printed on web-offset lithographic press. Approximately 880m broadsheet pages are produced per year and total costs for 1982-83 were £6.4m. In round figures. 400 staff are employed, 100 in administration and 300 production and editorial personnel. For accounts purposes journalists and editors are all classified under the heading editorial. Many journalists also perform some sub-editing. After further discussion with an editor it was decided that 15% could be attributed to editing and the remainder to origination. The breakdown of personnel into stages of the model then becomes:-

Origination	Processing	Reproduction	Distribution
153	108	29	10

The figures for processing and reproduction include 2 and 3 for maintenance respectively.

The Chief Accountant thought that it would be misleading to use man-hours in place of number of employees.

Table B shows a breakdown of the 1982-83 costs entered in the cost matrix of the model. Some difficulty was experienced in fitting the account figures into the categories origination, processing, reproduction and distribution. Some of the categories used in producing the company's accounts overlapped two stages of the model e.g. editorial as mentioned

TABLE B PROVINCIAL NEWSPAPER 1983 COSTS (£,000)

	Origination	Processing	Reproduction	Distribution	Row Total
Labour	1539	1171	350	892	3952
Material	30	107	1043	57	1237
Capital	2	43	90	47	182
Maintenance	.1	39.9	55	15	110
Energy	1	4	30	0	35
Other	0	0	0	120*	120
Column total	1572.1	1364.9	1568	1131	5636

Total cost = £6,426,000

*Promotion

above. Some items appeared in unexpected categories e.g. Wire Service costs were included as production costs in accounts figures. Other difficulties related to the company's contribution to group costs.

Labour costs include wages, pension and staff expenses. Capital costs are based on traditional accounting methods of calculating depreciation. This allows for equipment to be written off over a period which varies according to the nature of the equipment. In general this is ten years but for electronic equipment it is only six years and for a press 16 years. It was pointed out that the procedure could be queried, particularly for an item such as a press which retains its value very well. However, since this is an established method of accounting it is used to estimate capital equipment costs.

The information given in Table B does not, perhaps, reveal anything startling. Wages and associated costs are known to be the principal costs of any newspaper publisher and therefore, origination has the greatest total cost of the four stages of the model. The item, material costs of reproduction, is mainly due to the high cost of newsprint. It should be pointed out that the large entry for the element labour/distribution is due to the marketing methods adopted by this publisher since the late 1960s. The evening newspaper is now sold directly using a team of around 1600 newsboys.

As indicated above, the company is now part of a publishing group but until the 1960s it was still a family-owned business which was founded in 1873. It was then taken over by a company, which in turn was absorbed into a group of companies. As a result of these changes the company embarked on a programme of expansion, moving to a new location and

completely changing its methods of production and adopting more aggressive marketing methods.
In 1967 the company published only weekly newspapers, printing 390m broadsheet pages per year. The technologies employed were hot-metal composition, stereo plate-making and letterpress printing. Total costs were £411,400.

The company then employed 217 staff, 29 in administration and the remainder having occupations which can be allocated to the stages of the model as follows:-

Origination	Processing	Reproduction	Distribution
70	104	12	2

Table C shows the company's 1967 costs broken down and entered as appropriate elements of the model's cost matrix. Comparison of Tables B and C show clearly the differences of structure between the 1967 and 1983 companies. Table C has very low figures in the distribution column indicative of a totally different marketing approach. In 1967 newspapers were sold through general retail outlets, not by direct selling. Another contrast is that in the matrix for 1967 both the processing and reproduction totals exceed that for origination. This reflects not only changes in company structure but changes in UK society where wages have risen faster than prices between 1967 and 1983.

Tables B and C offer evidence that the model could have a practical use. It is difficult to make direct comparisons, however, because of the difference in monetery values between 1967 and 1983. Therefore, methods of standardising the elements of the model were investigated. Two possibilities were:-

TABLE C PROVINCIAL NEWSPAPER 1967 COSTS (£,000)

	Origination	Processing	Reproduction	Distribution	Row Total
Labour	89	130	16	2	237
Material	1	7	84	0	92
Capital	0	3	6	0	9
Maintenance	0	2	5	0	7
Energy	0	2	3	0	5
Other	0	0	0	7*	7
Column total	90	144	114	9	357

Total cost = £411,400

*Carriage and publicity

i. to convert the monetary values to a standard using GNP,RPI or some other coefficient

ii. to reduce the figures to unit costs

Again the Chief Accountant of the company was very helpful. He pointed out a difficulty with method ii in that there was no standard unit of production within the company. The composing, machine and platemaking departments all adopted different units of measurement. With regard to point i it was noted that comparison would still be difficult after standardising monetary values due to differences in company size. Therefore, it was decided not to use either of these two approaches in this investigation of the model. Methods i or ii or a combination of both are possibilities that could be explored at a future date.

The method adopted for standardising the matrices of Tables B and C was to use proportionate costs. Each element was converted to a percentage of the total cost, figures rounded off to one decimal place. The results of these conversions are shown in Tables D and E. In this form the matrices may be compared more easily. As a further aid to comparison a new matrix was constructed by subtracting the elements of the matrix in Table E from that of Table D. The resulting matrix, which shows the percentage changes between 1967 and 1983 are shown in Table F.

Table F indicates that the model could be useful in monitoring changes in a company over a period of years. An interesting further exercise would be to compile a series of matrices for different companies to test whether these were typical matrix templates for different types of company structure and technology.

So far this development of the model has concentrated on costs and has ignored the other measures suggested in section 3.5,

TABLE D PROVINCIAL NEWSPAPER 1983 % COSTS

	Origination	Processing	Reproduction	Distribution	Row Total
Labour	23.9	18.2	5.4	13.9	61.4
Material	.5	1.7	16.2	.9	19.3
Capital	0	.7	1.4	.7	2.8
Maintenance	0	.6	.9	.2	1.7
Energy	0	.1	.5	0	.6
Other	0	0	0	1.9	1.9
Column total	24.4	21.3	24.4	17.6	87.7

TABLE E PROVINCIAL NEWSPAPER 1967 % COSTS

	Origination	Processing	Reproduction	Distribution	Row Total
Labour	21.6	31.6	3.9	0.5	57.6
Material	.2	1.7	20.4	0	22.3
Capital	0	.7	1.5	0	2.2
Maintenance	0	.5	1.2	0	1.7
Energy	0	.5	.7	0	1.2
Other	0	0	0	1.7	1.7
Column total	21.8	35	27.7	2.2	86.7

TABLE F PROVINCIAL NEWSPAPER % CHANGE 1967-83

	Origination	Processing	Reproduction	Distribution	Row Total
Labour	2.3	-13.4	1.5	13.4	3.8
Material	.3	0	-4.2	.9	-3
Capital	0	0	- .1	.7	.6
Maintenance	0	.1	- .3	.2	0
Energy	0	- .4	- .2	0	- .6
Other	0	0	0	.2	.2
Column total	2.6	-13.7	-3.3	15.4	1

manpower and time. A useful aid for management planning could be obtained by combining the cost matrix of the model with manpower measures and lead-times. A measure of profitability or net profit could also be added. A suggested format for this extension of the model is shown in Table G. Although loosely based on the figures in Table B, the figures do not represent any existing company.

Table G could also be supported by brief notes on the company, particularly regarding the technology employed. This format of the model could be used to explore the implications of a management decision. For example, suppose Table G represents a litho newspaper, employing traditional methods of plate-making but considering the purchase of a laser plate-maker (cf The Cambridge Evening News, Appendix A3.3). A manufacturer claims a laser plate-maker would replace 2 men in the platemaking department, save 50% of material costs and reduce plate-making time by 20 minutes. These suggested modifications to production can be entered into a skeleton of the model as shown in Table H. The decision-maker can easily calculate a 50% saving in plate-making materials, suppose this is £30,000 p.a. The capital cost has already been given by the manufacturer, together with manpower and time savings. These figures can be immediately entered as elements of the matrix together with changes in row and column totals.

The decision-maker can now work through the rows and columns determining any implications. For example, maintenance and energy costs may rise. The labour and other headings should prompt an investigation of union attitudes to the new equipment. Is there an increased hazard to health? If the unions demand more money how much extra will be required? What is the cost of retraining? Will there be additional insurance premiums?

The decision - maker can then turn to the manpower row. If two

TABLE G SUGGESTED FORMAT OF THE MODEL

	Origination	Processing	Reproduction	Distribution	Row total	
Labour	1500	1000	300	900	3700	
Material	30	100	1000	60	1190	
Capital	5	40	90	50	185	
Maintenance	1	40	60	20	121	
Energy	1	5	30	0	36	Administration costs £ 900,000
Other	0	0	0	100	100	
Column total	1537	1185	1480	1130	5332	Total cost £6,232,000
Manpower	150	110	30	10	300	
Lead-times (minutes)	360	240	60	60	720	

Net Profit £100,000

Technology: computer-driven photocomposition, manual plate-making, litho printing.

TABLE H PROSPECTIVE USE OF MODEL AS AN AID TO DECISION-MAKING

	Origination	Processing	Reproduction	Distribution	Row Total	
Labour	-	?	-	-	-	
Material	-	-30	-	-	-30	
Capital	-	+20	-	-	+20	Administration costs
Maintenance	-	+?	-	-	+?	
Energy	-	+?	-	-	+?	Total cost?
Other	-	-	-	-	-	
Column total	-	-10?	-	-	-10?	
Manpower	-	-2	-	-	-2	
Lead-times (Minutes)	-	-20	-	-	-20	

Implications of the purchase of a laser plate-maker

men are not needed in platemaking what will happen to them? Union negotiations will need to take place. If the men are made redundant then payment for this would have to be included in costing the operation. Perhaps the men could be transferred to different departments. This would require a retraining programme, again this would need to be costed.

After this costing exercise the advantage of reducing platemaking by 20 minutes could be considered. It may well be that this is the overriding factor in a decision to purchase the equipment, even if it leads to considerable cost increases.

3.7 Use of the model in decision-making

The model has been developed to a stage where it could provide assistance to a decision-maker in a publishing company. It could be particularly useful in considering the introduction of different production methods. The model could be used in conjunction with the following procedure:-

1. Enter present cost, manpower and lead-time perameters in the format shown in Table G.
2. Survey alternative methods of production, ascertain costs and expected changes to manpower requirements and lead-times.
3. Enter changes in value in table and note changes in row and column totals.
4. Work through rows and columns of the table, noting implications of proposed changes particularly in relation to manpower (wage increases, redundancies, moves to other departments, retraining), maintenance (new staff, retraining, costs), energy (cost increases/decreases) and any other changes e.g. insurance.
5. Make a checklist of qualitative changes and quantitative changes not directly related to costs e.g. improved quality, reduction in production time, increased volume of production.
6. If 4 and 5 indicate that changes in technology appear advantageous identify further information necessary e.g. market research on reaction to improved quality, estimates of cost benefits associated with increased production.

It is expected that this approach would be useful at the initial

stages of decision-making. Suppliers naturally emphasise the strengths of their equipment in promotional literature and make little or no mention of any weaknesses. The decision-maker, after completing the six steps listed above, will be in a better position to assess the disadvantages of any new equipment. This will enable the decision-maker to probe more deeply into the capabilities of new equipment.

The decision-maker should also examine other aspects of the introduction of new equipment such as changes to the working environment, health and safety. If the initial investigation suggests that there could be advantages in changing production methods it is essential that the work-force should be informed before further steps are taken (See Appendix 3.3).

3.8 Summary

This chapter commenced with a discussion of the terms 'information' and 'information transfer' and adopted suitable definitions to avoid ambiguity in their use.

A comprehensive review of information transfer models revealed that there are few general models that could be applied in an analysis of publishing. A model was then proposed and developed, which could be incorporated in a more systematic approach to decision-making by management in its assessment of new printing technology. The model is also used in Chapters 7 and 8 as a framework for coordinating and comparing the many changes that are occurring in printing and publishing.

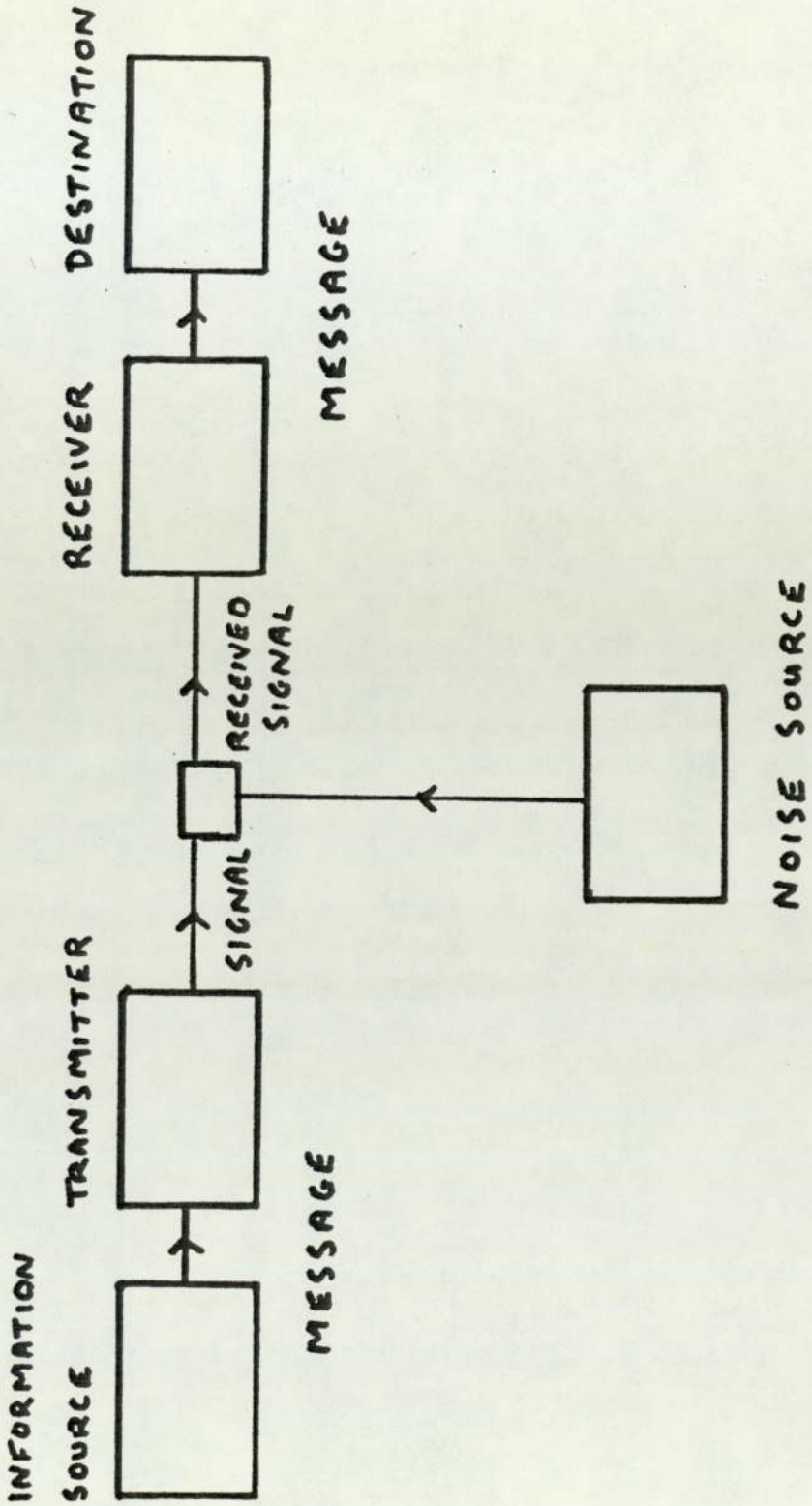


Figure 1. Shannon and Weaver model of a communication system

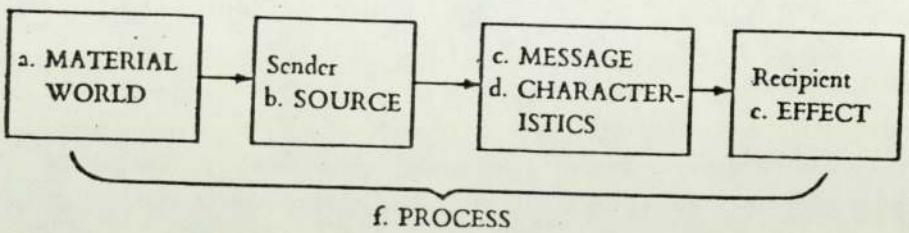


Figure 2. Wersig's schema for the typology of information definitions

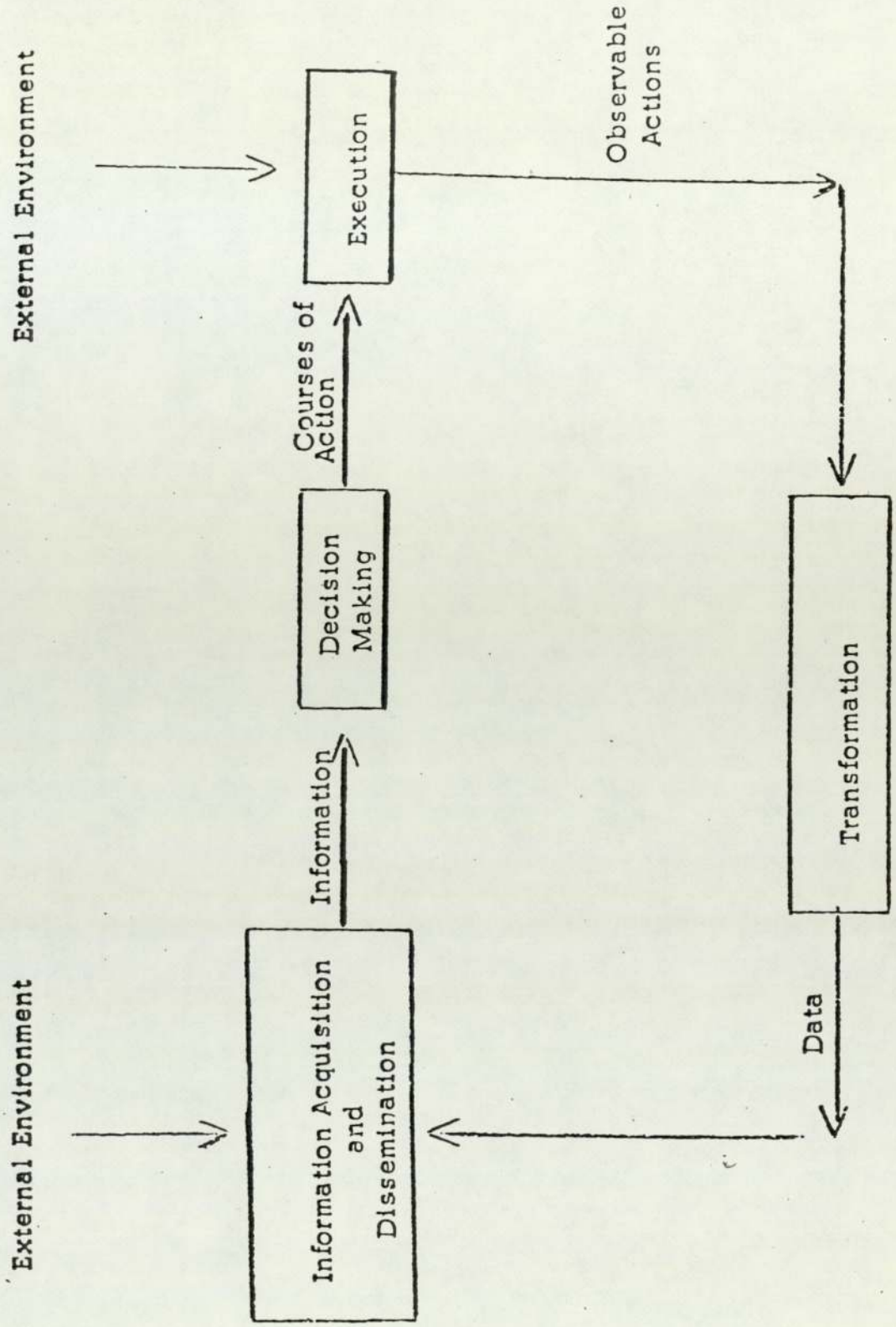


Figure 3. Yovits and Ernst generalised information system

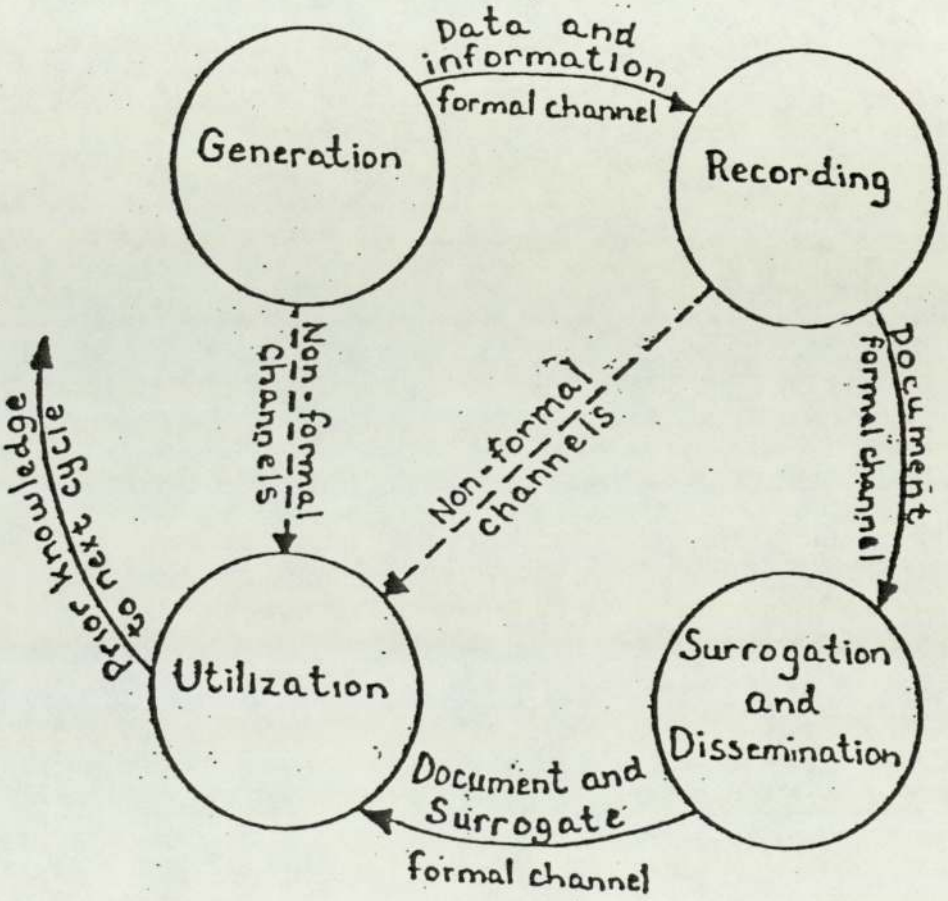


Figure 4. Subramanyam model for didactic science communication

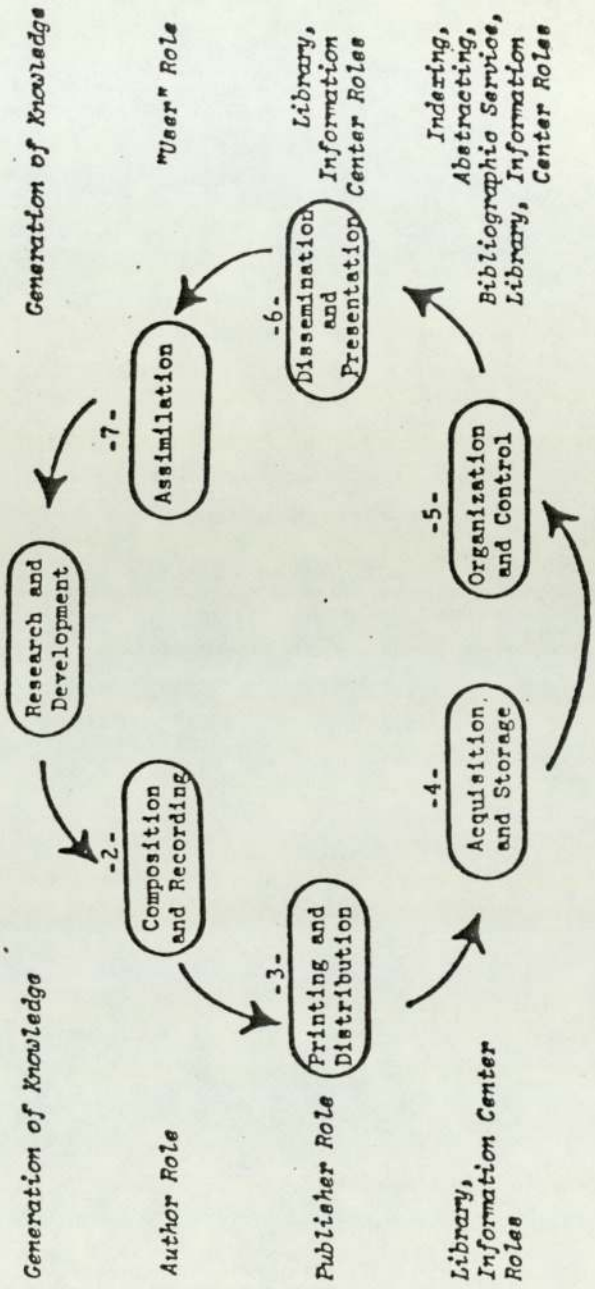


Figure 5. King and Wood scheme for the information cycle

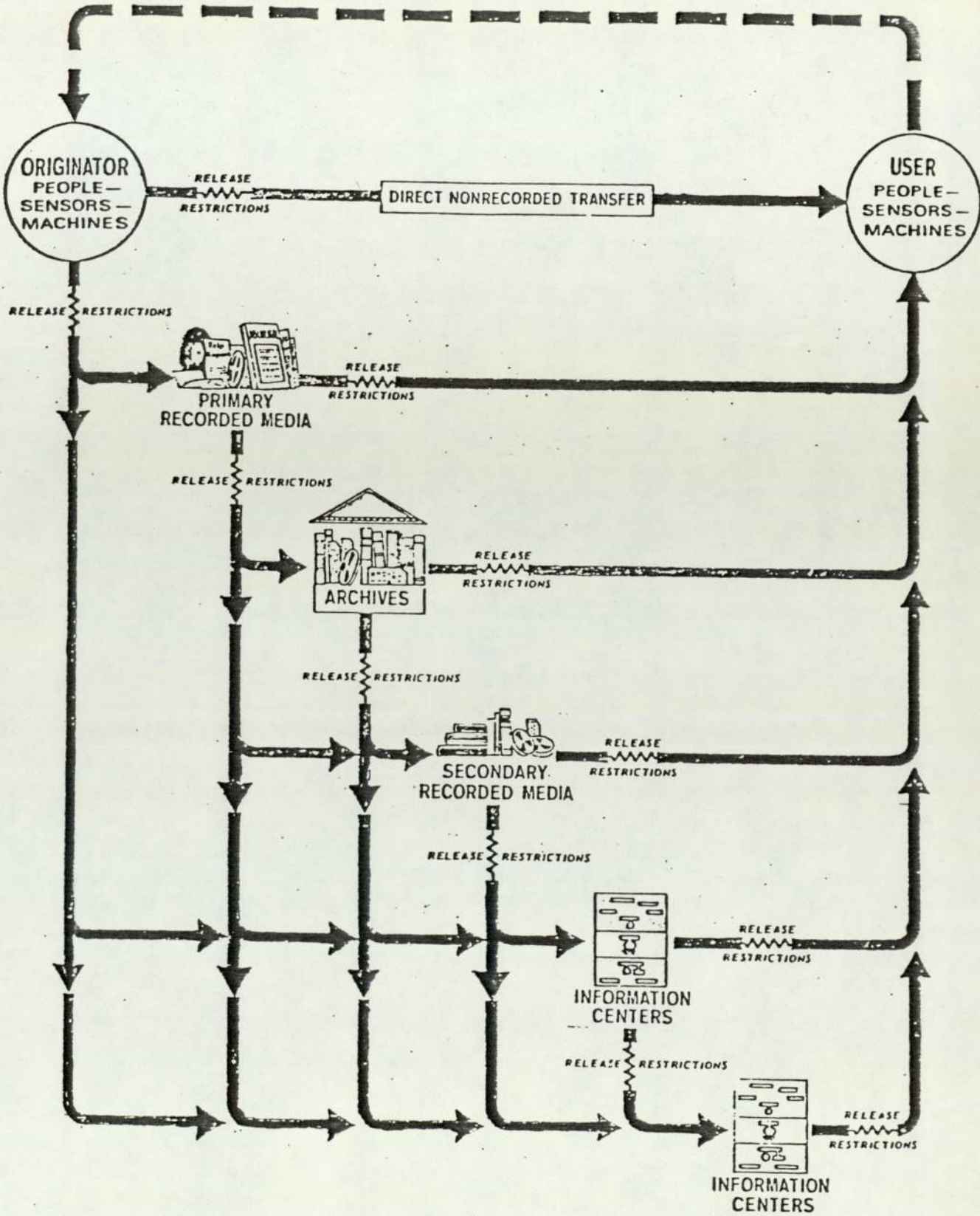


Figure 6. Murdock and Liston general model of information transfer

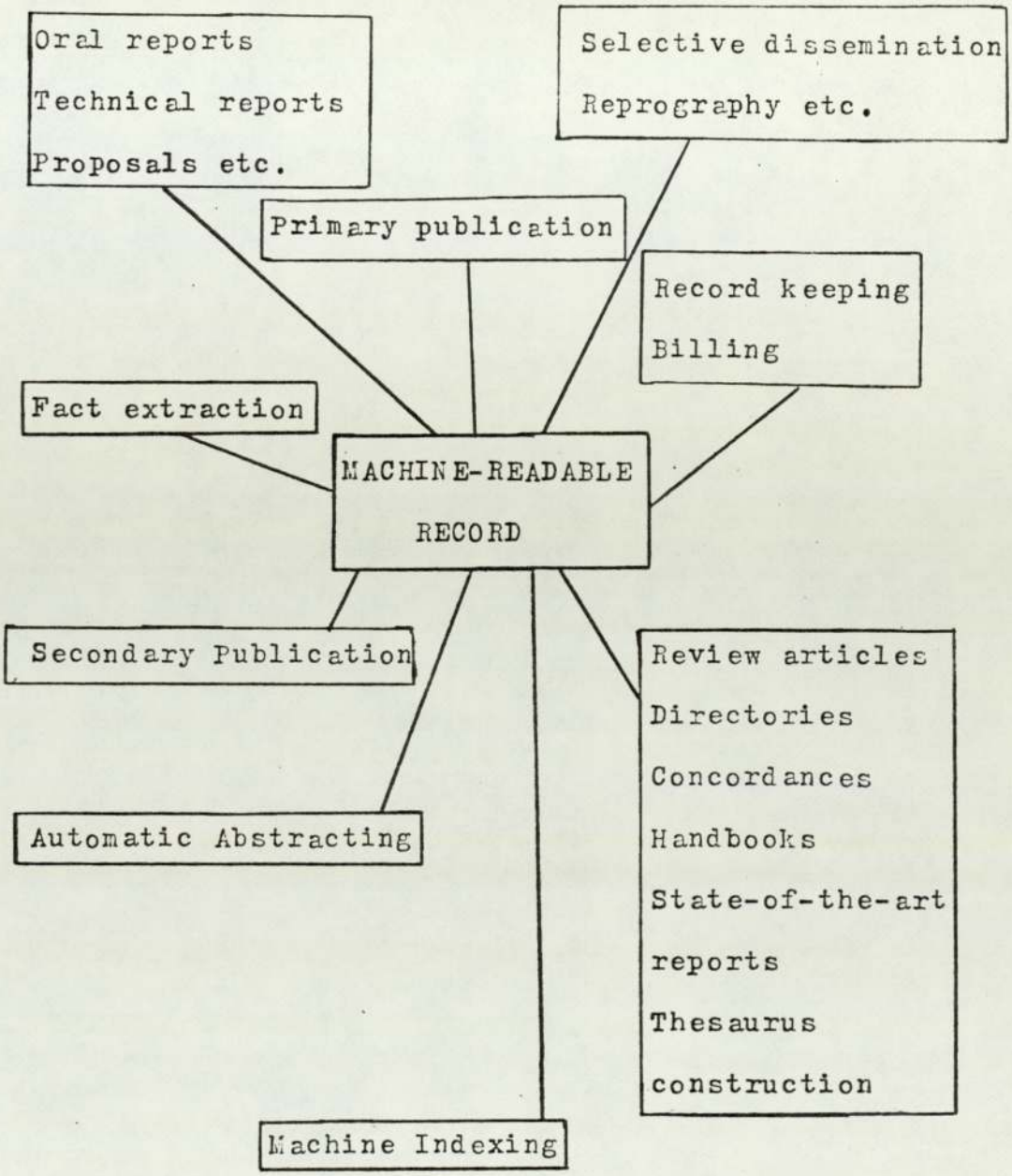
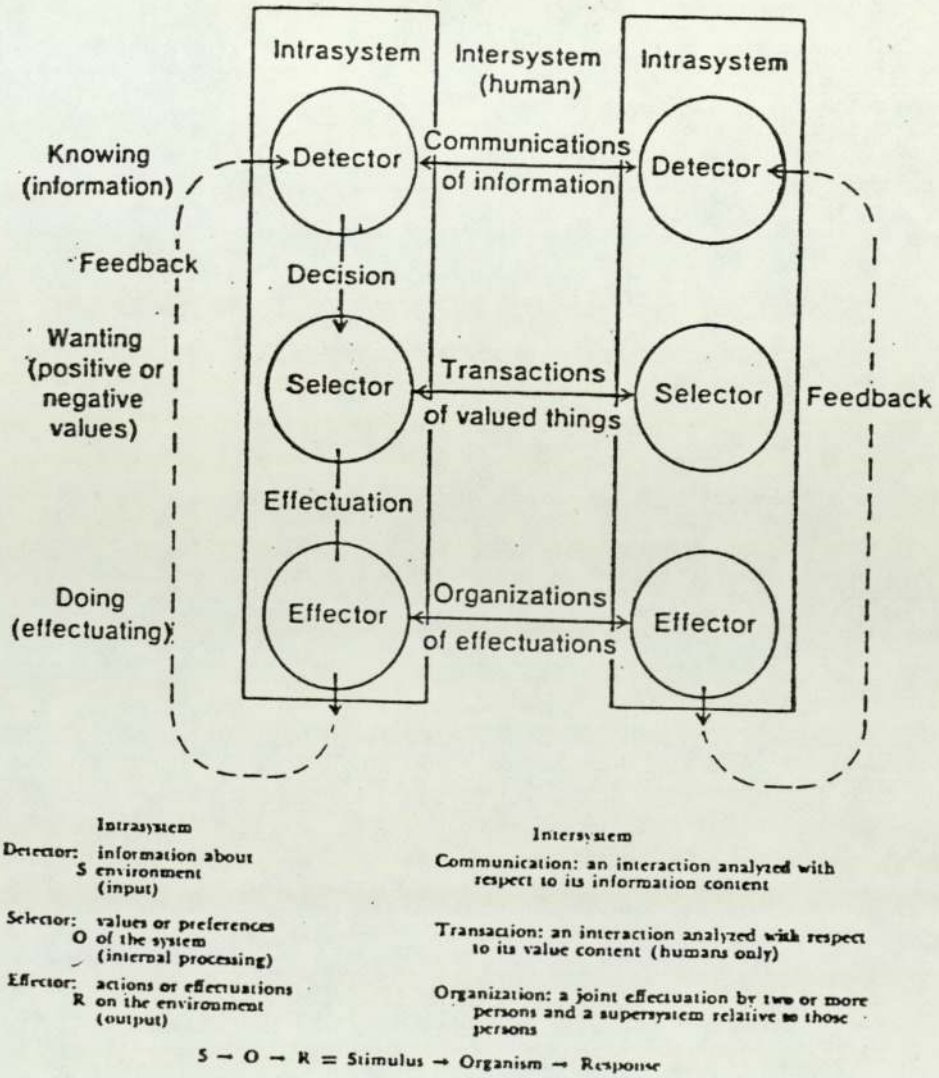


Figure 7. Libaw imbricated (overlapping) model of information transfer



Intrasystem-intersystem axis of controlled systems.

Figure 8. Kuhn Detector-Selector-Effector (D-S-E) model

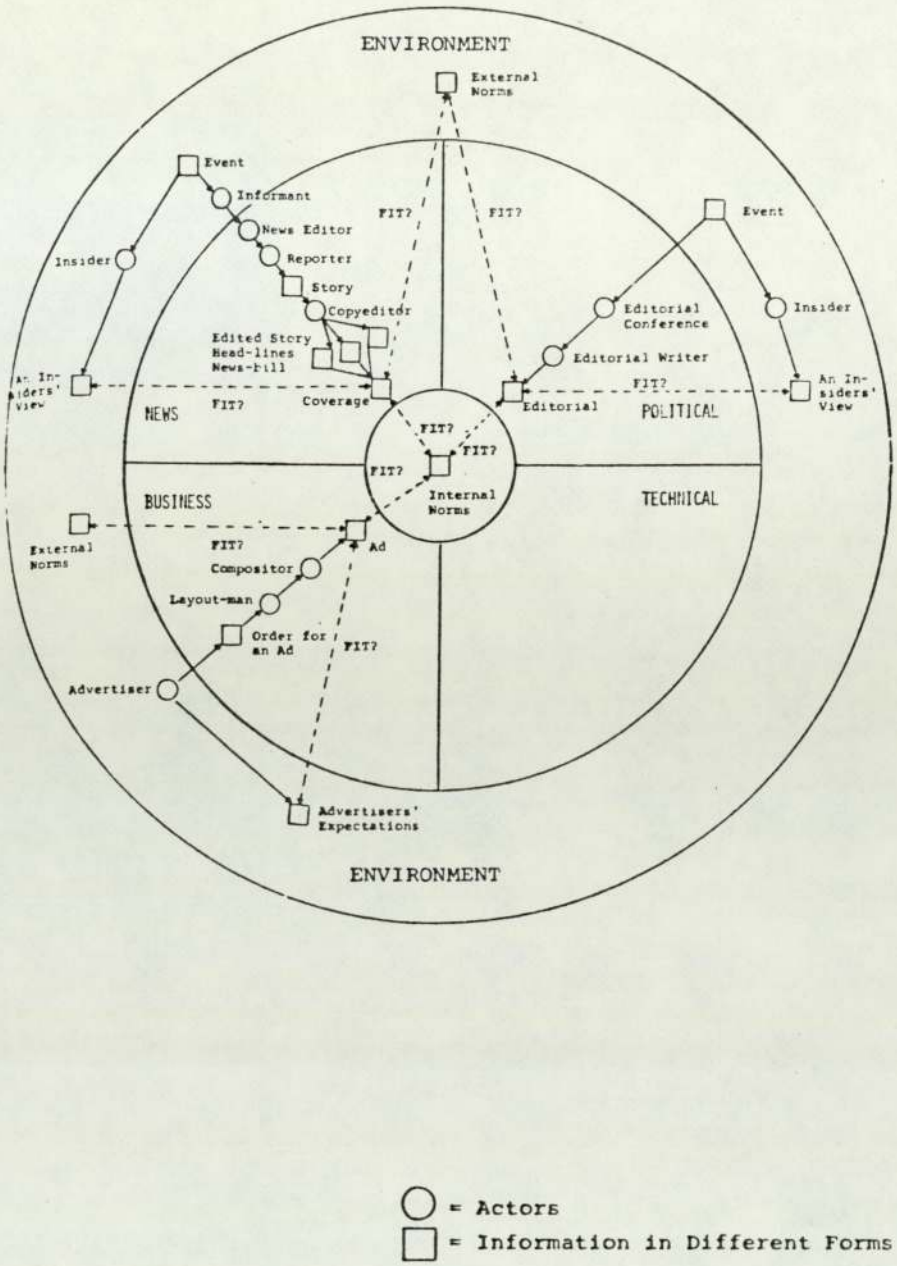


Figure 9. An organisational model of different roles in the publishing environment (Engwal, 1978).

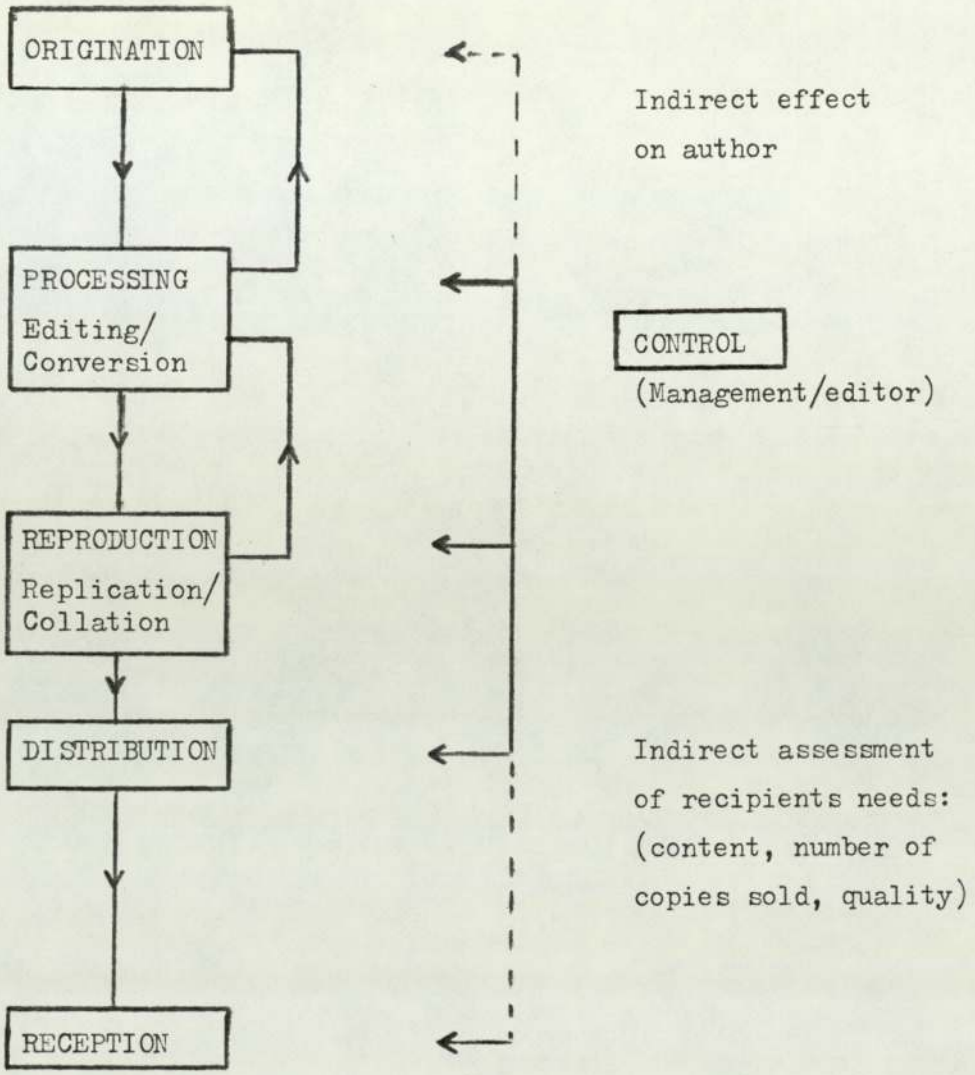


Figure 10. New information transfer model
(printing/publishing version)

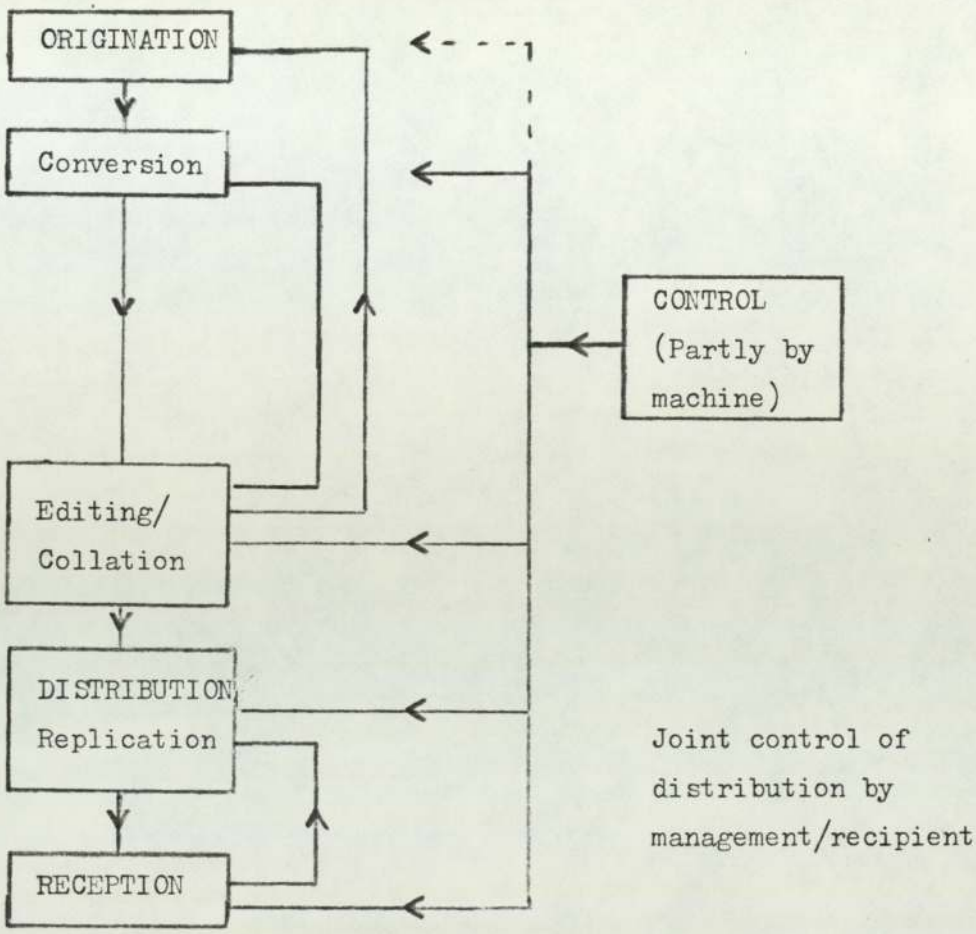


Figure 11. New information transfer model
(electronic publishing version)

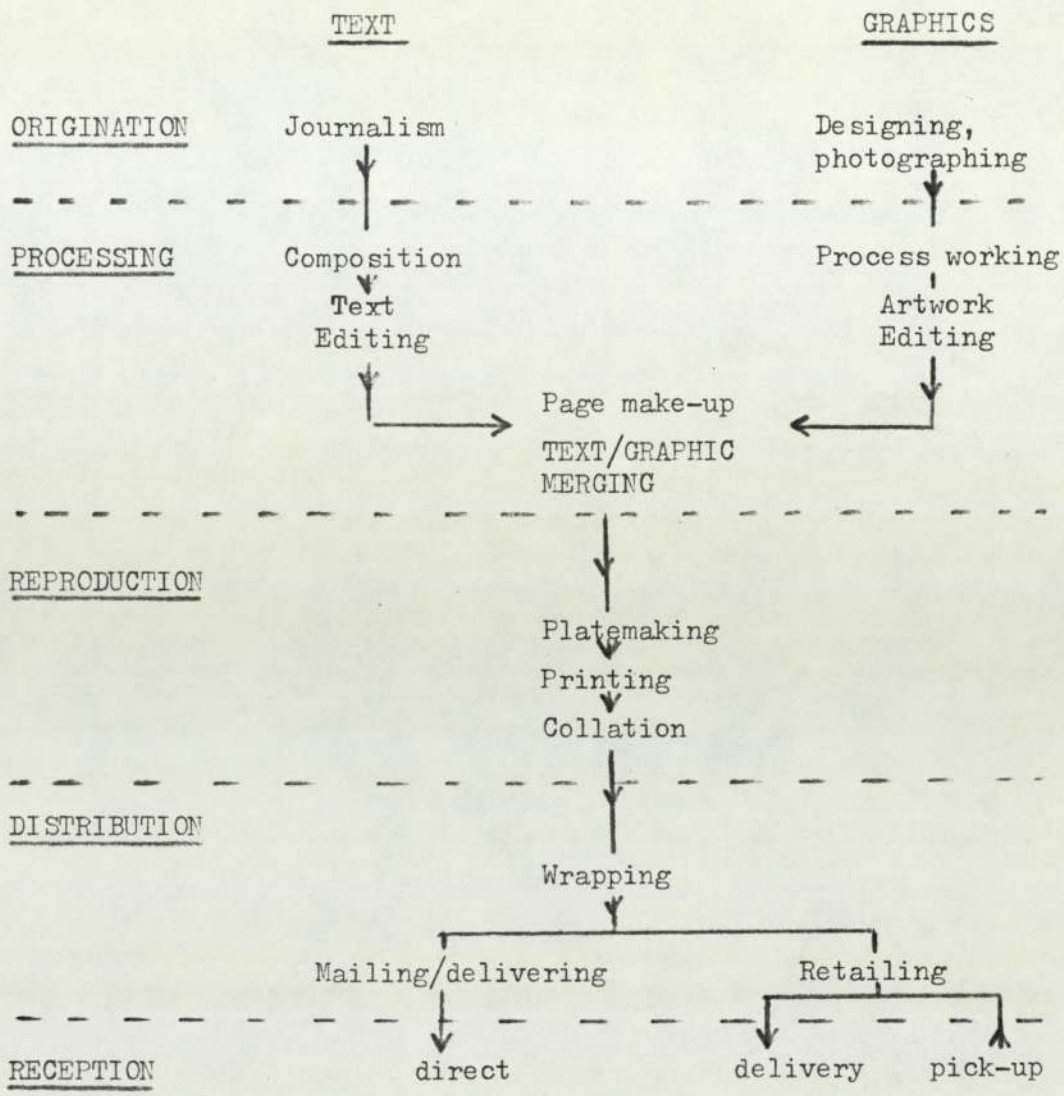


Figure 12. Newspaper publishing functions mapped onto the information transfer model.

C H A P T E R 4

TECHNOLOGY AND STRUCTURE OF THE PRINTING INDUSTRY'S COMPETITORS

4.1 Introduction

This chapter provides an overview of the industries and technologies which pose a potential threat to the printing industry. An overview of publishing and printing will be given in Chapter 5. When the movable type printing press was introduced in fifteenth century Europe printing and publishing were integrated. Today printing and publishing are separate industries although many integrated publishing/printing houses still exist. Until recently, however, printing was still the main method of reproducing publications. A number of alternatives to printing for replicating the written word are now available and several of these methods have already been used by publishers. If the products resulting from these new methods are acceptable to the public and costs are favourable compared to printing then these methods will be used increasingly by publishers.

In printing and publishing the industries which may emerge as rivals to the printing industry are usually referred to as alternative industries and new technologies that may substitute for printing are usually referred to as alternative technologies. These phrases will be used with this meaning throughout this thesis.

These alternative methods of publishing have emerged from the business and office equipment, computer and telecommunications industries. A description of these industries is given in Section 4.2 Alternative industries. This is followed by an account of the alternatives to printing in Section 4.3 Alternative technologies.

The chapter is concluded by Section 4.4 which provides a summary and indicates the relevance of the information transfer model.

4.2 Alternative industries

Alternatives to printing have been produced by three industries: the business and office equipment, computer and telecommunications industries. The proliferation of computer equipment in all industries has partially eroded the boundaries between industries in many cases. In particular many leading suppliers of office and business equipment are also leading suppliers of computers and peripherals. Examples of such companies are IBM, Burroughs, NCR, Olivetti, and Adler. Nevertheless, it is still possible to distinguish the three aforementioned industries at least by definition of perceived objectives.

The office and business equipment industry is a supply industry providing secretarial and administrative aids for the efficient running of businesses. The competitive nature of the market has caused supplier manufacturers to improve the sophistication of their equipment. This, in turn, has led to increased application of computer techniques. Thus even relatively simple and low priced electronic typewriters incorporate microprocessor-based technology, allowing the storage, display and amendment of characters prior to output onto paper.

The computer industry is also a supply industry providing equipment for a wide range of applications. It would be difficult to find a segment of industry where computers have not found an application. Indeed the computer has become available for use in the home and the supply of low-cost microcomputers has become a large and profitable sub-industry itself.

There has been a rapid fall in the price of microcomputers. The ZX-81, for example, is now available for less than £50. The phenomenal growth in this sector has forced mainframe computer manufacturers such as I.B.M., D.E.C., I.C.L., Burroughs etc. to introduce their own personal computers. However, these are much more expensive, approximately £3,000.

The telecommunications industry is interpreted here in its widest sense and therefore includes broadcasting as well as telephone services etc. and is mainly a service industry. Private manufacturing companies supply equipment but control of the use of equipment is firmly in the hands of the Government. This control is effected both by the use of legislation and the operation of State Monopolies. In the UK the application of a State Monopoly operates with respect to telephone and telegraph services through British Telecom which was formerly the telecommunication part of the Post Office but now is a separate company. A 1981 press release by British Telecom indicated that it was one of the largest telecommunications systems in the world with 27 million telephones, 90,000 telex lines and 70,000 computer data-links. Broadcasting, both of radio and television is also operated by private companies but programmes are monitored and controlled through the Independent Broadcasting Authority (IBA).

UK is the only country in Western Europe to have television fully commercially owned and funded (Anon, 1980 (3)). Although the three industries have operated with different objectives and in different markets they have emerged as rivals to the printing industry in the following ways:

- The office and business equipment industry has improved the capability of equipment so that current devices are able to perform operations previously confined to the printing industry. Composition and editing can be performed by secretarial-staff and good quality printed output can be achieved at high speed in a clean environment.

- The computer industry has acquired considerable expertise in providing computers for many different situations. Many computer manufacturers have become suppliers of equipment which is a potential threat to the printing industry. High speed printers designed to output data from computers are now capable of much higher quality and in a variety of type faces.

- The telecommunications industries offer electronic media as alternative to the printed word. In UK, Ceefax and Oracle of the television broadcasting companies and Prestel of British Telecom all offer up-to-the minute information in written form that may be seen as an alternative for the newspaper.

These industries may be broken down into various sub-industries such as; home and small business computers, large computer systems, and word processing systems (see Figure 13).

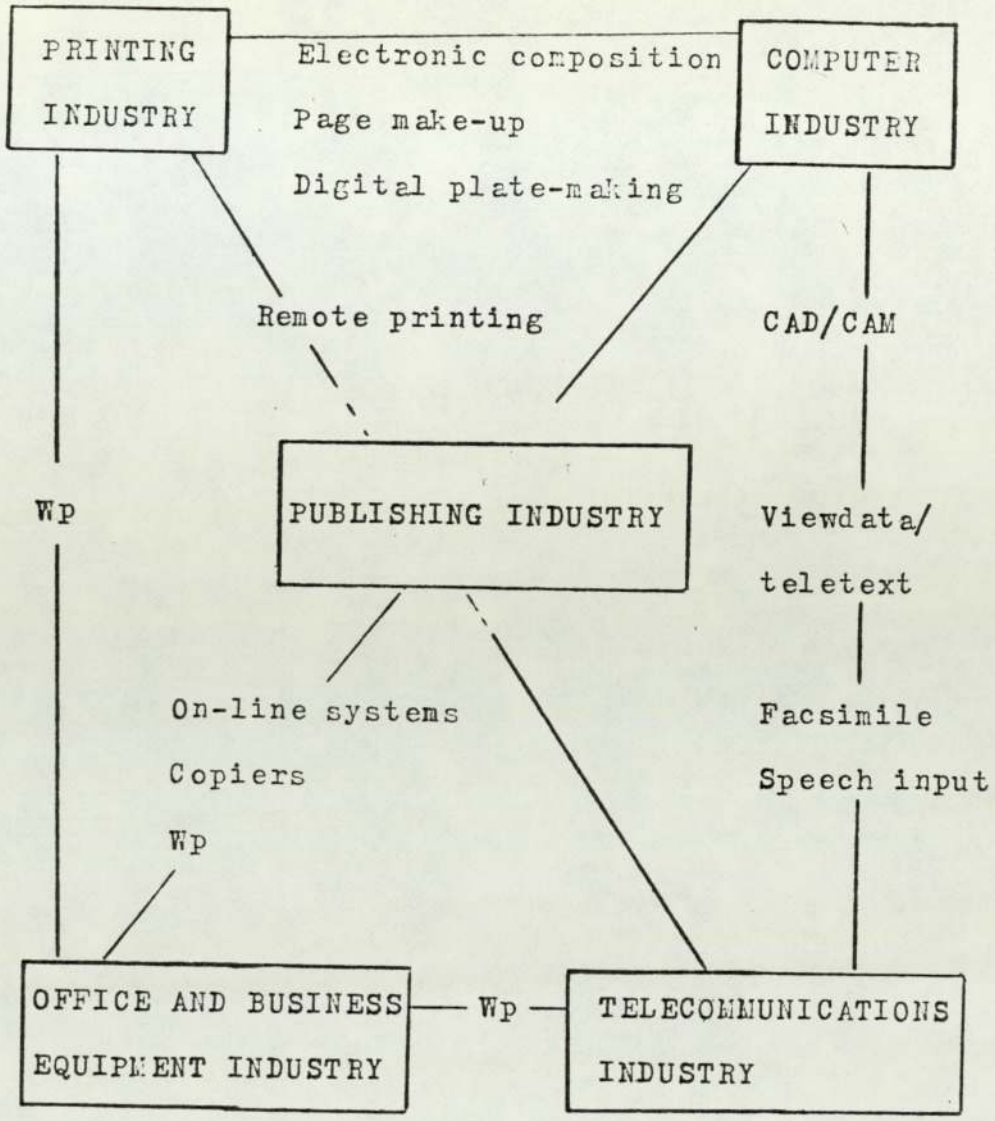
As well as competing with the printing industry these industries also will be competing amongst themselves. For instance, Commodore Business Machines produce the low cost Pet microcomputer for home and small business use and this has word processing capability. This low cost system is competing with the dedicated word processing systems produced by office and business equipment suppliers at the lower end of the market.

The situation is complex, rival companies often emerging from the quite different market sectors and having originally marketed products based on different technologies. The background of three major U.S.A. companies IBM, Xerox and Wang clearly shows this:-

IBM produced typewriters, adding machines etc

Xerox was founded on office copiers to the extent that the company's name is used, and often inappropriately, for all types of copiers.

Wang, the newest of the three companies, emerged at the forefront of the introduction of wordprocessing and is now (Seybold, 1981) the leading world supplier of this type of equipment.



All dependent on the electronic supply industry

Abbreviations : Wp word processing; CAD/CAM Computer-Aided-Design/Computer-Aided-Make-up

Figure 13. Communications infrastructure: industries and technologies

All three of these companies are now competing fiercely in the market to supply the major types of office automation equipment; word processors, networks and intelligent copiers.

Figure 13, Communications infrastructure: industries, illustrates the relationship now developing between industries in communications.

Evans (1979, p. 74) writes:

"There is a possibility of a convergence between printing and publishing, communications, word processing and data processing which may well affect the traditional nature of publishing".

This can be seen clearly in figure 13, which also shows that the convergence is not merely related to technology but to the business interests of different industries. The convergence of technology allows many different industry sectors to complete in the same markets; the production, processing or transmission of information. At the same time the increasing amount of technical, scientific and commercial information now handled by commercial, scientific and military organisations has created a need for devices that aid in the storage, processing and distribution of information. Contemporary society has also become more information conscious and thus is illustrated by consumer demand for new publications and new media. The demand for information is so great that Porat (1978) describes the U.S.A. as an "information economy" because by 1970 over 53 per cent of labour income was earned by "information workers".

Porat's definition of "information workers" may be open to question. For example, Appleyard (1979) scorns Porat's inclusion of the whole of Public Administration together with such areas as banking and architecture. Nevertheless, the amount of information generated is growing rapidly. White (1979) reviewing several forecasts of the growth of information gives figures of around eight per cent per year as the percent rate of growth in science and technology while the growth in on-line data bases is much higher.

He suggests that for USA alone on-line searches would reach 4,000,000 by 1980, having started in 1968 and reached 1,000,000 by 1975.

There is a growing interest in facilities that combine computer and telecommunication functions. Euronet is the European example of the large-scale networks that are being developed. Euronet uses a telecommunications network set up by the PTT Authorities of the member states of the EEC and offers 140 databases from at least 18 host computers. (Anon, (1), 1977). More recently much lower cost networking systems have become available. Seybold (1981) states that first in the field is Ethernet of Xerox but companies such as IBM and Wang are also pursuing research in this area. Ethernet is an open ring system allowing a large number of work stations to be connected to a baseband coaxial cable capable of carrying 10 Mbits/sec. Each work station detects and intercepts any messages intended for that particular work station. Xerox have developed the system and used it within the company for a period of eight years. The first commercial installation was in 1981. In the UK the Cambridge Grid offers a closed ring system which requires dedicated connections between work stations and each work station has to re-transmit each message intercepted.

Because of the convergence of technology and interests and also because of the multinational nature of most companies in both the business equipment and computer supply industry it would be misleading to look at only UK statistics. Barna (1979) lists the top 50 companies in the U.S.A. data processing (dp) industry. Reviewing figures for the 1978 fiscal year it was pointed out that dp related sales were $36.1 thousand million for the 50 companies reviewed. This was a 22% increase on that recorded the previous fiscal year. It was estimated that these 50 companies accounted for 95% of total dp industry revenues in the USA. Barna points out: "Many of the 50 firms are involved in a number of lines of business. In fact seven companies make the top 50 listing with less than 10% of total revenues accounted for by dp sales. Only 18 of the 50 companies obtain 100% of total revenues from dp activities". This is further evidence of convergence as mentioned above.

Solomon (1979) reviewing non-US firms in the dp industry ranked ICL, the UK firm, fifth out of 12 companies. The revenue of $1,019 million would have been less than seven US firms. Like all US firms it would be a long way behind the giant, IBM which with a dp revenue of $17,072 million accounted for 47% of the US total dp revenue in 1978 (Barna, 1979).

4.3 Alternative technologies

Gates (In: Blunden et al. 1979, pp 9.1-9.2) identifies 18 technologies which may be regarded as alternatives or competitors to the printing industry.

A list of these together with a brief description of each one follows:

1 Teletext. This is the method of broadcasting pages of mainly textual information for display on television screens. The system uses normal broadcasting channels and television sets although a special decoder has to be attached to the set. The UK pioneered this field with the services Ceefax of the BBC and Oracle of the IBA.

2 Viewdata. Again this uses a television set for display of text but the information is relayed over normal telephone lines. The British Post Office (now British Telecom) was the first PTT to provide such a service which is now called Prestel.

3 Electronic journal. This is a computer-based system that permits the publication of scientific journals on a TV screen via a distributing computer system.

4 Editorial Processing Centres. A suggested scheme whereby small publishing ventures could share a computer-based editing centre with a view to minimising editing and composition costs.

5 On-line information systems. These allow access to bibliographic data held in machine-readable form. Many companies are now offering access to information via these systems in Western Europe, including U.K., as well as U.S.A.

6 Facsimile transmission of text. The print-out of a copy of a document at a remote station after scanning the original and transmitting an electrical signal.

7 Electronic funds transfer. This is a system for transferring money without the use of cheques or other paper forms.

8 Microforms. This is the capture of text records on photographic film. It is used for the storage of archival material. It is particularly useful when part of a computer system that can retrieve particular items from a microform database using machine-readable indexing. Such systems are referred to as Computer Output Microform (COM).

9 Word processing. This is the capture and storage of text in machine-readable form. The text can be edited and amended before output in a final form.

10 High speed line and matrix printers. These are the computer peripheral devices that provide computer print-out.

11 Xerographic and electrostatic copying. These are the office machines used for copying documents.

12 Electrophotography and related systems. This refers to all other copying processes except Xerography and electrostatic copying. It is used in a number of copying machines.

13 Ink jet printing. This is a non-impact, image forming process in which there is no mechanical contact with the printing substrate; the image is formed on the substrate by guiding streams of ink droplets.

14 Video casettes and video discs. These are media for recording television programmes. Since these programmes could consist of teletext frames then they could be used for storing text at low cost. A 12 inch video disc, could store 9 million words.

15 Cable television. This refers to the carrying of a television signal by land-line rather than broadcast through the atmosphere. It is also called Community Antenna Television (CATV). Its advantage over broadcast television is the higher number of channels and the potential for two-way communication.

16 Local radio. This refers to the locally-based radio stations which were able to operate in the UK following the Government White Paper on Broadcasting published in July 1978. They are financed principally by spot advertising.

17 In-plant printing. These are the print shops established by and operating within companies whose main business does not involve printing.

18 Instant print shops. These are retail outlets offering a rapid means of producing urgent printed work.

Items 17 and 18 are not alternative technologies but indicate that new technology can generate new industries (18) or drastically alter established ones (17).

Of these alternative technologies item 16, local radio appears the least important. Firstly it is an indirect threat to printing, its main deleterious effect would be to capture advertising revenue from printing. Even this appears unlikely, however, since advertisers would be more likely to divert revenue from television advertising rather than printing advertising. Local radio has a separate source of revenue and is aimed at a special segment of the market e.g. young car drivers. This audience would not be reached easily by other forms of advertisement.

Items 10, 11, 12, and 13 above may be grouped together since they are all methods for creating a printed image on paper without the use of traditional printing methods. Both the quality and speed of production of all types of copier and computer printer have improved rapidly in the past decade. The Xerox 9700, for example, can output at a maximum speed of 18,000 lines per minute. This output speed

varies with format and type size. Output resolution is 300 dots/inch and type size can be varied from four to 24 point. In addition the 9700 is an intelligent copier i.e. has a computer built into it that can store various instructions and data such as names, addresses etc so that the output can be continuously controlled and modified. Therefore it has the advantage of the capability to change part or all of the content on each page produced.

Other technologies which may affect the printers market are the electronic media; teletext, viewdata and CATV (Items 1, 2, 15). These together with item 14, video discs and casettes are attempts to expand the information providing power of television. In the UK the most likely threat to printing, particularly newspaper printing, comes from Prestel. Edwards (1978) describes his experience when addressing a convention of 500 newspaper executives in the United States. At the convention he described the teletext and viewdata developments in Britain. He was surprised that no questions were forthcoming at the end of his talk. He quotes the chairman's comments on the executives lack of response:- "They were all in shock. They all realised something like this was going to happen someday but they just didn't realize it was already happening in England!"

Since then newspaper publishers have adjusted to this potential threat. Birmingham Post and Mail, for example, runs its own news programme on Prestel. There is a danger, however, that newspaper publishers may have become too well adjusted to the status quo and are ignoring a long term threat. Prestel has too few terminals operating at present to produce any discernible effect on newspaper sales or advertising revenue.

Prestel could affect other print sectors in addition to newspapers. It already provides business information and in addition there are future possibilities that could have an effect on various specialised magazines. Berkovitch (1979) describes a broadly-based science magazine, called SCITEL operated on Prestel. This has been developed by the Institute for Scientific Information to cover the same range of subjects as publications using the printed page. It

reports on science news and runs features on advances in all branches of science and technology. It also provides notices on books of general scientific interest.

Items 3, 4, 5, 6 are all related to computer-based publishing. Online information systems are not restricted to the supply of business, scientific and technological information. Bradley (1979) mentions four service organisations in the United States of America that provide online access to newspaper and other news media information. These are: Information Bank (New York Times Company), National Newspaper Index (Lockheed Dialog), Newspaper Index (Bell and Howell), News Research Service (Mead Data Central). He comments that if these services capture the imagination of the public then the number of customers, at present in the tens of thousands in the U.S.A. could increase to millions in the near future. Garson (1980) describes the development by the American Chemical Society (ACS) of a test file to explore the feasibility of providing primary journals in electronic form. The file consisted of full text versions of 1000 articles published in the Journal of Medicinal Chemistry. This could be accessed using ordinary telephone lines, modem and terminal and equipment capable of receiving the journal in electronic form could be purchased for $1200-1500 or leased at approximately $100 per month. It is intended to provide a new file in 1981 which would include 16 ACS primary journals. This indicates the potential of the electronic journal in the academic world. (See BLEND 3.3.2).

Word processing differs from the other alternative technologies in that it affects part of the printers work, not the end product. The output from a word processor (WP) can be via typewriter, matrix printer or intelligent copier directly onto paper. It can also be used as input to a phototypesetter and output from there eventually by a printing process. Again the WP output can be stored in machine-readable form and output via electronic media. The main effect of word processing would be to reduce the importance of the compositor. As with most technology innovations, word processing has had a more dramatic effect in the USA than in the UK. Seybold (1981) stated that a survey conducted by publishers in the USA on willingness of authors to use wordprocessors to produce their manuscripts found

that 25% of those surveyed already used wordprocessors for this purpose. Word processing is now well established. The market is large and still growing. An estimate given by the USA market research organisation, International Data Corporation gives the installed base of terminals with WP application up to 1980 as 667,000. This includes 250,000 IBM machines that use magnetic card storage. 70% of the total were installed in the USA. 50% of multiterminal WP systems were provided by one company, Wang, both in the USA and elsewhere. These figures may be compared with a summary of the estimates of the USA word processing market in 1976 given by four research organisations; A D Little, Creative Strategies Inc, Dataquest, Diebold (Blunden, Manning et al. 1978, p 33). Installed base estimates varied between 180,000 and 265,000 terminals. The same four research organisations projections for 1980 varied between 335,000 and 710,000 terminals.

Two other innovations which affect the composing section of printing are optical character reading (OCR) and speech input. OCR did not have a noticeable effect in the UK mainly due to union opposition. It grew rapidly in the USA but declined just as rapidly with the growth of word processing.

Its effect is likely to be limited. Its main use could lie in the conversion of previously printed or typed material to machine-readable form. At least one OCR vendor is suggesting that an OCR be used in conjunction with a word processor since the word processor could be used solely in editing rather than as an input device for text. The text would be input via OCR from manuscripts produced by standard typewriters and typists. The present generation of OCR machines are more sophisticated than those which met with some success in the USA and are now better able to deal with misalignment of type.

Speech input is in a earlier state of development compared to OCR or word processing. Marketed equipment has been designed for very spécial applications where a limited vocabularly may be used. Five companies are selling speech input devices now (Blunden, Holloway et al. 1980). These are: Threshold Technology Inc, Nippon Electric

Company, Dialog Systems Inc, Interstate Electronics Corp and Hitachi. Low cost isolated word recognisers for interface to personal computers are also available. A number of major companies having electronics expertise are carrying out research into speech input. These include Bell Telephone Laboratories, Sperry Univac, Texas Instruments, ITT, ICL, Marconi and notably IBM. The latter has an estimated annual budget of $1 m on speech recognition research.

4.4 Summary and relevance of the information transfer model

This chapter has provided background information on industries and technologies which are beginning to offer competition to the printing industry. The interrelationship of industries has already been referred to in figure 13. The technologies are mapped onto the model in Table I. The numbers are those used in Section 4.3.

TABLE I ALTERNATIVE TECHNOLOGIES MAPPED ONTO THE INFORMATION TRANSFER MODEL

Origination	9, 4	
Processing	9, 4	(1, 2, 3, 5, 15) All Stages
Reproduction	10, 11, 12, 13, 14, 17, 18	
Distribution	6, 7	
Reception		

Local radio (16) is not listed.

6 is likely to have a limited application and 7 will affect forms printing rather than the printing of publications which is the main interest of this thesis. The threat to printing from alternative technologies can now be separated into three categories:-

(i) alternative media (1, 2, 3, 5, 15)

(ii) printing substitutes (10, 11, 12, 13, 14) and substitute printing companies (17, 18)

(iii) alternative processing methods (4, 9)

(i) Publishers are considering alternative media for publishing and this topic is tackled in Chapter 5.

(ii) The use of substitutes is dependent on the quality, speed and number of identical copies which need to be reproduced. This topic is considered in Section five of Chapter 6.

(iii) 4 (Editorical Processing Centres) appear unlikely to significantly affect publishing in UK. 9, Word processing, however, is already affecting the printer in USA because authors and publishers are providing a disc from a word processor which is ready to produce, after interfacing to a phototypesetter, a page ready for printing. Thus the composing department of the printer is completely eliminated.

Further information, relevant to a consideration of the future of printing, is supplied in Chapter 5. Chapter 6 then provides further information on alternative industries and printing and discusses implications for manpower and consumer. Speech input is examined in Appendix 2.

C H A P T E R 5

TECHNOLOGY AND STRUCTURE OF THE PRINTING AND PUBLISHING INDUSTRIES

5.1 Introduction

This chapter is included to provide an over view of printing and publishing.

Chapter 4 has shown that a number of innovative methods of publishing are available and are being used by publishers. It is likely that the printing industry will need to utilise new printing technology if it is to compete with these innovative methods and retain a high market share of published material. The structure of the printing industry is important in this context since the capability to absorb new technology is dependent in part on the efficiency and flexibility of the industry's structure. In turn the absorption of new technology could affect the structure of the industry. The structure of the printing industry of the UK is described in Section 5.2. The relationship of the publishers with the printing industry is likely to change as greater use is made of alternative methods of publishing. Therefore section 5.3 describes the role of the publisher. A variety of equipment is available that can ensure that printing is carried out more efficiently and can therefore meet the challenge of alternative methods of publishing with some confidence. A description of the equipment is given in section 5.4 New technology in printing. Section 5.5 then provides a summary and indicates the relevance of the information transfer model.

5.2 The UK printing industry

The UK printing industry is the largest in Europe employing approximately 325,000 in 1979 (Anon, 1981, 1 and 2) . Perhaps the most detailed analysis of the UK printing and publishing industries was the survey conducted by the Department of Employment (Anon. 1970). This examined statistics for 1967 and covered six product sectors; general printing, books, provincial newspapers, periodicals, stationery and cartons/flexible packaging. National newspapers were excluded from the survey. It was noted that general printing accounted for 50% of manpower in the printing and publishing sectors surveyed in the report. 369,270 were employed in these sectors and an additional 42,350 in the national newspaper industry giving a total of 411,620 employed in printing and publishing in 1967.

An analysis of the UK printing industry as at 1977 was published by the BPIF (Anon 1979). Based on this Table J shows a breakdown of the printing industry into four sectors; general, newspaper and periodical, packaging and stationery. In each case the amount of sales is given, the percentage of manufacturing industry which this represents and the number employed.

TABLE J STATISTICS OF THE UK PRINTING INDUSTRY 1977

Sector	Sales (£ million)	% manufactured industry	No. employed
General	1350	1.13	161,000
Newspaper/periodical	240	0.2	13,000
Packaging	1280	1.07	46,000
Stationery	420	0.35	3,000
Total	3290	2.75	250,000

The BPIF also published a report in 1976 (Anon. 1976(1)) which provided the information on full time employment shown in Table K.

TABLE K FULL TIME EMPLOYMENT IN PRINTING 1976

No. of employees	No. of companies of this size
0-9	545
10-24	514
25-49	310
50-99	230
100-149	88
150-249	98
250-499	75
500-999	20
1000-1999	6
2000 +	2
	1888

This report also provided a breakdown of this information into product sectors and this is shown in Table L.

TABLE L NUMBER OF PRINTING ESTABLISHMENTS AND EMPLOYEES 1976 BY PRODUCT SECTOR

Sector	Number of establishments	Number of employees
General	1311	48,522
Book printing/binding	109	16,247
Periodicals	41	10,134
Cartons	63	11,901
Flexible packaging	19	4,283
Stationery	53	4,330
Trade typesetting	43	1,310
Newspaper	79	10,826
Others	170	11,934
Total	1888	119,487

The information in both cases is based on a response of 119,487 firms. Information was also provided on the process used by each respondent company. This is shown in Table M.

TABLE M PRINTING PROCESS USED IN A SAMPLE OF PRINTING FIRMS 1976

Process	No. of companies	Machine minders
Letterpress	1305	6565
Lithography	1105	5424
Gravure	77	1270
Small offset	166	513
Total	1888	13,772

Table K shows that in 1976 over half of the printing establishments employed fewer than 25 employees and over a quarter employed less than 10.

There are difficulties in obtaining a complete breakdown of the UK printing and publishing industries since most surveys are conducted by institutions which cannot canvass the total industry. For example the BPIF surveys are only conducted on companies affiliated to the organisation. Despite the difficulty it is generally accepted that the picture of the industry encapsulated in Table K is the correct one, namely that the printing industry is composed of a large number of small firms.

The most recent figures are provided by Government statistics. Reports on the census of production (Anon. 1981 (1) and 1981 (2)) give the following information:

i) General printing and publishing 1979; 9382 enterprises in 10,174 establishments providing employment for 187,800 and sales of £2,931,261,000.

ii) Printing, publishing of newspapers and periodicals; 1223 enterprises in 1583 establishments providing employment for 137,700 and sales of £2,579,071,000.

These reports confirm that the bulk of companies have few employees. This applies to publishing as well as printing. Lawrence (1981) says: "For every major British publisher (360 in the Publishers Association) there are statistically no fewer than 24 small ones".

Wagner (1981) compares the newspaper industries of UK, West Germany and USA. There is an emphasis on national newspapers in UK which has led to much larger plants and a more concentrated industry than in either of the two other countries. Despite this concentration the industry in the UK has not achieved expected gains in productivity. The concentration of the industry is shown by the fact that in 1976 the few largest newspapers in UK accounted for 80% of all newspaper sales while in West Germany it was 45% and in USA 16%. A comparison of productivity (newsprint consumption in short tons per employee annually) showed:

- UK 8.2
- W. Germany 17.6
- USA 21.1

Wagner concludes:

"Productivity in the printing industry is difficult to measure with any precision; taking a crude measure of newspaper tonnage processed per employee, it appears that Britain's productivity was under half of Germany and of the United States. More newspaper titles are printed in both Germany and the United States than in Britain, and if this is taken into account Britain's relative productivity would probably appear worse still".

While one may agree with Wagner as to the difficulty in measuring productivity the broad measure he uses does not take account of the wide differences between the National and Provincial Press and in particular the poor performance of Fleet Street newspapers. Bearing this in mind Wagner's figure for UK of 8.2 is probably too low although there is no doubt that the productivity in UK is lower than in West Germany or the USA.

The numbers employed in printing have fallen quite markedly in the past decade. Figures compiled for the 1976 Royal Commission on the Press (McGregor 1976 p 13) show a 7.7% fall in employment in printing and publishing including national newspapers between 1969 and 1976. The point is made, however, that this fall was due to the recession and not due to the introduction of new technology.

5.3 The role of the publisher

When printing started in Europe in the fifteenth century publishing and printing were integrated. Many companies are still integrated publishers and printers e.g. most newspapers, book publishers such as Oxford University Press. Other publishers have become established without their own printing establishment. In addition some publishers with their own printing establishments also use outside printers for some publications, e.g. HMSO. A further complication is that publisher/printers established in one printing sector may also print and publish other products. Most newspapers publish a variety of other material such as calendars, booklets, brochures etc. To this end many newspaper printers which use only monochrome presses with occasional spot colour also possess a four-colour press for their other publications.

Despite these differences certain functions are common to all publishers:

- To seek out or commission original manuscripts.
- To edit these manuscripts and supervise their progression to final printed form.
- To be responsible for all financial aspects relating to the publication; pricing, number of copies to be printed, advertising revenue.
- To be responsible for all legal and ethical consequences arising from the publication.

Although there are many small publishers in the UK there is a tendency for publishing to become concentrated in the hands of large companies. Fishwick (1977 p18) identifies four firms that had significant sales of both books and newspapers/periodicals:

- S Pearson and Sons Ltd (owners of the Financial Times, Westminster Press, Longmans and Penguin Books Ltd)
- Reed International (Mirror Group Newspapers and the International Publishing Company with its book publishing interests in Butterworth and Hamlyn)
- The Thompson Organisation (the Times, the Sunday Times, regional newspapers, a range of periodicals and books published by Nelson, Pelham, Hamish Hamilton, and other subsidiaries)
- Scottish and Universal Investments Ltd (a major newspaper publisher in Scotland and owner of Holmes McDougall, book publishers)

Recently there have been a sequence of take-overs, mergers and other deals such as exchange of shares which has confirmed this trend to concentration of publishing in large organisations. Wilkinson (1981) described a series of transactions that occurred after meetings between Mr Murdoch of News International and Mr Maxwell of British Printing Corporation (BPC). Bemrose, a Liverpool gravure printer was sold to BPC. News International, the new owners of the Times, were sold shares amounting to 9.4% of the publishers William Collins. This raised News International's holding in Collins to 41%. News International is attempting a take over of Collins. BPC is a subsidiary of Pergamon Press.

S Pearson and Sons Ltd. is now Pearson Longman Ltd. In the 1980 Annual Report, the company shows that it is investing in the new market opportunities created by developments in electronic storage and distribution of information and the development of cable television and video.

Lonrho had acquired most of the holding of Scottish and Universal Investment Ltd. Part of this was a 40% stake in the Scottish newspaper publishers, George Outram. This was exchanged for ownership of the Observer (Northedge and Brodie, 1981).

Publishing is not yet concentrated solely in these few large groups, however, nor is it only these large groups which are investing in or examining the impact of electronic media. Smith (1979) lists the following organisations that provided information on Prestel:

National Papers:	Financial Times, Daily Telegraph, Daily Express.
Local Papers:	Birmingham Post and Mail, Eastern Counties Newspapers.
Magazine Publishers:	Morgan Grampian, Link House, IPC, Haymarket Press.

This shows that a number of smaller companies have the capability to publish in a number of different product sectors including those of the electronic media. In addition to new media, publishers have launched various new printed publications in recent years. One trend in magazine publishing is to aim at a small specialist market. Johnson (1980) writing on this subject says "More to the point: publishers have created specialist titles within this specialist market". He suggests that specialist magazines including many esoteric hobby titles are increasing their circulations at a time when other publishers are experiencing a fall in sales. This may be contrasted with the demise in the USA of the large circulation magazines, Saturday Evening Post, Look and Life between 1969 and 1971 (Hall, 1976). All these magazines were closed shortly after achieving their highest circulation and largest revenue.

Mirror Group Newspapers recently attempted to launch a new illustrated weekly magazine, 'Picture Mirror' in UK. Test runs in the Midlands and North of England, however, indicated that the publication had no chance of nationwide success since a circulation of at least half a million was necessary if the publication was to be economically viable (Hooper, 1981).

This contrast in success between the large circulation magazines and the small specialist magazines is at least partly due to the dependence on advertising as well as circulation revenue by magazine publishers. Advertisers are not likely to continue to place advertisements in publications where the response to the advertisement is disappointing and will switch to publications where there is an indication of a better response. This probably explains another recent phenomenon in publishing, the rise of the free newspaper. Glascock (1980) estimates the market for free newspapers in UK to be around £50m. One effect of the success of these publications is that many paying newspapers such as the Chiswick Gazette and Brentford Observer of Westminster Press have been converted to free newspapers. This shows the importance of advertising revenue in general although it varies in different market sectors. In particular the newspaper and magazine sectors are outstanding with their reliance upon advertising revenue. Table F shows the content and revenue of advertisements for 1975 for an 'average' newspaper.

Figures are percentages of total content and total revenue. The revenue figures relate to the years 1973-1976.

Henry (1978), p12) analyses detailed press revenue statistics 1973-76 and draws attention to the following four points:-

1. "National newspapers, regional newspapers, and magazines as a whole, each take about a third of total press revenue.

2. So far as national newspapers are concerned, the essential distinction is not between dailies and Sundays but between populars and qualities, advertising revenue constituting only twenty eight per cent of total revenue in the populars but sixty per cent in the qualities.

TABLE F ANALYSIS OF ADVERTISEMENTS IN NEWSPAPERS 1975

		Percentage of content			percentage of revenue		
		Display	Classified	Combined	Display	Classified	Combined
Popular	Daily	28	7	35	22	5	27
Nationals	Sunday	40	5	45	28	3	31
(Quality	Daily	24	19	43	35	24	59
Nationals)	Sunday	33	23	56	38	27	65
Regionals	Daily	23	30	53	26	34	60
	Weekly	30	30	60	39	43	82

Source: Henry H (1978) p29

3. Advertising provides sixty per cent of the revenue of the regional dailies and a massive eighty-two per cent of the revenue of the regional weeklies.

4. Advertising revenue is one-third of the total revenue of consumer magazines, but almost two thirds of that of trade and technical magazines."

The importance of advertising for all these publications is clearly shown by these statistics. The responsibility for obtaining and retaining this revenue lies with the publisher. In many cases newspapers and periodicals are produced by integrated publisher/printer companies.

Other categories of publishing do not receive advertising revenue. Books, catalogues, yellow pages, brochures are publications which generally do not receive advertising revenue.

The traditional relationship between publisher and printer whether separate or integrated organisations was simple.
The present relationship is far more complicated since the publishing, printing, telecommunications, office equipment, and competing industries are combining as an information industry as described in the preceding chapter (see figure 13)

5.4 New technology in printing

New technology in the printing industry has received considerable publicity in the media recently. Partly this is due to the confrontation between unions and management over the use of some equipment. Fleet Street newspapers in particular have been affected, most noticeably in the case of the Times. It is also due, however, to a difference in nature between present and previous generations of 'new technology'. One of the most important innovations in the 1950's was the rapid change to the offset lithography process. This was made possible by new plate materials. Photocomposition and automated methods for collating and finishing were introduced around the same time. Although these helped to improve productivity the effect on the work force was mainly related

to the provision of re-training rather than redundancies. Page make-up with film or paper photographic materials is still manually intensive. In contrast, present 'new technology' has a greater potential for manpower savings.

The ten year forecast (Blunden B et al 1979) divided printing into four areas; composition, graphic reproduction and platemaking, printing processes, binding and finishing. The latter two areas will be dealt with first using information from this reference.

The major printing processes are lithography, letterpress, flexography and gravure.

Lithography has grown dramatically to become the dominant printing process, penetrating into all market areas. There is a trend to the use of web-fed rather than sheet-fed presses. Present press speeds are in excess of 10,000 sheets/hour.

Letterpress has declined from a former position of dominance. Many companies are adapting letterpress machines to use the direct lithography process or photopolymer plates. Flexography is also a relief process, like letterpress. It differs from letterpress in the type of ink and press used, the products with which it is associated, and the fact that it is increasing its market share. Its main use is to produce flexible packaging and wallpaper.

Gravure is another process that has increased its market share. It is used for long runs at highspeeds. Speeds of 1500 ft per minute are possible.

In all processes there has been an introduction of electronic controls. This has led to improved productivity due to higher press speeds, fewer stoppages, reduction in press downtime, reduction in wastage. It is also leading to improved consistency of print quality.

Binding and finishing includes a variety of operations such as cutting, folding, gathering, sewing, glueing and covering for the production of books, magazines and brochures. The bindery accounts

for some 40% or more of the total manpower in printing plants. Although there is therefore great potential for automation in this area of printing, manpower savings have not been forthcoming. Indeed a breakdown of printing into three sections, pre-printing, printing and finishing showed that in the period 1975-1978 the first two sections had reductions in costs and number of employees while finishing had increased costs (from 31% to 36% of total cost of printing) and increased staff (from 38% to 43% of total staff). The technology to reduce manpower levels is certainly available, a reduction of 20% is possible using in-line working. This technology has not been applied on a large scale in the UK. Out of 100 installations of an in-line binding system sold world-wide only three were located in the UK.

For certain products, particularly paperback books, which have a high volume of production, completely integrated printing and binding machines are available. Again of 20 machines of this type (Cameron and Book-O-Matic) only one was installed in the UK.

There are many technological developments taking place in these two areas of printing ie printing processes and binding/finishing. These changes are evolutionary, however, and have not resulted in any major upheavals in the printing industry. They are not the reason for the continued union opposition to the introduction of new technology. The main union concern has related to the developments in the pre-press area, composition and graphic reproduction and platemaking. Here developments can be described as potentially revolutionary. Equipment at present available as separate items would be combined to create integrated systems that could process and output complete page images without any manual intervention. These page images would either be as a press-ready plate, directly onto paper using some copying process or onto an electronic display. These technology developments will be described in some detail.

There have been major changes in the methods of capturing text. Printing and publishing required re-keying at least once and in many cases three or more times, up to the 1960s. The introduction of the computer and photocomposition has helped to reduce the need for re-

keying. Improvements in computer-driven composition and the introduction of OCR has meant that it is possible to key-in text once only. Wordprocessing can have the same effect when used as an input to phototypesetting.

One effect of the growth of electronic composition is the widespread adoption of the Sholes or QWERTY typewriter keyboard layout. Not all manufacturers offer the option of layouts more familiar to compositors, such as the ETAOIN of the Linotype keyboard. Where this option is available, however, many purchasers are adopting the QWERTY layout although this requires a retraining programme for the operators. There is therefore an anomaly in the widespread use of a keyboard layout which was designed to restrict keystroke speeds in the days when typing too fast caused typewriters to jam. Despite the availability of more efficient, ergonomically designed keyboards such as the Maltron keyboard the QWERTY layout is likely to remain the most used keyboard layout.

Once keystrokes are captured and stored in a computer system they may be output at high speeds on photographic film or paper ready for plate production. Phototypeset film or paper can be output at speeds of around 8000 characters per second.

Illustrations, as well as text, can be captured, stored and output via computer systems. Various types of scanner are available to input graphic subjects. Output can be by means of the output facility of these scanners, or in some instances phototypesetters. In the latter case there is the advantage of treating text and pictorial subjects together. This eliminates the need for manual merging of text and graphics.

Digital methods are used in a variety of pre-press equipment for the capture, storage, processing and output of text and graphic images. Therefore it is conceivable to devise a system that can produce a press-ready plate using these methods. Although no such system is commercially available a number of companies are known to be researching this possibility. One company has successfully produced a system that outputs a page image on photographic film or paper

ready for plate production. Holloway (1981, 1) describes the products of 23 companies that were available in 1980 and could form the base of an integrated pre-press system providing either press-ready plates or photographic page images ready for plate production. He classified the equipment in six categories:

- Page make-up systems, subsystems and terminals (14)
- Phototypesetters with graphic output potential (11)
- Scanners and electronic cameras (5)
- Planning and proofing aids (8)
- Platemaking subsystems (4)
- Electronic merging systems (film outputs) (1)

The numbers in brackets refer to the number of different items of equipment available in each category.

5.5 Summary and relevance of the information transfer model

The changes in printing technology described in this section have important implications for manpower requirements and skills. These issues are discussed in Section 6.5 of the next chapter.

The main objective of this chapter was to provide background information on printing and publishing and the new printing technology being introduced. This information, together with that provided in Chapters 4 and 6 will be used in Chapters 7 and 8 to compare various methods of publishing. At this early stage in the use of this information, however, there are already some interesting points to note with reference to the information transfer model. The various items of new technology in printing described in Section 5.4 are mapped onto the information transfer model in figure 14. The main changes are occurring in the processing stage and conversion substage of the model. The use of remote printing could have an effect on the distribution stage of the model. The replication substage and the reception stage of the model appear unlikely to experience any major changes due to the new technology now being introduced.

Further information on new technology and implications for the printing industry is given in Appendices 1, 2, 3.

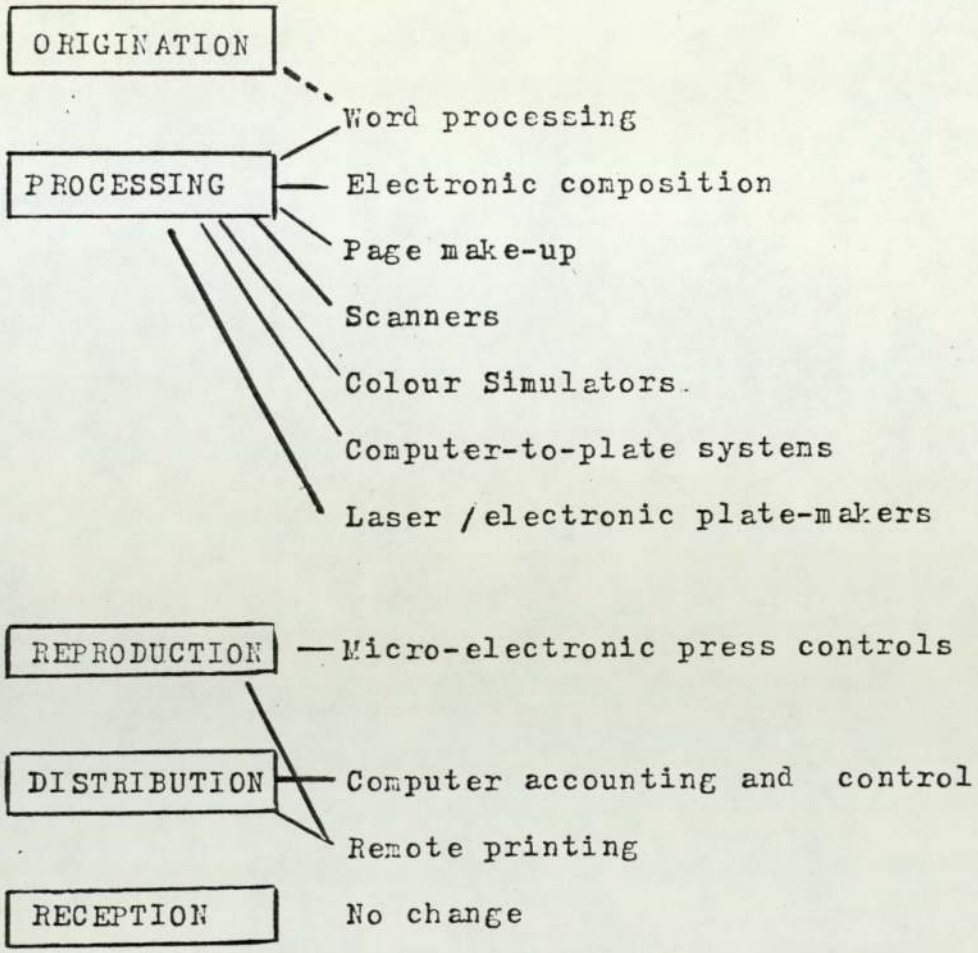


Figure 14. New printing technologies mapped onto the information transfer model

The effects on the printing and publishing industries are quite different. Publishing will continue to flourish although the alternative industries described in the preceding chapter could initiate new publishing companies. Printing, on the other hand, will become just one output option for the publisher.

These points will be returned to in Chapters 7 and 8. The next chapter provides more detailed information on alternative and printing technologies and also examines the implications of these technologies for manpower and consumer.

C H A P T E R 6

THE EFFECT OF NEW TECHNOLOGY ON PUBLISHING AND THE IMPLICATIONS FOR MANPOWER AND CONSUMER

6.1 Introduction

Chapters 4 and 5 provided an overview of innovative technology and its effect on printing and publishing. This chapter examines the effect of new technology in greater detail and the implications for manpower and the consumer. Section 6.2 gives an account of what can be achieved by non-conventional printing and electronic media and the limitations of quality and page size. Section 6.3 describes the possible effects of computer technology on the choice of printing processes in conventional printing and the merging of text and graphic subjects.

The manpower implications of the new printing and alternative technologies are examined in Section 6.4. Section 6.5 provides some background information on the consumer and discusses some possible affects of new technology on the consumer and vice versa.

6.2 Limitations of quality and page size in alternative technologies

Conventional printing has a number of advantages over alternative technologies at present. These advantages are quality (usually measured by the resolution in number of dots per inch), speed and quantity of production (only over printed alternative technologies not electronic media) and page size (and therefore quantity of information). The following two sub-sections describe the present limitations of quality, speed and page size in non-conventional printing and electronic media.

6.2.1 Non-conventional printing

There is a variety of printing/reprographic equipment used in in-plant printing and instant print shops. This equipment can be classified in two different categories:

i) equipment similar to conventional printing equipment but lower in cost and requiring less skill to use.

ii) non-conventional equipment, in particular the intelligent copiers such as Xerox 9700.

The equipment of category i) uses conventional printing methods, particularly those of small offset printing (lithography).

The summary of current practice given in section 6.4 is adequate for this category of equipment and will not be described further in this section.

The equipment of category ii) poses a threat to conventional printing. Copying techniques rather than printing have already been used by established publishers for the production of monographs.

Seybold (1981) stated that publishers in USA were seriously considering various techniques as substitutes for conventional printing. The concensus of opinion was that the quality of text produced by the present generation of copying machines was adequate for producing camera-ready copy for the production of

plates for conventional printing. For printing of photographs (half-tones) a higher resolution (600 dots/inch rather than 300 dots/inch) was required. Higher resolutions are possible for these copying machines but any modification would result in a reduction of output speeds.

At present most of the computer-driven copiers are not used for the production of complicated text/graphic pages. The method adopted in forms production on the IBM 3800 appears adaptable, however, so that a text/graphic page could be output. A form master with appropriate rulings, headings and logos is placed in the machine. Other information which may vary with each page is stored in the computer system and added as each page is produced. A future system with provision for half-tone additions appears feasible. There is no technological reason why half tones cannot be produced on IBM 3800, Xerox 9700 or other similar equipment. Quality would be limited but could equal or surpass that of the average daily newspaper.

Xerox have produced a composition system to be used in conjunction with their 9700 machine (Anon,1981 (3)). This is called the Xerox Integrated Composition System (XICS). This system is designed so that the user needs no computing or typographic skills. Output can be via a 9700 or a phototypesetter. In addition output can be via conventional line printer, Diablo printer, Tektronix terminal or the user work-station terminal.

At present some expertise is still required to produce combined text/graphic pages. This expertise is provided either by instant print shops or in-plant printers which are acquiring these machines in addition to or instead of conventional printing equipment.

Most copiers are designed to output A4 size of page but this is sufficient to produce the majority of publications other than newspapers.

6.2.2 Electronic Media

Teletext and viewdata can only display a relatively small amount of data on each page. A page of text consists of 22 effective lines, each containing 40 characters. The average page provides approximately 100 words. For graphics there are 6x22x40 spaces available since each character can be split into 6 areas or elements.

The present UK teletext system uses seven-bit codes. It has a set of 96 display characters.

Chambers, J (1980) decribes a proposal for an enhanced system using eight-bit codes. This would provide 224 display characters. The number of graphic characters would be more than doubled. It is also possible to include still pictures and text together. The teletext pages in this case have a similar appearance to some magazine pages. A page of text requires 1 Kilobyte of memory store while a high quality still television picture requires about 1 Megabyte. The system would allow any intermediate requirement between these two values to be assigned to exploit any redundancy and retain maximum compatibility with the basic system.

Similarly the British Post Office (now British Telecom) has conducted research aimed at improving the graphics capability of the system. Clarke (1980) states that photographs have been transmitted using differential pulse code modulation (DPCM). When transmitted over public switched networks at 1.2 kbps, the usual viewdata speed, the pictures require about one minute to build up. This will be reduced to about 15 seconds on the next generation of the viewdata system which will operate at 4.8 kpbs. The picture area is about one ninth of the screen area which can display several pictures located at different points on the screen. The picture data requires about eight data pages. Since complete compatibility has been maintained between the UK teletext and viewdata systems the method could be used in teletext. No special skills are required to create the pictures on screen. The process is completely automatic once the

photograph has been placed in a TV slide scanner and positioned. Therefore future teletext/viewdata systems would offer a capability to merge text/graphics by a low-skilled operator. At present the graphics on all three of the UK systems Prestel, Ceefax and Oracle require skilled graphic designers.

6.3 The effect of the computer on choice of printing process and production methods

Whatever printing process is used the majority of pages with a mixed text/graphics content are now produced using a photographic merging method. Text is produced by a phototypesetter or in some cases by repro-pulls (i.e. proofed output) from letterpress equipment. Text and graphic subjects are then assembled in position on the page and a photograph taken of the page. This photograph is then used to produce the plate/forme which is the image carrier in the printing process. This may be achieved directly by exposing a photo-sensitive plate material through the photographic page image. It can also be achieved indirectly by scanning the page image via opto-electronic equipment and producing the plate/forme by laser or electro-mechanical engraving.

The four main printing processes in use today are letterpress (newspaper), lithography, gravure and flexography. It is outside the scope of this thesis to describe in detail the changes of technology in printing and the interested reader should refer to Blunden et al (1979) and Holloway (1981,1).

Computer-driven systems are available and used in printing which can combine text and graphic subjects and output a page image on a photographic medium ready for plate production. Output could be linked to the plate/forme rather than the photographic medium. Future computer-driven systems could have a variety of output; film, plate/forme, page, or viewing terminal.

Most printing companies have been associated with particular printing processes. To change from one process to another is an expensive, time consuming operation requiring retraining of personnel. There must be good reasons, therefore, for changing the printing process. The provision of computer-to-plate systems may provide such reasons in the future.

Lithography and gravure are the most likely processes for the application of integrated systems to give a direct plate output. Of these two, gravure would appear to have the most to gain from the reduction of number of operators. Lithography is the more versatile process being suitable for a wide range of publications and as indicated in Chapter 5 is the dominant printing process.

A key subject in the comparison of different methods of publishing is the merging of text and graphics. In all cases text and tone subject matter must be originated and then be put into a suitable form for printing (processing). This requires the creation of a page and the text and graphic subject matter passes through a series of refinement stages. This is referred to here as processing whether by man or machine. It can then be assembled into a page and replicated.

In conventional printing a plate or forme is the first preliminary to this stage. Before this stage is reached graphic reproduction and photocomposition involve many man-machine interfaces and a labour intensive procedure. All required alterations to text/tone and their merging are carried out manually. In a computer-to-plate system, however, many alterations can be carried out by machine. Within the restriction of format imposed by the system, the operator will be free to make only decisions relating to appearance, typography etc. In conventional page make-up various pieces of paper used in the course of page composition also serve as memory store. In a computer system magnetic memory requirements are large and expensive but an advantage of this different type of memory in computer systems is flexibility. Where certain items (text, illustrations or completed pages) will be required for future publication, information may be stored in machine readable form; paper tape, magnetic tape or disc, solid state memory such as bubble memory, microfilm. It may also be copied onto paper to be read by magnetic character reading or optical character reading equipment.

Another difference between conventional methods and computer-to-plate occurs once the page image has been constructed. In a computer-to-plate system the page could be instantly transmitted for output at another geographical location. Where conventional page make up is used in

association with remote printing the page must first be created on an intermediate, usually a photographic image which is then loaded into scanning equipment for transmission.

Once a computer system has a stored page there are a variety of output options; VDU, plateless printing or conventional printing. In a computer-to-plate system the output would be a press-ready plate. Different software packages could alter screening, dot size and other characteristics of the image so that it could be used in any of the printing processes. This contrasts with conventional procedure where production is tied to one printing process and text and tone subjects are treated separately and differently.

The output from the system does not have to be a plate or forme. The page image could be created on film, paper or VDU. An integrated system outline is shown in figure 15.

These comparisons are summarised in table 0

TABLE 0 TEXT/TONE MERGING COMPARISONS

COMPUTER-TO-PLATE	CONVENTIONAL METHODS
Routine tasks carried out by machine	Labour intensive
Various memory options	Paper used as memory store
Text/tone merged by system	Separate treatment of text and tone
Various output options	Associated with particular method of output
Remote printing easy	Remote printing requires additional man-machine interaction.

Due to the introduction of computer driven printing/publishing systems the merging of text/graphics is likely to become easier for operators both within the printing industry and in competitive industries.

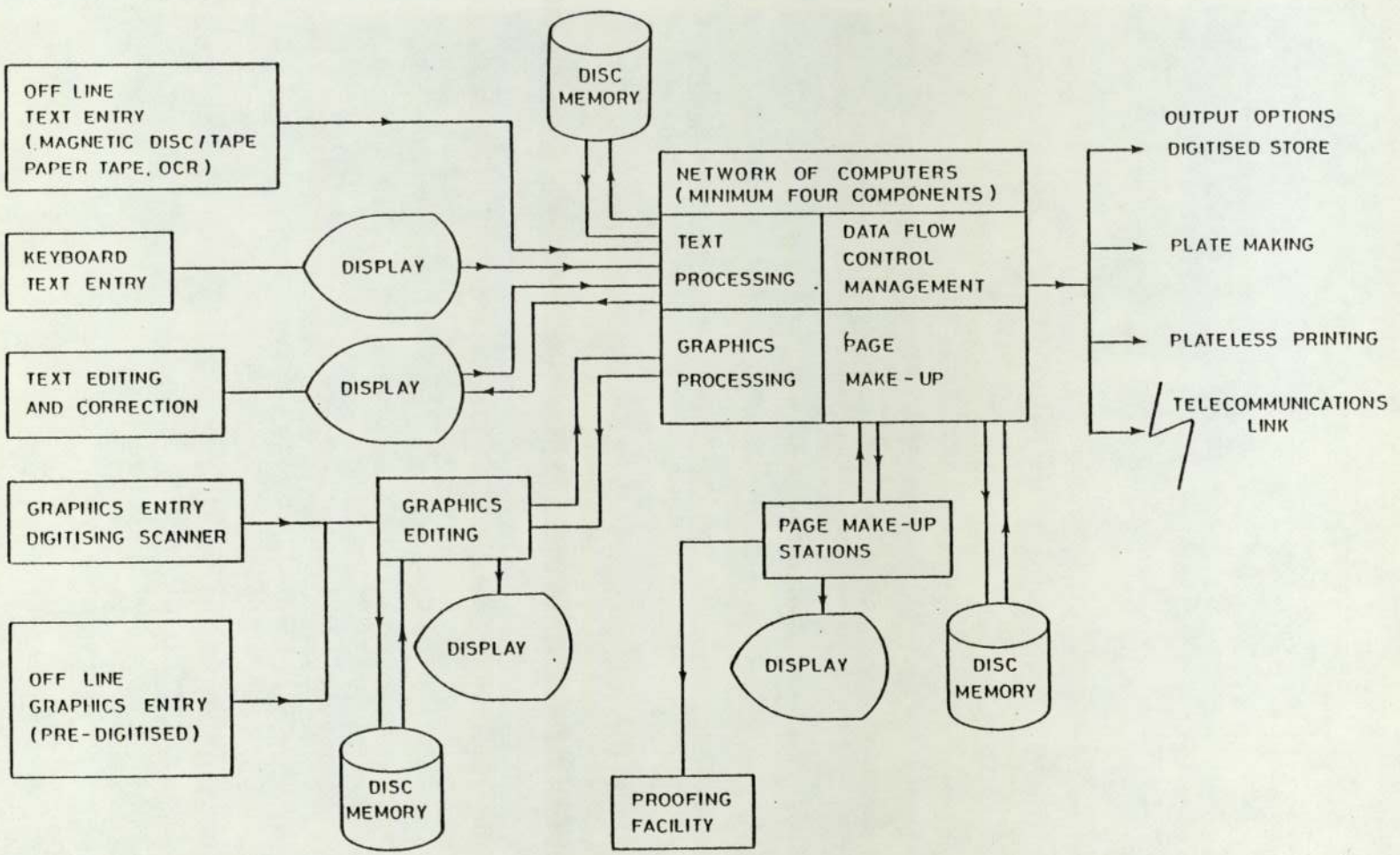


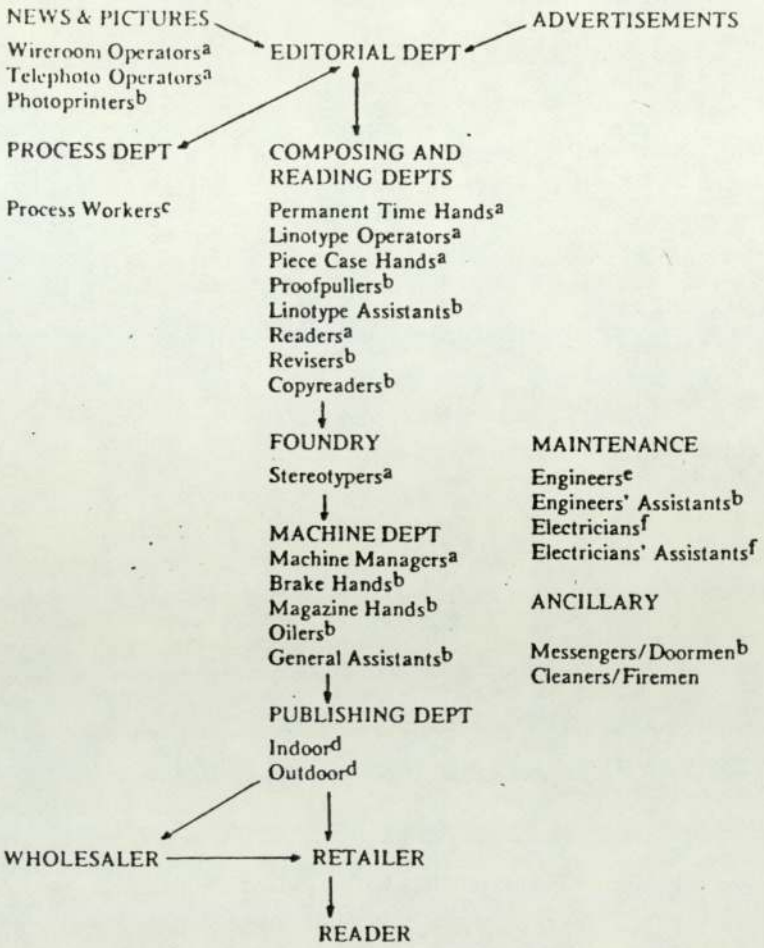
FIGURE 15. INTEGRATED SYSTEMS OUTLINE

6.4 Manpower implications of computer equipment on printing and publishing

There are at present four major printing unions. These are:

NGA	National Graphical Association
SOGAT	Society of Graphical and Allied Trades
NATSOPA	National Society of Operative Printers, Graphical and Media Personnel
SLADE	Society of Lithographic Artists, Designers, Engravers and Process Workers

In most industrial negotiations concerning printing two other unions, the Amalgamated Engineering Union and the Electrical, Electronic and Plumbing Trade Union also are represented. The direct input of text by journalists would also involve the NUJ, National Union of Journalists. It is not surprising, therefore, that many agreements on the use of new printing equipment require protracted discussion. However, there is a move towards rationalisation. Sisson (1975, p125) states that the number of unions involved in printing Fleet Street newspapers fell from nine in 1961 to six in 1974; these six being the four listed above and the two engineering unions. Furthermore the 206,000 members of SOGAT and 55,000 members of NATSOPA are to vote in March 1982 on a proposed merger of the two unions. The two leaders of these unions are in agreement and feel that the merger would be part of a continuing process leading to a single union in the printing industry. It is reported (Anon 1981 (5)):- "They argue that amalgamation is inevitable because of new printing technology which has eroded traditional demarcation lines". The complicated situation at present is illustrated by figure 16. This shows the occupations and union involvement in a hot metal i.e. traditional technology newspaper. Many provincial newspapers have already changed to newer technology, in particular photocomposition and lithographic presses, so that some of the effects of newer technology are known. Re-training of process, composing and machine department personnel is required and in some cases the personnel have changed unions. In lithography there is no foundry so sterotypers are retrained and transferred to different departments e.g. a plate-making department which would replace the foundry. An assessment of the effect of lithography was made in the



KEY

a National Graphical Association
b National Society of Operative Printers, Graphical and Media Personnel
c Society of Lithographic Artists, Designers, Engravers and Process Workers
d Society of Graphical and Allied Trades
e Amalgamated Union of Engineering Workers
f Electrical, Electronic, and Plumbing Trade Union

Figure 16. Occupations and union involvement in a traditional newspaper

report (Anon, 1970) already mentioned in 5.2. Make-up and imposition by film/paper was faster than hot metal, requires fewer hand compositors and copy preparers but more readers. New presses increase the output per minder and reduce the need for assistants although in lithography twice the number of assistants per minder are used than in letterpress due to union agreement.

The effect of more revolutionary equipment such as computer-to-plate would have a more drastic effect than the new technology of the late '60s and early'70s. Referring to figure 16, the process department would disappear and the composing department would lose job categories such as Piece Case Hands, Proofpullers, Permanent Time Hands and Linotype Assistants. Linotype Operators would be retrained to use electronic keyboards.

Other changes would depend on the configuration and design of the system used. Some very complex hierarchical composition systems have been designed by computer equipment suppliers for some large American newspapers such as the Washington Star which incorporated 165 terminals, but these editorial systems, as they are called, have not been as successful as the newspapers wished. A production system is favoured in U K and Europe and the chances of success of such systems is greater than for the more complex American designs.

The effects of new technology on individual workers, companies and even industries could be drastic. Many jobs, particularly those which are craft-based could disappear. This is often referred to as de-skilling but while it is true that individual craft-skills may disappear the overall skill level is likely to increase.

One point needs to be emphasised. The use of micro-electronic and computer based technology need not lead to overall higher unemployment. On the contrary, if applied successfully it could lead to a more profitable home industry and therefore reduce unemployment. Millar (Millar et al, 1980) commenting on the rise in unemployment between 1970 and 1978 in the UK from 560,000 to 1,450,000 states that the major cause of job loss in manufacturing industries was due to lack of competitiveness in the international market and rising import

penetration. This was due to the failure of British manufacturers to adopt new technology at the rate of their major competitors. He paints a dismal picture by adding that the future uptake of micro-electronics in UK is unlikely to proceed at a faster rate than in the 60s and 70s.

An example of the potential job creation effect of micro-electronics is the economy of the state of California. The location of many micro-electronic chip manufacturers in 'Silicon Valley' initiated a boom to the Californian economy. Schwartz (1979) states that California is the eighth largest economy in the world worth 25 thousand million dollars. With a population of 20 million California had created over 500,000 jobs per year since 1973 although the electronics industry only employed 200,000. He contrasted this situation with that of Europe which had incurred a three million job loss in the same period.

The switch to micro-electronic controlled processes can be made in UK. Watson (1979) describes the success of the British Sugar Corporation (BSC) in investing heavily in microprocessor controls. Planning began in 1974 and the change over was achieved at a capital cost of £150 million, financed by BSC itself. The result was that the efficiency attained made the cost of sugar production at BSC the lowest in Europe. A major feature of the introduction of the new technology was the involvement with the staff; retraining began a year before the introduction of the new equipment. The use of microprocessors allowed flexibility which resulted in operators retaining a high level of skill.

New technology can also be applied successfully in the printing industry. Holloway (1981,(1)) describes three case studies where digital equipment was successfully applied, two in UK and one in France. In each case there were no redundancies although retraining and transfer to other departments was necessary for some of the staff. The new equipment was paid for by improved efficiency.

Bass (1979) who was personnel Manager at BSC during the change to microprocessor-controls described above considers that training is a major requirement in the successful introduction of new technology. He says:- "The training which is required to ensure the success of a

major project is often hopelessly under estimated at all levels. It is an expensive item and it is therefore difficult to justify until the project has failed due to inadequate personnel".

These are two distinct types of new skills that personnel will need after a change to microprocessor-controlled equipment:-

a) skills required to operate the equipment

b) skills required to maintain and modify the performance of the equipment.

Type a) skills can be easily obtained by the methods traditionally used in the printing industry; through the offices of colleges, training boards and research associations while a major part of the skills needed are imparted in-house.

Type b) skills are at a much higher level and it is unlikely that these skills can be taught by any of the means listed above. They will only be acquired by recruiting suitably qualified personnel from outside the printing industry.

Friebe (1980) forecast a severe shortage of personnel with the required skills in electronics. West Germany has a better record than UK on planning the introduction of microprocessor-based technology. Despite this there is likely to be a severe shortage of skilled personnel in West Germany. For example, in 1980 5,000 graduates in electronics were expected but one firm alone, Siemens, required 2,500.

Bass (1979) writes:-
"If the generally predicted speed of micro electronic applications comes true, the availability of these engineers and technicians will almost certainly be the major limiting factor. Many industries will have little alternative than to spend heavily on training their existing personnel".

While one must agree with the logic of this argument, it is unlikely that the printing industry would be able to pursue this possibility due to the totally different nature of the traditional and microprocessor

based skills. At present the number of companies using new technology is a small fraction of the total number of companies and so the problem of shortage of personnel does not arise. Personnel are often recruited from supplier companies. When the shortage becomes apparent then there is likely to be intense competition for these personnel.

This subject is returned to in section 7.6 of the next chapter.

6.5 The implications of new methods of publishing on the consumer

Some statistics on the UK consumer are given by Ramprakash (1982). The disposable income of the consumer rose from 100 (1975) to 115 (1980). The pattern of consumer expenditure (again with 1975=100) changed between 1966 and 1979 and is shown in Table P.

TABLE P COMPARISON OF CONSUMER EXPENDITURE

	1966	1979
Television	47	134
Television Rental	42	127
Newspaper and Magazines	120	97
Books	87	107
Other entertainment	82	121
Telephone	40	134

The percentage of households with telephones rose from 25% (1966) to 72% (1980). The number of book titles rose from 24,893 in 1961 to 48,158 in 1980.

There were 10,000 Prestel sets in use in March 1981 of which 8600 were for business use and the growth was estimated at 600 users/month.

Reading habits are changing and newspapers and general interest magazines are becoming less popular. It is reported (Anon, 1981,(4)) that in ten years to 1981 readership of woman's weekly magazines fell by 8% and general magazines by 9%. Although the market in magazines and periodicals fluctuates (it has been estimated that between the mid-1960s and mid-1970s, 2300 titles were created and 1900 lost) the total number of periodicals rose from 4,258 in 1970 to 5,508 in 1980. As has

already been mentioned in Chapter 5 there is a boom in specialist magazines. The most popular weekly magazines are the Radio Times and TV Times each with circulations of around 3 million and read by 9.5 million adults.

Robinson (1980) analyses the change in reading habits in America between 1946-1977. He indicates that daily newspaper readership declined from the 1950s onwards with the sharpest drop occurring in the past decade. Moreover the greatest decline was in the 20-29 age group, the lowest age group examined. This trend was also evident in book and magazine readership. Estimates of the time spent reading newspapers also showed a decline but the amount of time spent reading other printed material showed an increase between 1965 and 1976. The analysis suggested that the behaviour of the under-30 age group differed significantly from other groups. This appears to be a more important point than Robinson's conclusion that the overall pattern of expenditure on mass communication was stable. The large-scale impact of teletext and viewdata systems is likely to be dependent on the willingness of a large section of the public to accept information in the form imposed by the limitations in the number of characters displayed in one frame on the television screen. Proponents of print media tend to exaggerate the deficiencies of quantity of information and quality of display exhibited by electronic media. There is little evidence that the opinion of the consumer has been ascertained in this respect. Most experts assume that the consumer has the same assessment of the different media as themselves and surveys are mainly directed at groups such as librarians which have an inbuilt bias towards print media. A new generation, familiar with written information on TV screens, may have a different attitude to teletext and viewdata systems and there is scope for research to assess this attitude. An important part of this assessment would consist of an evaluation of trade-offs between cost-quality and cost-immediacy.

The specialisation trend in magazines mentioned above may be followed by newspapers. This is noted by Malloy (1978) who suggests that the American newspaper is becoming more aware of market segmentation and is attempting to give the readers what they want. This is also the case in UK and one result has been an increasing proportion of editorial material i.e. comment and special articles compared to reporting news.

6.6 Summary

This chapter has provided further background information in order to complete the description of the changing scene in printing and publishing. The limitations of new media with respect to quality and capability of handling large quantities of data were first considered. The potential effects of computer technology on choice of printing process and text/graphics merging in conventional printing were then examined. Finally manpower and consumer implications of new technology were drawn. These are examined further in section 7.4 of the next chapter. Chapter 7 will analyse the effect of new technology on publishing and printing using the model introduced in Chapter 3 as a framework.

C H A P T E R 7

A QUALITATIVE ANALYSIS OF PUBLISHING USING THE INFORMATION TRANSFER MODEL

7.1 Introduction

The objective of this chapter is to apply the information transfer model, described in Chapter 3, to several different publishing situations. Various methods of publishing will be examined so that a comparison can be made concerning four technologies:-

(i) publishing using traditional printing technology

(ii) publishing via printing using new technology

(iii) publishing using alternative printing methods ie reprography and plateless printing

(iv) publishing via electronic media

Chapters 4 and 5 provided an overview of changes in technology and industry structure that are affecting printing and publishing while Chapter 6 provided more detailed information on technology and the effect on the individual. This chapter serves to give a balanced picture combining elements of Chapters 4, 5 and 6.

Section 7.2 maps information transfer and publishing onto the model. This includes a review of the roles played by individuals and groups in the information transfer process. Section 7.3 extends the theme of role playing to a consideration of control of the information transfer process. Section 7.4 then considers the effect of new technology and new methods of publishing on the role players.

Two publishing sections are examined in detail. Section 7.5 reviews the situation in newspaper publishing and Section 7.6 looks at scientific and technical publishing. Section 7.7 describes some matrix configurations of the information transfer model. Section 7.8 summarises the results of this chapter.

7.2 Information transfer and publishing

The term information transfer is used mainly in the context of disseminating scientific and technical information. The term can be applied generally and is used in this way by Murdock and Liston (1967) in their theme paper for the 1968 Convention for the American Documentation Institute. Their description of different communication channels has already been described in Chapter 3. The majority of the recorded media listed in their paper are published material viz:-

Primary recorded media; newspapers, technical reports, handbooks, monographs, texts.

Secondary recorded media; abstract journals, accessions bulletins, bibliographies.

Thus publishing plays an important part in information transfer.

Figure 15 showed an integrated system outline with various output options and applicable to various product sectors in printing and publishing e.g. newspaper, book, commercial and technical publishing. Figures 10 and 11 showed versions of the information transfer model. The following description of the five stages of the information transfer model is given as background to comparing figures 10, 11, 15.

Origination

Original material is provided from a variety of sources. Contributors may be individual authors or part of a team. Originators may be employed by the publisher e.g. journalists in newspapers. They may work for service organisations such as news agencies or advertising agencies.

Although some publications e.g. Government reports, minutes etc. may be text only, the majority of factual publications are a mixture of text and graphics. Authors of the text may suggest or provide the actual graphics used. Artists, photographers and designers may then be used to produce the graphics.

Occasionally graphics may cause text to be generated. For example a photograph may be included in a newspaper with a caption added. The majority of information, however, is initially recorded in text form.

Processing

Text and graphics are initially edited separately and then a page is composed i.e. text and graphics are merged. In the course of this stage further editing and secondary origination may be necessary.

Reproduction

Once the image of the page has been constructed a method of reproducing a number of copies is followed. In printing this is achieved by first creating a plate or forme and then using this on a press. In reprography a copy of the original page is reproduced by a copying method. An electronically stored image may be transmitted directly to a receiver station.

Distribution

The published information may be delivered to the recipient by mail, electronic transmission or via a retail outlet with its own delivery system e.g. newsboy. Alternatively distribution may be achieved via a wholesale distributor to a retail outlet where the recipient calls for the publication.

Reception

This is essentially the end of the distribution stage but differs in that it is controlled mainly by the recipient not the distributor. The recipient may obtain the published information by ordering a publication or by selecting it at a retail outlet.

There are many personnel involved in the information transfer process. Some of the roles played in each of the stages of information transfer via publishing are shown in table Q.

The effect on these roles of the introduction of alternative media and new technology in printing is discussed in section 7.4.

TABLE 6 ROLES PLAYED IN INFORMATION TRANSFER VIA PUBLISHING

Stage of Model	Individual Roles	Group Roles
Origination	Authors Journalists Editors	News agencies Government publishing departments
Processing	Editors Sub-editors Compositors Graphic reproduction personnel Platemakers	Publishers Trade Houses (typesetting, graphic reproduction plate and cylinder production)
Reproduction	Machine operators	Printers
Distribution	Delivery men	Wholesale distributors Retail outlets
Reception	Consumers Scientists/technologists	Libraries Companies purchasing information Civil Service) Armed Forces)Government

7.3 Control of the information transfer process

Publishers provide a link between the information providers (originators) and the recipients. In the course of this service they directly or indirectly control the processing, conversion and distribution stages. Partial control of reception can also be obtained by means of advertising, marketing and pricing strategies. They also exert some control over origination either by commissioning or directing their own authors to write on a particular topic or by selecting the material they wish to publish.

This control is exerted at two levels. First at the policy making level and secondly at the editorial level. Once a policy has been set for a publishing house the key role of controller is played by the editor. He controls origination by specification and selection. He may also produce primary origination (editorial) or secondary origination (rewriting, amending). In the processing effected by the editor information may be modified to give a different emphasis. Information may also be lost either intentionally or by accident. The extreme limits of this editorial processing are censorship in the case of excessive intentional information loss and propaganda in the the case of excessive slanting of the information and addition of reinforcing statements.

Although the editor may not directly control the conversion and distribution stages his comment on number of copies, quality etc. will be seriously considered by managers concerned with production and distribution.

Figures 10 and 11 of Chapter 3 applied the information transfer model to traditional and electronic publishing. In both cases an essential function was that of control. In figure 10 the control process is centred around the editor and the processing stage. Control commands are fed back by the editor to the origination stage. Since the quality and nature of the product are essentially determined at this stage the sale of the publication to the recipient is effectively decided by the editor. The recipient has little control over the information transfer process in the case of conventional publishing via printing. The complete sell-out of an edition or poor buying response may result in changes to a later

publication. However, the recipient cannot directly alter any of the stages origination, processing, reproduction and distribution of the product that he buys. In electronic publishing an element of control is transferred to the recipient (see figure 11). This is discussed in the next section.

7.4 Effects of new technology and new methods of publishing on role players

The decision to use new methods of publishing by a publisher could affect all or any personnel involved in the processing stage of the model. The effects of new printing technology are most noticeable in the origination and processing stages but e.g. laser platemaking could have far reaching effects for personnel involved in the conversion stage of the model.

The introduction of computer typesetting has focussed attention on the pre-press area in printing. As indicated in Chapter 5 the 'new technology' in printing is pre-press equipment particularly electronic composition and make-up systems. Many recent stoppages in Fleet Street newspapers relate to the introduction of sophisticated composition systems particularly at Mirror Group Newspapers and Times Newspapers Limited.

Printing unions have legitimately attempted to look after the interests of their members concerning the introduction of computer aided composition. However their methods in pursuit of this objective have been open to question in many instances and a poor choice has been made on the issues on which to confront management. For example, they raised objections to VDUs as being hazardous to health. These union objections were not confined to UK unions and were particularly vociferous in USA. This issue has declined as a major topic of union objection since the publication of a U.S.A. Government report (Anon, 1977 (2)) which concluded that there was little or no hazard in the use of VDUs. Another tactic by unions is to seek large wage rises upon the introduction of new technology. Since one reason for the introduction of new technology by management is to reduce operating costs the cycle continues with management seeking further manpower reduction.

Where the management approach is sensible and involves continued negotiations with personnel, new technology in printing can be introduced successfully. Korbuly (1977) points out that:- "When a documentation support function at a company switches to automated composition to lower costs or improve turn around times, the people problems encountered can be far more difficult to solve than the technical problems of getting the equipment fully operational." To overcome these problems Korbuly advocates a team approach where all interested persons are involved in the transition process as soon as possible.

The bulk of literature on changes in publishing methods and printing technology has concentrated on the technology per se and because this technology is mainly concerned with the processing and reproduction stages of the information transfer model little appears to have been written concerning personnel involved in distribution and reception. Rosenberg and Hirschman (1980) describe the effects of new technology developments which are affecting retailing in U.S.A. and these provide a guide to what may happen in publishing. Telecommunications will enable merchandise to be ordered from home, delivery systems will replace pickups by customers, money will be transferred without the face-to-face transactions necessary when cash or cheques are exchanged. Tangible examples of the rise of non store retailing are given (ibid):-

"(i) The increasing volume of telephone-and mail-generated orders received by traditional store retailers such as Bloomindale's, J.C. Penney, and Sears, Roebuck and Co.

(ii) The experimental use of interactive, two-way cable TV as a means of ordering merchandise.

(iii) The expanding selection of merchandise offerings made to credit card customers by VISA, Master-Card and American Express.

(iv) The increased popularity of in-flight shopping catalogues of major airline companies.

(v) The success of televised promotional offerings for records and tapes of popular music "not available in any store"

(i),(iii) and (v) are trends repeated in UK. (ii) has been initiated via Prestel in the UK instead of cable TV.

Davidson and Rodgers (1979) estimate non-store annual sales to be expanding from three to five times faster than those of traditional store outlets.

Rosenberg and Hirschman (1980) suggest that a sophisticated telecommunication retailing system to enable home ordering of merchandise could be launched as soon as entrepreneurs consider that consumers and technology are ready. They suggest that there is already a base of consumers emerging that is sufficient to support telecommunication retailing. They offer the following developments to support the statement:-

"(a) Increased emphasis on consumer self-identity, on developing and maintaining individuality in goods and services (leads to a desire to consider more items than a store can display).

(b) A higher proportion of women who are entering the work force (they have less time to shop)

(c) Desire for increased leisure time to further self-development and creative expression (means less time to go from store to store.)

(d) Heightened consumer demand for speciality products and services (they are often hard to get in most shopping centres).

(e) Increasingly rapid consumer acceptance of technically complex items such as videotape recorders, home computers and debit cards for automated teller machines (consumers have more experience using them).

(f) The popularity among consumers of such recent nonstore innovations as pay by phone, special interest mail-order catalogues and televised direct marketing (people are becoming psychologically prepared for new forms of shopping)."

These trends are suggested as indicative of consumers willingness to change.

Points b-f are relevant to consumers attitude to electronic news media as well as new retailing systems. These indirect measures of consumers attitudes are doubly suggestive in the absence of detailed research on consumer preferences. For example, a major criticism of teletext and videotext is the small amount of information that can be displayed on each frame or 'page'. This can be a handicap where the information consists of editorial and comment particularly when a verbose style of writing is used. Where information can be conveyed in raw data form or in terse statements videotext and teletext displays are likely to be acceptable. Indeed depending on the personality of the recipient this form of information display may be welcomed.

The growth in the number of teletext/videotext users in the UK has not as yet been great. In the case of Prestel this was partly due to a poor marketing strategy. In the case of Ceefax/Oracle it was probably at least partly due to the relatively high cost of a teletext conversion. In 1983 the financial incentives for purchasing a teletext conversion are quite good. For the recipient the cost of a suitable conversion module is around £120 while the weekly cost of quality newspaper is around £1.50 equivalent to £75.00 p.a. Thus the cost of a teletext conversion would be repaid in less than two years.

It is important to bear in mind the different roles played by people when considering the impact of new technology. The decision to use new technology is taken by the controlling group of people, managers, directors, union leaders. New technology will affect the nature of jobs and initiate the need for retraining. The recipient too has an important role to play in the introduction of new technology.

The recipient is likely to favour the introduction of new technology if it results in improved quality of product, lower price or, improved immediacy or flexibility of information provision. In the case of electronic publishing the effect on the recipient is likely to be more profound.

Holloway (1981(2)) makes the point that there is potential for the recipient to have a direct effect on distribution.

The following two sections examine two sectors of publishing that are likely to feel the impact of new technology in printing and new methods of publishing.

7.5 Newspaper publishing

The personnel involved in origination are journalists, editors and sub-editors. Other material at the origination stage is produced by news agencies and advertising agencies. The material supplied by these agencies may appear in the newspaper or magazine in the form provided by these agencies or it may be modified by the editorial team. When such modifications are made this processing stage is under the control of the editor.

Personnel involved in the processing stage are editors, sub-editors, compositors and graphic reproduction workers. Graphic reproduction and platemaking are often linked as activities in printing. This appears to be because they embody new skills possessed by new groups of workers that evolved in printing after compositors had established themselves as an elite group.

Another possibility is that historically they are grouped together because they both utilise a photo-chemical method of production. In the context of the information transfer model, however, they appear to belong to two different stages. Graphic reproduction is part of the processing stage while platemaking is the essential first step in reproduction.

Once papers are printed they are cut and folded and parcelled ready for distribution. This is usually accomplished by a fleet of delivery vehicles which deliver the parcels of papers to retail and wholesale pick-up points. Some provincial newspapers have their own retail outlets through company owned shops.

The recipient obtains the newspaper either by casual buying at a shop or news vendor, or by placing an order. In the latter case the paper may either be held at the shop for the recipient to call or be delivered to the recipient. This scheme of production and distribution is summarised in Table R.

TABLE R PRODUCTION AND DISTRIBUTION OF NEWSPAPERS

Origination	Material supplied by journalists and editors or by news agencies, syndicates, advertising agencies
Processing	Editorial control of composition, graphic reproduction and page-make-up
Reproduction	Plate making, mounting on press, printing, cutting, folding.
Distribution	Parcelling and distribution of paper to distribution points (wholesale/retail outlets)
Reception	Recipient calls and receives newspaper at shop or paper is delivered to recipient.

The impact of technology on the newspaper industry in the past decade has been at the processing stage (photo composition, electronic composition and page make-up), conversion stage (new methods of platemaking, new printing process (lithography either direct or offset) and the use of computerised methods of accounting and production control.

Webb (1979) describes three case studies involving the introduction of photo composition and web offset printing in provincial newspapers. In first case study the advantages of using the photocomposition with web offset were that the newspapers produced had a clearer printed image thus helping to give a more modern look to the product, there was greater flexibility in design, there was the opportunity for colour printing. Productivity was improved mainly because management could switch workers to different key tasks at times of high pressure.

Disadvantages were tighter production schedules and difficulty in making corrections. There was also higher production cost due to the photographic materials which would not be recycled as was the case when hot metal methods were used.

In the second case study described the main reason for the change of technology was "to maintain viability in today's highly competitive market", to quote the Managing Director of the newspaper group. Partly the objectives were financial. It was hoped that substantial manpower savings could be achieved through a voluntary redundancy scheme. The manpower savings expected were 35% in the case room, 5% in the stereo department and 18% in the machine area.

Similar reasons for change were given in the third case study.

At an earlier stage in technology development of newspaper printing most change occurred at the conversion and replication stages. For example the introduction of steam powered presses led to almost a hundred fold increase in output rate. Sadler (1970) writes:- "By 1850 machines had been developed capable of producing 20,000 impressions per hour compared with the 250 of the hand press." He adds that: "One result of this innovation was the separation of the roles of compositor and machine operator."

From the middle of the fifteenth century up to the end of the nineteenth century type was set entirely by hand. The introduction of mechanised typesetting machines such as Linotype (1886) and Monotype (1887) meant that the compositor was no longer immune from

technological change. Sadler further suggests that the main effect of these innovations on composing work is to remove from some compositors the skill of producing justified lines of type and to substitute the less demanding skill of keyboard operation. He adds that despite the changing skill requirements brought about by technology innovation: "The compositor retains his position in the status system of the industry, and the machine minder is still regarded as somewhat inferior."

This situation is likely to continue and is one of the reasons for the difficulty in reaching agreement in some newspaper printing disputes. For example in the long dispute at the Times a major point of contention was the NGA insistence on control of keyboarding. The NGA attitude at the start of the dispute was described (Baker, 1978) as being " ..... opposed in principle to direct input into computerised technology by non-NGA members."

The reduction in number of printing unions described in Section 6.5 could eventually help to avoid these disputes. Until then, however, the special status of compositors is likely to continue to create problems for management in introducing computerised composing equipment.

7.6 Scientific and technical publishing

Although this includes a wide range of publications there are characteristics that are common to the scientific and technical publication treated here. These are defined as those publications which:-

(i) endeavour to publish in as short a production time as possible

(ii) require clarity in typography rather than ornament

(iii) in respect to (ii) use any appropriate printing method.

Many papers are produced initially in typewritten form and then photocopied. When a larger number of copies and perhaps higher quality is desired the paper is usually published in a journal which is typeset and printed.

Keeler (1977) describes the evaluation of several possible publishing systems considered for the naval education and training command of the US Navy. This produces 80 publications and 568,700 bound copies per year. The manpower and publishing function requirements of a suitable system are given in Table S.

TABLE S REQUIREMENTS OF A PUBLISHING SYSTEM FOR THE US NAVY TRAINING COMMAND

	Manpower (man years)	Publishing function (million characters)
Author	75.3	45
Encoding	6.6	45
Reviewing	5.4	-
Editing	2.4	4.5
Composing	4.9	48
Illustrating	13.2	4.8
Typesetting		48
Platemaking		48.8

The evaluation considered the system in existence and four others. The system then used involved typing of the manuscripts before these were sent to be typeset. The alternative systems proposed were:-

(a) Existing system

(b) magnetic card word processing systems

(c) advanced word processing systems plus typesetter

(d) text editor system

(e) text editor system plus graphic scanner.

It was suggested that system (b) would enable a labour saving of 50% in encoding and 75% in editing. System (c) would yield an additional 10% labour reduction in encoding. It would also yield materials savings in text negatives (32%), plates (25%), pages (26%).

A further development in scientific and technical publishing would be the electronic journal as described by Senders (1977). This would allow the storage, processing and retrieval of documents within a computer system. The use of such a scheme as that outlined by Senders would lead to drastic reductions in manpower and time of production for the reproduction and distribution stages. The reduction in time for processing, reproduction, distribution and reception suggests that the electronic journal has a future in scientific and technical publishing. Manten (1978) suggests three problems in the transfer of primary scientific information:-

(i) the growth in output of primary publications (2.5 million papers per year, cumulative number of papers 50 million.

(ii) due to the branching and ramification of science the user has more difficulties in locating appropriate papers.

(iii) the long delay in transferring the information to the reader.

He suggests that a number of alternative media be examined to determine whether improvements in the communication of scientific and technical information can be achieved.

The matrix for the electronic journal (see Section 7.7) suggests that it would certainly assist in curing point (iii) above. Since the computer system can access records very quickly and information retrieval systems are becoming more efficient the electronic journal could also help to overcome the problems of (ii) and (iii) above.

Urquhart (1978) states that the purchasing power of UK libraries has been reduced recently. This has led to subscription concellations which will result in a further increase in journal prices, further cancellations etc. At the same time the annual increase in the

number of titles is 2.5 to 3%. This will also effect an increase in the unit cost of individual titles. A plot of the number of subscriptions received against the number of journals receiving them is a hyperbolic curve. This he summarises:- ".... a few journals have many subscribers, many have a few." The hyperbolic nature of the graph prompts him to suggest that if the conditions of publishing stay the same then the number of economically viable publications tends to be proportional to the total amount of money available for purchasing those publications. He concludes " .... even if the size of the market keeps pace with the information explosion the amount of information that can be economically marketed will not increase accordingly." He considers that one result of this situation is that there could be a decline in the quality of information published.

His remedy for this situation is a clearing house which would work for the mutual benefit of publishers, booksellers, libraries and academics. While the electronic journal is not an alternative to this it does offer advantages over conventional publishing. In addition to the reduction in the time it takes for the information to reach the recipient, more efficient publishing can be achieved since the only copies printed will be those ordered by the recipient. Thus electronic publishing and print-on-demand could offer a technical solution to the problem compared to Urquhart's organisational solution.

7.7 Matrices for different publishing product sectors

It has already been stated that detailed quantitative data for comparison of the various publishing/product sectors are not available. In the absence of these data some estimates are proposed as elements of the matrix structure of the information transfer model. These estimates are based on the various data items included in this thesis and on information provided by colleagues in a discussion of these matrices. The values suggested are only to be used as a platform for discussion and are not intended as definitive.

Time comparisons

An interesting comparison of various publishing methods can be made by considering the production and distribution times. The five figures given relate to the time required to complete each stage of the information transfer model namely origination, processing, reproduction, distribution and reception. The following code is used:-

0 (less than 2 seconds), s (seconds), m (minutes), h (hours), d (days), w (weeks), M (months), y (years), x (not known)

Newspapers (National daily)

(i) 1960 hot metal technology (h h h h m)

Using information obtained from a number of publications including, McGregor (1976), Webb (1979) and Blunden (1979) and assigning a norm of 100 for each 1960 element, later generation technologies would have matrices:-

(ii) 1970 generation technology
(photocomposition and lithography) (100 90 95 95 100)

(iii) 1980 generation technology
(electronic composition, page make-up, laser platemaking)
(98 85 95 95 100)

Scientific publishing

Text book	(y M w w h)
Periodical	(M h w d m)

Electronic media

Print on demand	(x h m s s)
Teletext/videotex	(x h 0 0 0)

Manpower and operating costs

The time factor is not the only consideration in ascertaining the most appropriate publishing method or associated technology. Efficiency of production must be taken into account. Two factors to be considered in relation to this efficiency are manpower levels and operating costs (excluding wages). These may be included as rows in the matrix of the information transfer model ie.

	Origination	Processing	Reproduction	Distribution
manpower level	x	x	x	x
operating costs	x	x	x	x

The column relating to the recipient is not included since he plays no part in discussions relating to production and distribution.

Newspapers

Using a 1960 generation newspaper as standard:-

1970 generation technology	(100 100 90 100)
(photocomposition)	(100 100 100 100)
1980 generation technology	
(electronic composition, page	(100 98 88 100)
make-up, laser platemaking)	(100 100 100 99)

Scientific and technical reports

The following estimates are based mainly on the information of Keeler (1977) and Senders (1977). Using a photocomposition system with an involved production process with typing and retyping prior to phototypesetting as standard:-

Advanced automated system	(100 72 100 100)
	(100 80 80 100)
Electronic journal	(*100 70 5 0)
	(*100 80 100 10)

*Where the author uses a word processing system these figures could alter substantially.

These comparisons have utilised the simple format of the model outlined on pages 53-5. Even so, use of the model pinpoints some interesting differences. In the case of newspapers, while new technology may reduce the time needed for each of the stages origination, processing, reproduction and distribution, the recipient will still receive his/her newspaper by the same method. Therefore, there will be no change to the time taken for the reception stage. Comparing 1960 and 1980 technologies of newspapers, the greatest reduction in lead-time is occurring at the processing stage.

In the case of scientific publishing no figures have been given for any reduction in lead-times due to new technologies. In the case of textbooks, changes are likely to be of the same order as for newspaper publishing. One difference would be where the author has access to a word-processor which the publisher is able to link to a phototypesetter. In this case both the origination and processing lead-times could be substantially reduced.

There would be dramatic reductions in replication, distribution and reception times if the periodical was available in machine-readable form. Output could be obtained in minutes via a print on demand system or in a fraction of a second for an electronic journal.

It is worthwhile to state the obvious; the greater the electronic involvement, the greater the reduction in production and distribution times. Thus, in publishing printed media there is only a small, albeit worthwhile, percentage reduction in production time. Moreover this reduction is concentrated in the first three stages of the model. In contrast to this print on demand and videotex systems require virtually no time to distribute information and reproduction is also reduced to a smaller value than in the case of printed media.

The brief comparison of manpower and operating costs shown on page 153 is interesting. However, as has been pointed out, the

figures used, while based on information obtained from a variety of sources do not represent any existing company. Therefore, the reader is directed to the discussion of the model in Chapter 3, pps 56–75 which is based on information obtained from a real company and a more detailed format of the model is adopted.

7.8 Summary

The information transfer model as used in this chapter has drawn attention to a number of points concerning the use of new technology in printing and new methods of publishing. While pre-20th century technologies mainly affected the reproduction stage, present generation technologies are having an effect on the processing and even origination stages in the case of newspapers. In the case of electronic media and print-on-demand the effects are most noticable on distribution and reception.

Another effect in the case of electronic media and print-on-demand is the enhanced role of the recipient. Holloway (1981,(2)) points out that the recipient has a passive role in conventional publishing. In an electronic journal or on Prestel where the number of times an item is accessed can be counted this information can be fed directly to the publisher and hence affect future publications. In a print-on-demand situation the recipient would order only what he/she required. A further possibility would be an individually tailored document; Chapter 1 from source A, Chapter 2 from source B etc. Thus the recipient would play a much more active role in the information transfer process.

C H A P T E R 8

FORECAST

8.1 Introduction

The objective of this chapter is to produce a forecast for the printing industry to 1995. Inputs from Chapters 4 to 7 are used for this purpose, together with additional information from other sources. Socio-economics as well as technological factors are taken into account. Section 8.2 provides a brief review of phases in the development of written communication. Significant technology developments are suggested and attention drawn to the shortening time intervals between them. Historical evidence points to the imminent introduction of the next significant development; integrated text/tone printing/publishing systems. Section 8.3 reviews other forecasts that are pertinent to this thesis.

Section 8.4 discusses the implications of economic and sociological factors in the introduction of new technology. Section 8.5 then provides a forecast for the period to 1995. Finally Section 8.6 summarises this chapter.

8.2 History of technology development in graphic communication

The author proposes the following overview of developments in the technology of graphic communication. The development of graphic communications can be classified as occurring in three distinct phases.

- tactual phase
- mechanical phase
- cybernetic phase

The tactual phase refers to the time when writing could only be achieved by the direct use of the hands, and involves one individual who produces one written copy.

The mechanical phase introduced methods that enabled multiple copies to be made which was a significant step forward.

The cybernetic phase refers to the use of machines capable of automation of the printing and distribution stages of the information transfer model.

The tactual phase ended and the mechanical phase began with the development of block printing. The beginnings of the cybernetic phase can be seen in the introduction of computers in the 1960s.

During the tactual phase the ability to write was confined to a small group of craftsmen. In Europe, in the Middle Ages, this group was mainly controlled by the Church. Copies of books and documents, including the Bible, were copied painstakingly by these artisans. The printing presses of the fifteenth century led to the virtual disappearance of this type of craftsman. It also led to far reaching changes in society. Although the Church also used some of the first presses, the wider availability of graphic communication made possible by printing was a major factor in loosening the stranglehold of the Church.

The cybernetic phase will produce a similar impact. Job functions within printing particularly those associated with composition and graphic reproduction will change.

An additional characteristic of the cybernetic phase is the capability of replication at a distance and at multiple locations by a variety of media. Output does not need to be by conventional printing methods or even onto paper. This will affect the nature of our society, although it is difficult to predict the outcome in detail. Old skills will die out and new skills will be needed. At the same time much of the expertise of printers classified as the processing stage of the information transfer model, is now embodied in computer-driven equipment such as word processors. The cybernetic phase could break the stranglehold of the printing craft guilds just as printing broke the stranglehold of the Church.

Within these three phases there have been a large number of innovations. Progress has been by a series of jumps rather than a smooth, continuous progression. Some of these jumps can be regarded as more significant then others. Table T on page 160 gives the author's suggestions of the most significant developments in graphic communication of both words and pictures.

The first recording of syllabic or phonetic signs and symbols of language is believed to be that of the Sumerians c.2900 BC (Wallbank, 1962, p.17) although pictographs had been used much earlier.

Although printing can be traced to the use of moulded type by Pi Sheng in China, AD 1041, the next major step forward was that of Gutenburg in Mainz 1450, when he developed the printing press and re-usable type. There were many improvements to the press in the next 400 years, such as the introduction of rotary presses and the use of engines to drive the presses, the next significant development can be regarded as the introduction of modern typecasting machines Linotype 1886, Monotype 1887, Typograph 1889 and Intertype 1912.

The history of picture-making follows a similar course. Certainly by the late Paleolithic times art had been developed to a high degree. The Altamira murals give striking evidence of this and are believed to have been made c.15000 BC (Wallbank 1962, p.11). The Japanese were printing pictures from wooden blocks c.900 AD with the Chinese some time in advance of this, possibly around 800 AD (Bowles 1961, p.3). Wooden blocks, hand-engraved were also used in letterpress printing until the introduction of photoengraving for line subjects in 1872 (Ibid, p.13) and tone subjects about 10 years later.

Although photocomposition was not widely accepted until the 1950s and later, photocomposing machines were developed before the second world war. The Luminotype, for example, was introduced in 1929 (Clair, 1965). A median date of 1940 is therefore suggested for the introduction of photocomposition.

The introduction of commercial digital computers led rapidly to their use in printing, first as business systems in large printing establishments and then in 1962 several large publishing companies started to use computers for typesetting, an example being the Los Angeles Times (Nebel, 1966). 1962 is therefore taken as the starting date of electronic composition.

It is anticipated that the next significant development will be a completely integrated system, where original text and pictures are fed into a computer and processed within the system. Within printing the systems would be computer-to-plate which would output a press ready plate or forme without any intermediate medium such as film or paper. Alternatively output could be directly onto paper or via electronic media.

TABLE T SIGNIFICANT STEPS IN THE TECHNOLOGY DEVELOPMENT OF GRAPHIC COMMUNICATIONS

- Drawing (cave paintings)	first known attempt to record information (15000 BC)
- Writing	recording of the spoken word (2900 BC)
- Block printing	first attempt to replicate information (800 AD)
- Gutenburg printing press	mechanised use of movable type (1450 AD)
- Photo-engraving/ typecasting	these are separate innovations combined as one significant development (the dates 1872 (photoengraving) and 1886 (typecasting) are averaged to 1880)
- Photocomposition	the development of the use of the phototypesetter in a production system for assembly of text and artwork (1940)
- Electronic composition	the use of the computer in the processing of text (1962)
- Integrated system	the use of computer system for all processing and merging of text and pictures with output onto plate/forme, paper or electronic medium.

The dates of these significant developments up to photocomposition are shown on the graph in Figure 17 using linear scales. It is difficult

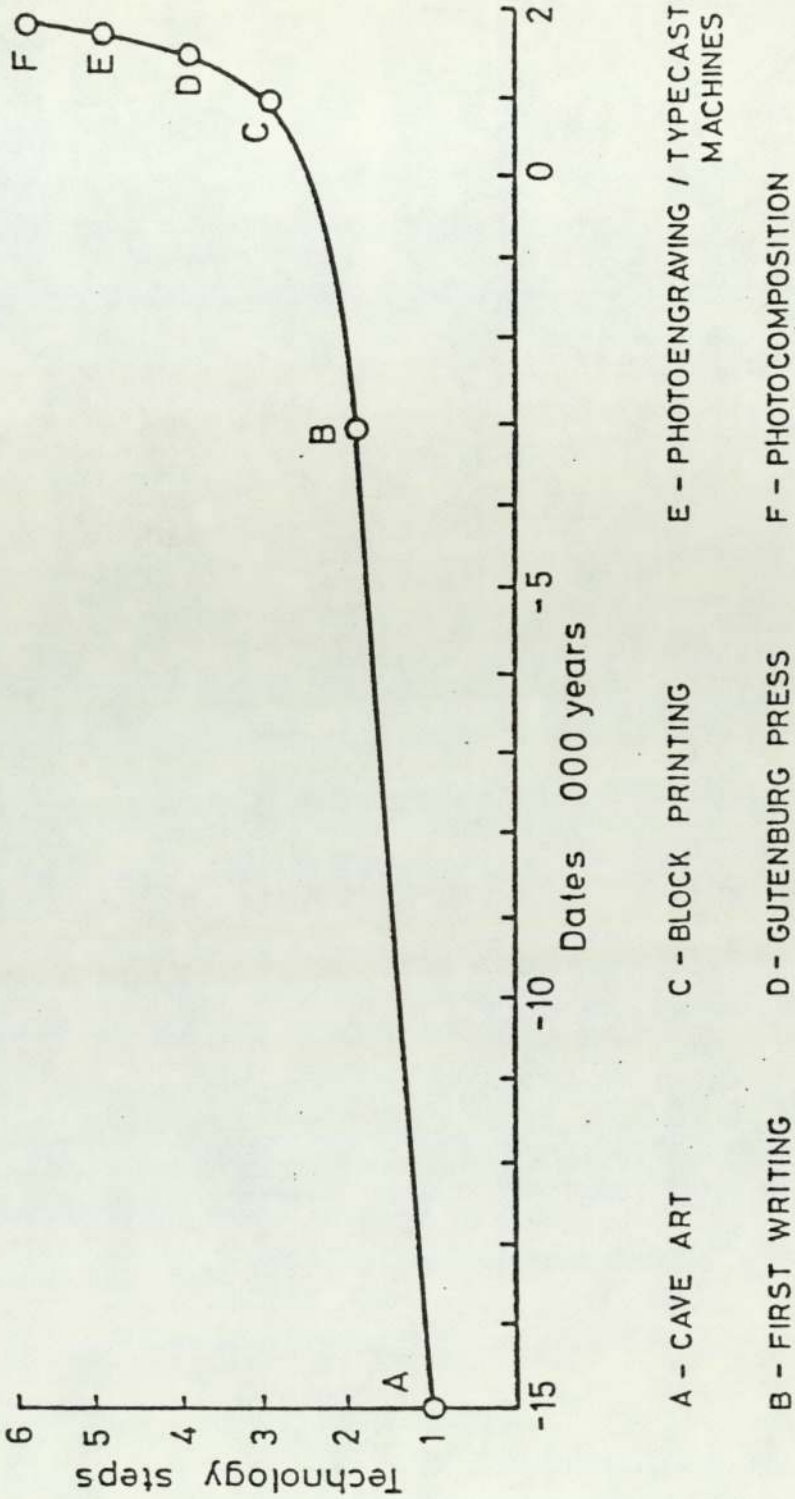


Figure 17. Significant developments in graphic communication

to show electronic composition on this linear scale and this is therefore omitted from the graph. The intervals between these events are:- 12,000, 4000, 650, 430, 60 and 22 years up to electronic composition (1962). These time intervals are numbered respectively 1, 2, 3, 4, 5, 6. Figure 18 shows the logarithms of the time intervals between significant developments plotted on the horizontal axis and the time interval number on the vertical axis. The use of the log linear scale gives a startling indication of the rapid rate of introduction of technological innovation although no exact prediction is intended. By extrapolation a time interval of around 10 years is indicated between electronic composition and the next significant development.

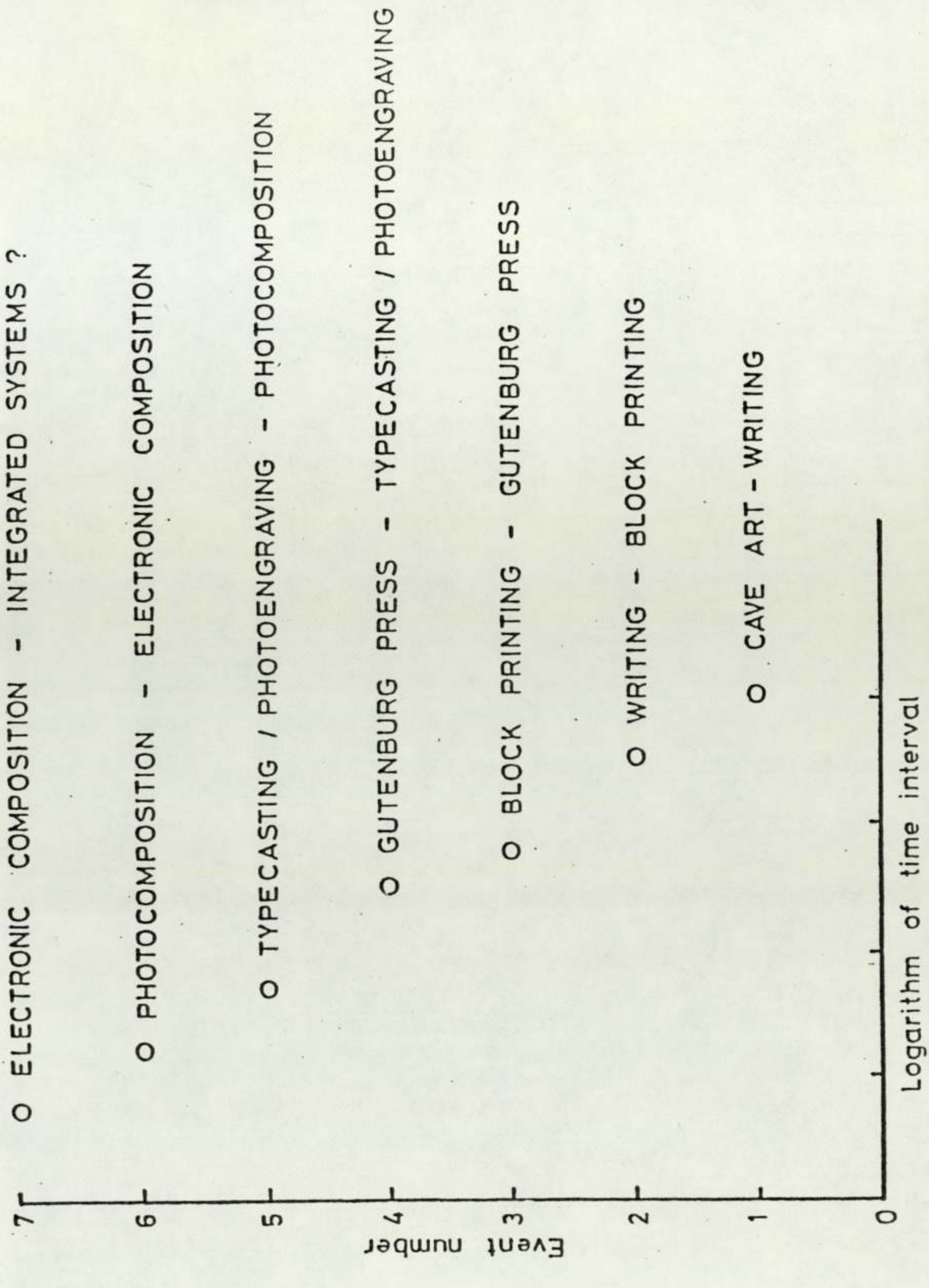


Figure 18. Linear-logarithm plot of time intervals between significant developments in graphic communication

TABLE U CHRONOLOLOGY OF IMPORTANT EVENTS IN GRAPHIC COMMUNICATIONS TECHNOLOGY

1450	GUTENBURG PRESS	(Foundation of Letterpress)
1796	SENEFELDER	(Foundation of Lithography)
1872	PHOTOENGRAVING	(Method of replicating photographs)
1873	NEW YORK "DAILY GRAPHIC"	(First illustrated newspaper)
1886	LINOTYPE MACHINE	(Machine typecasting)
1905	HOLWEG	(Foundation of Flexography)
1912	KLIC	(Foundation of Gravure)
1934	TTS "THE SCOTSMAN"	(Remote typesetting in UK)
1946	FOTOSETTER	(First phototypesetter)
1954	KLISCHOGRAPH	(Machine engraving in letterpress)
1964	HELIOKLISCHOGRAPH	(Machine engraving in gravure)
1966	DIGISET	(First digital phototypesetter)
1977	COMPUTER-TO-PLATE	(Demonstration by EOCOM at ANPA)

Some other important technology developments are shown in Table U which provides further evidence of the rapid rate of introduction of new technology in graphic communications over the past hundred years. It is also possible to discern that these innovations had impacts at different stages of the information transfer model.

In the initial stages of the tactual phase, progress occurred in the origination and processing stages of the model. The advent of written communication immediately helped to ensure that information was distributed over long distances. During the later stages of the tactual phase was almost entirely devoted to progress in reproduction.

The machine phase commenced with the introduction of printing. Improved methods of reproduction led immediately to improvements in distribution, aided by developments in transportation. The introduction of typecasters led to some improvement in the processing stage. The advent of the modern newspaper saw the introduction of a production system that took into account processing, reproduction and distribution. Photographic methods of platemaking and photocomposition led to improvements in processing, particularly conversion.

The initial stages of the cybernetic phase continued improvement in processing. However, word processing is potentially the first real progress in origination since the tactual phase.

The main feature of the cybernetic phase, however is the development of integrated systems. These may embody the first four stages of the model; origination, processing, reproduction and distribution. These systems are being developed both within the printing industry (computer-to-plate, remote printing) and alternative industries (document delivery systems). Electronic media (videotex, electronic journal) also allow the recipient to intervene more actively in information transfer.

8.3 Other forecasts

Printers appear to be inordinately interested in forecasting judging by the trade press. Almost every edition of a trade journal contains an article forecasting either the future economic situation or the impact of technology. It is surprising, therefore, that there are few in-depth forecasting studies on printing and publishing. It has already been mentioned that the Printing Technology Forecast (Blunden et al, 1979) was the first serious attempt at such a study for the UK printing and publishing industries (see Section 5.4).

Despite the gap in the literature a number of forecasts have been published which are pertinent to this thesis. They are of two types:-

(i) General forecasts on the impact of microelectronics

(ii) Specific forecasts on communications, printing and publishing and particularly on new technology that may impact, directly or indirectly, on printing and publishing.

General forecasts

Evans (1979) in a report prepared for the European Trade Union Institute comments on the affect of microelectronics on employment. He points out that the concern over new technology arises from its labour saving potential, and argues that any capital, material or energy savings ultimately also impact on labour saving. He adds (ibid, p. 73)

"Labour saving innovation does not necessarily result in a negative impact on employment. The 1960's were years of sustained labour saving innovation in the primary and tertiary sectors in Europe. However, between 1958 and 1967 employment grew by an average of 0.2 per cent per year in EEC Member States because at the same time output, measured by Gross Domestic Product in real terms, grew by 4.5 per cent per year.

The impact of technological change is, therefore, crucially dependent upon both the impact on labour productivity and the impact on the level of output."

Therefore using this argument it would seem possible for the UK printing industry to retain a large proportion of its manpower if it utilised new technology effectively.

However, Anderson and Hersleb (1980) describe a current massive shortage of computer-related manpower in UK and this is the overwhelming constraint on the adoption of computer technology. They estimate the total stock of computer-related skilled manpower at 1979/80 to be at least 275,000 which is at least 25,000 below requirement. Of this shortfall a major proporton (16,000) was suggested for higher skilled personnel (programmers/analysts). They suggest that these shortages will worsen in the period to 1985 when they estimate around 400,000 computer-skilled personnel will be required.

"Even on conservative estimates of future growth of computer usage, the pressure of demand in key occupational areas is unlikely to abate in the period to 1985. The balance of skills in industry will change, with greater emphasis upon higher skill levels. To sustain even the most conservative rate of growth envisaged in this report, the incremental requirement of programming/analysis skills will be approximately 500 per month. Both computer suppliers and users will find themselves in increasing competition for these skills".

This point has already been made in Chapter 6.

Printing/Publishing forecasts

The forecast for the UK printing industry (Blunden et al, 1979) has been outlined in Chapter 5. It has already been stated that this is the first UK in-depth forecast for printing. Several reports have been published in USA, mainly by private research companies such as Arthur D Little Inc. One report of this type (Anon, 1977 (3)) looked at the effect of electronic media on news publishing up to 1982. It concluded that electronic media would have little effect on

news publishing until 1985. By 1992 electronic media would pose a serious threat to newspapers and the long term threat would be to erode newspaper advertising revenues.

Freedman et al (1980) look at the technological merging of electronic page make-up with computer-driven print on demand systems. They refer to this merger as CAMIS (Computer Assisted Make-up and Imaging Systems). They state: "There is considerable evidence to suggest that the technology of CAMIS in conjunction with supporting electronic systems will lead to a highly integrated, managerially concentrated, heavily capitalized, international network of equipment manufacture and services". They envisage that CAMIS will have a major impact on printing in the 1980's and will help to cause restructuring of information media.

These examples of other forecasts present a balanced cross-section of these types of report. While there may be differences of opinion in these reports on degree of change, particular items of equipment that will have the most impact and time scales involved there is considerable agreement on the following points:-

(i) New technology will have a major effect on printing and publishing and the information industry will be restructured.

(ii) There will be changes in job skills, some types of job will disappear and new ones appear; most new types of job will have a higher skill level.

(iii) The new technology has advantages of faster and/or greater throughput, faster and/or easier distribution and flexibility.

8.4 Socio-economic factors

The increasing use of electronics and innovative methods is changing the skills required in printing. While this indicates a move away from craft-based skills, it does not necessarily mean de-skilling. Machines will look after the control of various processes with a far higher accuracy than can be achieved by a man and will give opportunity to use creative skills and a freedom from mundane tasks. Re-training will be essential as job roles change and new task descriptions will evolve; the skills of the maintenance engineer altering from mechanical through electro-mechanical to electronic. An important question is whether the necessary electronic skills in manpower can be obtained by re-training present staff, by recruiting from outside the printing industry or from anywhere. West Germany is already aware of a gap between the number of electronics experts required and those available, and a similar situation exists in the UK and will lead to fierce competition between the various industries, industry sectors and individual companies. A shortage of manpower with the requisite electronic skills in the printing sector could adversely affect the take-up of computer-to-plate systems.

The slowdown in productivity in the 1970s following the high economic growth rates of the 1960s has prompted speculation that the industrialised world is now on the downward phase of a Kondratiev cycle (Rothwell and Zegveld, 1979; Ray, 1980). Carlsson (1980) states that it is difficult to find evidence for this when the GNP per capita growth rates for the United States, West Germany, United Kingdom and Sweden are examined. From 1870 to 1978 the most noticeable effect was the post-war period which was an era of rapid growth practically without historical precedent. Carlsson (1980) gives the following values for average GNP/Capita growth rates in %/year for 1870-1978:-

Sweden 2.5 - USA 1.8 - W Germany 1.9 - UK 1.1. One reason for the relatively low figure for UK could be a failure to implement technology innovation.

This appears to be the case in the UK printing industry which has generally lagged behind the printing industries of USA and Europe in introducing technology innovations.

TABLE V ANNUAL PERCENTAGE CHANGE OF GRAPHIC ARTS PHOTOGRAPHIC MATERIALS SOLD IN UK

	1974	1975	1976	1977	1978	1979
Film (not photocomposition)	+9.5	-5.2	+3.1	+4.9	+5.6	+2.6
Photocomposition film/paper	+15.0	+7.5	+8.0	+12.0	+25.0	+30.0
Total	+9.8	-4.4	+3.4	+5.4	+7.1	+5.0

(Blunden et al, 1979, p.11.19)

Table V shows the relative slowness of the introduction of photocomposition in the UK. It has taken a long time for photocomposition film/paper materials to capture a significant proportion of the graphic arts photographic materials market (approximately 10% of the UK market for 1979).

The uptake of other new technology including computer-to-plate systems could also be delayed in UK.

An economic factor that could speed the introduction of computer-to-plate systems is the price of silver. This increased from £4 per ounce in August 1979 to £21 per ounce in January 1980. Because of the quantity of silver in photographic products (9 sq m of roll miniature film releases 60g silver, continuous tone printing paper 15g, graphic arts photographic materials have increased in price over the same period by as much as 40% (Chambers, E 1980). Larger businesses may be able to absorb these increased costs, particularly where silver recovery is used, but the impact on smaller businesses is appreciable. There are a number of graphic arts materials using non-silver chemistry but none can match the sensitivity of silver-based photographic products - a 1/60th sec exposure of Kodak 64 film

in a 35 mm camera would take more than a month for a non-silver material (Anon 1980 (2)). This has led to the development of non-silver materials triggered by silver chemistry thus reducing silver content by 50%. The difference in energy required to expose silver or non-silver based materials is shown in Table W.

TABLE W SENSITIVITY OF PHOTOGRAPHIC MATERIALS

Panchromatic silver halide film	1/100 to 1/10	ergs/sq cm
Dry silver material	70 to 1600	ergs/sq cm
Photopolymer colour proofing	20,000	ergs/sq cm
Photopolymer printing plate	200,000	ergs/sq cm
Diazo	300,000 to 10,000,000	ergs/sq cm

The cost of photographic intermediates means that computer-to-plate or even computer-to-film systems can show materials cost savings to partly offset capital equipment cost. Plate materials are being developed that can be exposed by visible lasers and this will also affect the development of computer-to-plate systems.

Union opposition to new technology would probably be reduced if there were fewer unions. There has been some progress in this direction in the U.K. Spector (1967) gives the number of trade unions in the printing industry as twelve and states that there were sixteen three years previously.

It has already been stated in Chapter 6 that the number of unions involved in printing Fleet Street newspapers is six and that negotiations are proceeding between NGA and SOGAT. Other mergers which could also take place have been suggested:
National Union of Journalists (NUJ) and NGA, NGA/SLADE, SOGAT/NATSOPA (Anon, 1981 (6)).

The emergence of one union in printing is possibly to the general advantage of workers. The issue is not clearcut, however, especially since the emergence of other media. Winsbury (1979) refers to the involvement of unions in Prestel. He suggests that unions face three questions regarding new media:-

(i) do videotex terminals cut across present demarcation lines for print unions

(ii) what are the implications for telecommunication workers of the installation of equipment by non British Telecom personnel

(iii) new sources of material for publishing houses may have non-union personnel.

Points (ii) and (iii) would not be solved by the existence of only one print union.

8.5 Forecast

The previous sections have examined a number of separate issues pertinent to forecasting the future of the printing industry. In 8.2 it was suggested that the next significant step in the technology development of graphic communications was likely to be an integrated publishing system. Moreover, historical trend evidence indicated that such a system was imminent. This is supported by an assessment of graphic arts technology (See Appendix 3).

In 8.3 a summary of other forecasts indicated that these agreed

that new technology had advantages over traditional printing technology and was likely to have major effects on both individuals within printing and publishing and on the structure of these industries. These statements are supported by evidence contained in Appendices 1, 2 and 3, particularly A1.3 and A1.4. The trend statements contained in A1.3, A1.4 were made in 1979 but continue to hold in 1983.

Section 8.4 provided an assessment of socio-economic factors. It was suggested that a rise in the price of silver combined with a fall in computer and electronic costs provided a financial incentive to introduce new technology in printing. At the same time the UK printing industry lagged behind its US and West German counterparts in introducing new technology.

In order to attempt to forecast the future role of the printing industry it is necessary to take account of these and other factors. The availability of proven new technology will not necessarily lead to its take-up. Industry attitudes and the cost-effectiveness of new methods coupled with consumer attitudes to changes in product all play a part. Unfortunately there is no accepted methodology for dealing with such a disparate set of data. However, this thesis is based on the experience gained while working on Techno-economics projects which incorporated forecasting and is supported by summaries of these reports in Appendices 1-3. The fact that the ten-year forecast holds up well, four years after being published offers evidence of the merits of the methodologies used. The following pages summarise the forecast statements made in the Techno-economics reports and elsewhere in this thesis.

Much of the technology needed for computer-to-plate systems is available now, and indeed some of the technology is 10 or more years old. Computer-to-film systems are already available for A4 size output. Remote printing of colour pages has been achieved using

similar equipment (Bergland, 1980). Various devices are available that could output from a computer directly onto plate or forme for the printing processes lithography, gravure and flexography. Supplier companies are researching the possibility of computer-to-plate systems, Dr-Ing Rudolph Hell, for example, are developing such a system, called Helio Data Processing (HDP).

A major technological obstacle is software development. Software is expensive and time-consuming to produce, but a large amount eventually becomes embodied as hardware or rather firmware on the microprocessors and integrated circuits used in electronic equipment. At one time the capacity/ performance of "chips" doubled and the cost halved every two years. This period is gradually lengthening but the lowering of cost will continue during the 1980s and will offset the cost of software. Yet to be resolved is the provision of copyright or other protection for the software producer.

Although the hardware and software problems could be overcome in a short time span it is market acceptance that will be the major determining factor. Before computer-to-plate is accepted it is likely that a period of acceptance of computer-to-film will occur. Holloway (1981,(1)) suggests that computer-to-plate systems could be in use by 1984. Other forecasters have similar views: Roland Dunkley, Managing Director of Crosfield Electronics Limited says:

"Before the end of the decade, fully electronic pre-press, covering a merger of phototypesetting, scanning and digital page and forme make-up, without intermediate processes to directly produce plates and cylinders, will be established practise in at least a substantial number of printing plants, worldwide" (Anon, 1980 (1)).

The reliability of computer-based systems has improved considerably in the past 20 years. Holloway 1981, (1) suggests this is due to three factors:

- increased experience in the practical application of computer techniques

- improvements in system design, software development and hardware

- the use of integrated circuits and microcomponents which use very small currents and are therefore not subjected to the heating effects present in former electronic components such as valves.

The modular construction of micro-electronic equipment also means that the failure of a component can be quickly and easily dealt with by a routine fault-finding procedure. Many failures within computer systems relate to electro-mechanical components where the electrical signal is changed to another physical form, eg papertape punches and readers, transport mechanisms. A computer-to-plate system would require fewer changes in physical form of the signal. Only two are needed: a change to electrical form at input and vice versa at output. This is easily accomplished by Analogue/Digital Conversion. Therefore, computer-to-plate systems are likely to be reliable.

The introduction of page make-up is likely to be delayed by management as well as union attitude to page make-up systems. New equipment is scrutinised carefully and tested against standard methods of working. This tends to highlight the weaknesses and play down the strength of page make-up systems. All technology has its limitations. Present page make-up procedures evolved because of the limitations of the then available technology; hot metal composition. The paste-up techniques of photocomposition copied hot metal methods but with the advantage that paper/film is easier to manipulate . It is not necessary to slavishly copy present methods of page make-up in which a phototypeset galley is pasted into position on a page. If it does not fit it is cut to size or a new galley produced. Electronic page make-up systems may have trouble in fitting some galleys into specified positions on the page. The sensible procedure in this situation would be to let the computer find another position for the galley. Computer-to-plate systems should utilise the advantages of computer-made decisions and not introduce complications by following established procedures.

While care should be taken to ensure that new methods are reliable and cost-effective, it is often necessary to act rapidly once technology has matured. Failure to do this resulted in disaster for many companies

producing cash registers and watches. In the watchmaking industry, for example, in less than 10 years approximately 45% of the world wide production of watches switched to electronics (Rothwell and Zegveld, 1979 p. 136). Freeman and Curnow are quoted (ibid p. 137) suggesting eight features of the electronic revolution that may be repeated in other areas. These are summarised:

(i) Disbelief in the potential of new technology

(ii) Savage price competition

(iii) New cost-volume elasticities in manufacture and new price-volume elasticities in new markets

(iv) Different skill embodiments

(v) Relocation of different stages of production internationally, with considerable (ie greater than $200m) savings in balance of payments for individual countries

(vi) Diminution of market turnover and labour requirement

(vii) Decreased economic activity in previous outlets and activities

(viii) A differential impact of these consequences

All of these points are relevant to printing and point (i) is repeated in full:

"Total disbelief by established watch assemblers and their suppliers in the potential of the new technology, citing prestige, quality, protected outlets with high margins, marketing know-how, absence of appropriate repair and maintenance facilities as barriers."

Perhaps in 1995 someone may make the same statement substituting "printers" for "watch assemblers"?

The observation by Evans (1979) and others on the convergence of technology uppears to be a key theme for consideration in any attempt to forecast the future of the printing industry. This convergence of technology means that the objectives and capabilities of quite different industries are now coming closer together. The publishing, printing, telecommunications industries are all involved in the processing and dissemination of information. The office/business equipment and computer suppliers are also becoming closely involved in fierce competition to provide the equipment for these information disseminators.

This convergence of technology is founded on the use of digital electronics. The digital computer has been applied to an increasingly diverse variety of tasks. At the same time the growth in the use of digital techniques has been phenomenal. Allied to this growth in the use of digital computers are the techniques in electronics which have led to the development of the micro-chip. The introduction of the micro chip and the fierce competition between suppliers of equipment based on micro-electronic circuits has led to a rapid fall in computing costs.

Therefore the convergence of technology is founded on the utilisation of digital electronics. Holloway (1981,1) suggests three advantages that digital techniques possess when compared to analogue techniques:-

(i) Precision of input and control
(ii) Flexibility of input, output and operation
(iii) Communication with machine

Digital electronic signals are discrete and sophisticated methods have been developed for the automatic detection and correction of errors. Digital signals can be recorded on a variety of media or transmitted over short or long distances. They can be utilised to accomplish an increasingly wide range of tasks. Finally digital signals are machine readable.

The latter point is the key to developments in machine intelligence. Sophisticated programming has resulted in the computers that give an appearance of 'understanding' information. The work of Winograd (1976) shows the difficulties to be overcome before machines can be used to perform relatively mundane tasks, but at the same time shows the substantial progress that has been made in this direction.

The present generation of computer-based equipment that is likely to be used by printers or their rivals does not have to reach the sophisticated level of the machines described by Winograd (ibid). Nevertheless word processing and electronic composition equipment gives an appearance of intelligence, performing tasks such as hyphenation and justification that were previously achieved only by man. Future systems are likely to include other, more sophisticated tasks such as page make-up.

Another way of looking at the convergence of technology is to emphasise the versatility ((ii) Flexibility above) of digital techniques. Thus the same basic components can be utilised to provide enhanced facilities for conventional printing and publishing, rival methods of printing or electronic media. Chapters 6 and 7 indicated how these basic components could be integrated in systems that could output by conventional or non-conventional printing or onto display screens. When used in conventional printing and publishing these electronic systems appear to offer the means of improving efficiency in production. In the face of competition from both rival media as described in Chapter 4 and foreign printers it appears necessary for the UK printing industry to utilise the digital electronic equipment described in Chapter 5. At the same time it will be necessary for companies to provide enlightened management.

It is difficult to imagine any such re-structuring without a reduction in manpower on 1979 levels. However the monetary policies of the Thatcher Government have already resulted in large scale redundancies in the printing industry. Large scale introduction of new technology in the printing industry could partly off-set the reduction of manpower in printing that has been caused by present Government policy.

If large scale introduction of new printing technology does take place then the skill requirement of manpower in printing will change. As indicated in Chapter 5 and 6 there will be new requirements for maintenance personnel with electronic rather than mechanical engineering skills.

The printing industry will remain most competitive in the production of higher quality printed material, particularly colour. It is also likely to retain speed advantages when used to print a large number of copies of a publication.

Changes in consumer attitude as well as advances in technology indicate that in some product sectors rival technologies and media could replace printing in whole or part. Competition from rival media could help to accelerate trends already noticeable e.g. newspapers are increasing the amount of editorial content compared to the amount of 'news'.

A generation of information seekers is emerging that is accustomed not only to watching television but to using TV games, home computers and teletext/viewdata. It appears likely that these will develop different attitudes to news media than those of the present newspaper reading public.

The UK printing industry at the end of the 20th century is likely to be smaller than present and utilising a much higher proportion of electronic equipment, particularly in the pre-press area. It will face fierce competition from foreign printers and from non-conventional printing and alternative media.

Taking into account the information gathered in this chapter and Chapters 4, 5 and 6 the technology status in the 1990's is likely to be as follows:-

(i) Printing

Little or no change to press speeds but microprocessor controls will ensure more consistent quality. The major changes in printing will occur in the processing stage and conversion sub-stage of the information transfer model. In printing terms composition, graphic reproduction and plate/forme production will be affected. These will be integrated in a computer-controlled production system.

(ii) Alternative printing

The various substitutes for printing as described in Chapter 4 will improve in speed and quality and also offer colour printing. The major advantages of these methods will be their linking to print-on-demand systems.

(iii) Electronic media

There are unlikely to be major changes in viewdata and teletext systems although the inclusion of still television - quality pictures will be standard. The major developments are likely to be in linking various technologies together so that the television set becomes the focus of a large number of information providing services; television; teletext and viewdata, home computer, games console, remote booking of tickets and money transfer.

The major advantages of conventional printing would be quality, lower cost of producing a large number of copies and higher quality colour.

The large-scale introduction of these technologies depends on economic and social factors.

The following scenario is proposed for developments during the period up to 1995. It is assumed that there will not be any drastic changes to the world and U.K. economic situation in the time period. Despite the recession there is still a high level of consumer spending and it is assumed that this will continue.

Publishers will continue to diversify into non-conventional printing. This is likely to lead to two distinct groupings by size; very large groups with interests in a variety of publishing fields but particularly newspapers and electronic media, small newspaper publishers and businesses using new technology for printing on paper. The growth of special interest magazines could be followed by special interest newspapers. Advances in pre-press printing technology could aid in this by offering rapid changes to the content of each edition and reduce the number of copies of each edition that need to be produced for optimum economic performance. The page dimensions of newspapers could be reduced.

The number of printing enterprises could be slightly reduced. Although there would still be a number of small jobbing printers operating old-fashioned presses, most printers would utilise modern technology. Continued consumer spending on printed material would be directed to high quality colour printing and special interest newspapers and news magazines.

There would be further growth in instant print shops. These would almost entirely replace the jobbing printer. In-plant printing (apart from where used by the packaging industry) would be re-geared to non-conventional printing. Large in-plant printing establishments could be sold and a switch made to non-conventional printing methods or printing sent to an outside printer.

Supplier companies of complete equipment would compete in a market where there was an increasing overlap of technology. This could result in a situation where e.g. little difference could be perceived between a word processor with data processing capability or a small computer system with word processing capability. Suppliers would offer a unit with a VDU and keyboard and options of various models for functions such as word processing, accounting, mathematics, filing etc.

The consumer would have access to a wide range of information via the home television set. Teletext and viewdata would offer improved services while computer supplier companies could provide equipment that could store and retrieve information recorded overnight. Peripherals could include a print-out of data required in hard copy form.

8.6 Summary

The available information suggests that the status of technology is sufficient for major changes in printing and publishing. There is also evidence that social attitudes to new media are changing and publishers are considering these new media as alternatives to printing. The economic evidence points to the use of computer driven technology for information processing and distribution. The major question is whether printing companies can utilise computer methods at the processing/reproduction stages of the information model to preserve their lead in the field of publishing information because alternative media or alternative printing methods have advantages at the distribution and reception stages of the model.

CHAPTER 9

CONCLUSION

9.1 Introduction

Section 9.2 provides a summary of the thesis followed by an appraisal in Section 9.3. Some suggestions for further research are then made in Section 9.4. Section 9.5 concludes the thesis with a discussion of some implications for the UK printing industry.

9.2 Summary

This thesis was initiated by a research proposal from Pira to IHD in 1978 (see p 10), with the objective of examining the future role of the printing industry in UK. The research project would involve technology assessment, forecasting and the social and economic implications of the impact of new technology.

Such a wide-ranging proposal was open to many interpretations. This thesis has followed the main theme of the proposal although there may be some differences in detail.

Research for this thesis was mainly conducted within the Techno-economics Group at Pira. This group, produced reports that differed from the 'hands-on' research reports produced by the

three industrial divisions of Pira. Techno-economic Group produced statistical and economic reviews, sector studies and assessments of new technologies. It was in association with the latter that research for this thesis was carried out.

The three main Techno-economics Group reports compiled in association with this thesis were reports A, B and C described on pages 15-17. Synopses of these reports are given in Appendices 1, 2 and 3. In addition to these reports, two projects (see Reports D, E p18) were proposed which would have provided useful inputs to the thesis. Unfortunately, funding was not available and these two projects could not be instigated. In the absence of suitable projects a contribution was made to a Pira project on Document Delivery Services (see Report F p 18). Research material from this report was not suitable for inclusion in the thesis.

A number of methodologies were considered in researching this thesis. Statistical forecasting techniques were not selected due to the inadequacy of available statistics on printing. Simulation was not chosen because there was no previous work in printing that could have provided a suitable platform on which to build a simulation model. To have constructed such a model from scratch would have been impossible within the constraints imposed by working for a commercial organisation.

Two methodologies were selected for this thesis. In technology assessment the methodology of the Techno-economics Group was adopted. A model of information transfer relevant to publishing was proposed and used as a framework for coordinating the varied types of information pertinent to a forecast of printing.

A review of communications models showed that there was a lack of general quantitative models, particularly in reference to publishing. A model was proposed which divided information transfer into five stages; origination, processing, reproduction, distribution and reception. The model was developed taking account of a case study of a provincial newspaper.

The proliferation of micro-electronic based equipment and the flexibility of such equipment has helped to erode the bounderies between the business and office, computer and telecommunications supply industries. There has been a convergence of technology as a result of which there are now viable alternatives to traditionally printed products. These alternatives incorporate both substitutes technologies for producing print-on-paper and substitutes for paper products. 18 alternative technologies or competitors to the printer could be identified.

The UK printing industry is the largest in Europe although there has been a sharp drop in the number employed by the industry since the mid-70s. The majority of UK printers employ less than 50 employees.

Publishing and printing, while distinct activities are closely associated and many companies integrate both functions. Publishing, like printing is characterised by the large number of small companies. However, there is a tendency for publishing to be concentrated in large company groups. Takeovers and mergers continue to occur in this industry. Many publishers both large and small are investigating the potential of electronic media and alternatives to traditional printing for print-on-paper products.

A recent phenomenon has been the success and growth of small circulation, specialist magazines. This contrasts with the demise of some large circulation publications. A key factor in the analysis of different publishing sectors is whether or not advertising forms a significant part of revenue.

New printing technology has received considerable attention recently. One of the reasons for interest in new technology and a major cause of industrial disputes was that the present generation of equipment had a greater potential for manpower savings than previous printing equipment.

Letterpress printing had declined and lithography and gravure had

grown at its expense. The introduction of electronic press controls had led to improved productivity. The most manually intensive operations occur during binding and finishing which may account for up to 40% of total manpower in a printing plant.

Technological innovation in the areas of press, binding and finishing equipment was evolutionary. The new technology being introduced in pre-press was potentially revolutionary. The many separate types of electronic equipment available for the capture, storage, processing and output of text and graphics could conceivably be integrated in a single system. Such a system would completely transform methods of production.

Alternatives to printing for producing print-on-paper products had been more expensive and took longer to produce long-run jobs and were lower in quality. Improvements to this type of equipment had made them more competitive. Resolution and output speeds were increasing.

Electronic media were also limited by quality. In addition the quantity of data which could be displayed was restricted. Microelectronics would have a dramatic effect on manpower in the printing industry. New equipment would cause the elimination of many jobs and erosion of many craft-skills. This would lead to redundancies and necessitate re-training for many employees. At the same time the skill-level and status of some jobs could be enhanced e.g. compositors taking over some of the functions of editor.

The need for an electronic-based maintenance force could lead to intense inter-industry competition for these skills. A predicted shortage of personnel with the requisite skills was likely to lead to each industry re-training its own work force. The printing industry was badly placed in this respect since there was a complete contrast between traditional craft-based skills and electronics-based skills.

New technology was also causing changes for the recipient of information. Electronic media offered instant information and also allowed the recipient a measure of control of the distribution of information.

The historical development of graphic communication could be divided into tactual, mechanical and cybernetic phases. The 1960s had seen the commencement of the cybernetic phase which would eventually encompass the complete automation of the origination, processing, reproduction and distribution of information.

A number of forecasts had been published in the past few years pertinent to this thesis. There was general agreement that new technology would have a major effect on printing and publishing. The new technology had advantages of improved productivity, ease of use and better distribution capability. It would cause changes of job skills, some jobs would disappear and new ones emerge, in many instances with a higher level of skill.

Socio-economic factors could assist the take-up of new technology which had initiated as a technology push phenomenon. For example, the increased cost of silver was a factor in making electronic aids to graphic reproduction and platemaking financially attractive. Society was changing, new reading habits were being developed and there was increasing acceptance of new media. This would have a considerable impact on the market for printed products.

The printing industry of the UK in 1995 was likely to be slightly smaller than at present. There would be greater use of new printing technology in the face of fierce competition from non-convential printing and new media.

9.3 Appraisal of results

Research conducted for this thesis has spanned many disciplines, including computer science, telecommunications, physics of printing, communications, sociology and management science. Methodologies were selected from many fields of research including, operational

research, system analysis, econometrics, social survey research and technology assessment. It was necessary to acquire a detailed knowledge of printing and publishing and the technological innovations that are having a dramatic impact on these industries. Therefore, in the course of research for this thesis, Holloway acquired a unique accumulation of knowledge from a wide range of disciplines and sources. This enabled him to gain an insight into the problems of the printing industry which would normally be out of reach of the specialist researcher or indeed graphic arts personnel. This thesis is representative of this accumulation of knowledge, collating as it does, information from many disparate sources.

It is expected that this thesis will help to disseminate information on the graphic arts to other sectors of industry as well as academia. In particular it allows access to Pira sources of information. These are not normally accessible to non-Pira members. This information is transferred in two ways. First, it is incorporated as an integral part of the main body of the thesis. Second, Appendices 1-3 are synopses of Pira reports published at higher prices than can be afforded by most libraries or institutes. The three reports upon which these Appendicies are based were initially priced in the range £120-£650 for non-Pira members.

The review of information transfer models in Section 3.3 of the thesis indicates that although there are many models of differing nature and scope, none are suitable for general application. In particular, publishing appears to have shunned the use of modelling techniques except for some limited econometric modelling. In view of the dramatic impact that new technology is expected to have on printing and publishing there is a need for a methodology or evaluation instrument to assist in the assessment of different production methods.

Chapter 3 introduced a new model of information transfer relevant to publishing. This has been developed to a stage where it would be useful in guiding management of a printing/publishing company through a systematic assessment of new technology. The model takes

account of both the quantitative and qualitative nature of decision-making with regard to technological innovation in printing and publishing.

In summary this thesis makes an original contribution to knowledge in three ways. First, it enables the dissemination of a body of knowledge accumulated from a wide variety of sources, some of which are not normally accessible. Second, it identifies a lack of suitable research instruments for evaluating new technology in publishing. Third, it proposes a model which could help to fill this void.

It has been noted several times in the thesis that the available statistics on printing are not suitable for a detailed analysis of new technology. The main weakness is that there is a lack of refinement in these statistics which cannot be broken down for use in models such as that proposed in Chapter 3. The statistical sources of other countries, in particular USA and West Germany are generally superior to those of UK. However in the treatment of printing and publishing statistics of the type referred to here, they also lack refinement. In the USA, respected researchers such as Machlup and Leeson (1978) and King et al (1979) have pointed out the difficulties they have experienced in compiling statistics for their research into publishing.

All four Pira publications in which Holloway participated were successful.

Pira published a follow-up to the ten-year forecast concentrating on developments in electronic composition and graphic reproduction.

Pira also published a follow-up to the report on document delivery systems.

All sponsors of the multi-client study on Speech Input and recognition systems expressed satisfaction with the report. It is interesting to note that one of the sponsors has now marketed its

own speech input system.

The on-sale publication "The Electronic Merging of Text and Tone" received good reviews in the UK trade press. Its sales compared favourably with similar Pira reports and copies were sold overseas in Europe, USA and Australia.

The reports summarised in Appendices 1-3 were published between 1979 and early 1981. All contain some element of forecasting and it is worth noting that these forecasts are holding up well in 1983.

9.4 Suggestions for further research

The information transfer model proposed in Chapter 3 of this thesis has been developed to a stage where it could be applied in various ways.

The model was initially proposed as an aid to comparing different methods of production and publishing via different media. This warrants further examination. In order to pursue this objective it would be necessary to identify and receive the cooperation of at least one publishing company which utilises a number of different methods of production or different media. Information could then be obtained in-house and the model tested for usefulness as a comparator by obtaining the views of the management of the company.

The format of the model shown in Table G on page 72 could form the basis of a survey of publishing/printing companies. The information obtained would thus be in a suitable form for computer storage and analysis. If a sufficiently large number of companies could be stimulated to provide returns then this survey could also go some way towards overcoming the present deficiencies of printing industry statistics mentioned in the previous section.

The use of the model as an aid to decision-making need not be limited to the publishing industry. The increasing variety of methods of storing, processing and distributing information coupled with the forceful promotion of information technology has multiplied

the problems faced by managers responsible for the information requirements of a company. The model and the scheme for its use in decision-making given on page 74 could be helpful to management analysing the information system requirements of a company.

9.5 Implications for the printing industry

The alternative industries and technologies discussed in Chapter 4 together with the changing attitudes of society towards media discussed in Capters 5, 6 and 7 will have a dramatic effect on printing and publishing.

The comments directed at printing companies which follow will also apply to integrated publishing/printing companies. Publishing companies which do not own their own printing works will be in a more fortunate position, although they will still need to be aware of changing markets, buying patterns and production methods.

The printing industry is unlikely to disappear overnight. Printing has dominated communications since the introduction of the printing press in the fifteenth century. However, by 1995 the industry will be smaller and more efficient than at present. Its size has already been reduced by the recession and the strict monetary policies followed by the UK Government since 1979, although the remaining companies are not necessarily efficient at present.

Faced by increasing competition from both alternative technologies and foreign printing companies which have adopted new technology, UK printers will have to reassess their marketing strategies and production methods. In doing this they would be wise to adopt a more systematic approach than is evident in many of the printing and publishing companies, not only in UK but throughout the world. Companies which are successful in introducing new technology, such as outlined in appendix A.3.3, form a minority. The majority of printing and publishing companies in UK appear to muddle along, particularly in their attitude to new technology. Where new equipment is introduced it is usually after it has been seen to work well in other companies. This safety first policy may be

satisfactory where the market is stable and competition is limited. In a fiercely competitive market, however, this approach appears foolhardy.

The introduction of new technology is itself beset with difficulties. The trials and tribulations of Fleet Street newspapers in regards to the introduction of new technology have received considerable publicity. However, these are not the only publishing/printing companies in UK which have difficulties in introducing new technology. There have been numerous other instances which have received little or no publicity. Printing companies have taken delivery of new equipment which has had to be returned to its supplier without being used. In many cases the equipment has not even been unpacked.

Whether these pieces of equipment were returned because of union opposition, unsuitability of equipment, or equipment malfunction the responsibility lies with the purchasing company and poor management decisions must have been made. In order to avoid this a more systems-oriented approach to decision-making by management of publishing/printing companies with respect to new printing technology. is needed. The model introduced in Chapter 3 of this thesis and particularly the approach suggested in 3.7 would help to guard against many of the pitfalls of decision-making with regard to new technology in printing.

It has been suggested that it is unwise to consider a major investment in new technology during a recession. Obviously this will depend upon the particular needs and capabilities of individual companies. The case studies of new technology in printing carried out by Holloway (1981) (summarised in A3.3) indicate that the introduction of new technology in a recession can be a springboard to success. The trade house described has since confirmed its belief in new technology by purchasing the electronic colour page make-up equipment it was considering at the time and the company has continued to meet with success. The French general printing company has been very successful and is now one of the largest in

France.

The introduction of new technology both within and outside the printing industry will change the status and skill requirements of print workers. An increasingly sophisticated output is possible utilising alternative technologies. This will challenge the concept of the printer as being the only person able to supply a quality print-on-paper product. The anomalous position of the compositor within society will also be challenged. The printing industry has given rise to a class with working class roots and identification, together with middle class wages, status and aspirations. New technology will free the compositor from mundane skills e.g. spelling corrections and offer the opportunity to apply a higher level of skill. Thus the role of the compositor would be moved closer to that of sub-editor.

The role of the printing industry of the future will be mainly to supply only one of the output options of computer-stored text and graphics. Control of typography and other factors is moving closer to the originator. However, printing companies which recognise this will be in a strong position. By utilising the flexibility of new technology, taking advantage of their own specialised skill and identifying their best markets the printing industry should continue to be an important part of the communications infrastructure of the UK, at least to the end of the century.

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Appendix 1 Pira/PPITB Forecast of Printing Technology (1979)

Appendix 2 The Impact of Speech Input and Recognition Systems on the Communication Industries (1980)

Appendix 3 The Electronic Merging of Text and Tone (1981)

APPENDIX 1

SUMMARY OF CONTRIBUTION TO PIRA/PPITB TEN YEAR FORECAST OF PRINTING TECHNOLOGY.

A1.1 Introduction

Section 1.4 of the thesis included an outline of Report A, the Pira/ PPITB forecast of printing technology. This appendix provides a more detailed description of the parts of this report (Blunden et al, 1979) relevant to the thesis. Holloway worked as part of the project team and co-author. In particular he was responsible for writing chapters of the report concerned with technological factors, composition, graphic reproduction and platemaking.

A1.2 Technologies likely to impact on printing

Chapter 4 of the report provided an overview of economic, social and technology developments. Part II of this chapter focussed on technological aspects. Facsimile, lasers, developments in telecommunications such as packet switching and optical communication, digitisation, computers and microprocessors were selected as technologies which would have both a direct and indirect effect on printing and publishing.

The review of facsimile covered both commercial facsimile and the

application to remote printing. A brief description and history of facsimile was included.

The versatility and advantages of lasers were emphasised. The laser if more than, 'just another light source', as it has often been described by graphic personnel. The physical characteristics of the laser beam enable its use for burning, cutting and welding. It can easily and rapidly be directed with great accuracy to any desired point.

Various applications of the laser were given in Metrology (alignment, surveying, distance measuring) and Fabrication (cutting, perforating, welding) as well as Communications and Printing. In Communications, lasers involved in storing and distributing information. Holography could see application as computer memory. Lasers could be used as generating stations in optic fibre communications. A commercial application under development was the Philips disc storage system, read by laser.

In printing the laser was used in a number of innovations. Monotype's phototypesetter, the Lasercomp, used a helium-neon laser for output. The Eocom Laserite incorporated two lasers; one to scan copy and the other to expose offset-litho plates. The ECRM Autocon electronic camera was used in make-up for newspaper production. Rubber flexographic rollers could be engraved from scanned copy using a system which utilised two lasers, one to scan the copy and one to engrave the roller.

Lasers were used in a number of graphic arts scanners from manufacturers Crosfield, PDI and Hell. Other applications of lasers were in copiers e.g. IBM3800 and Computer Output of Microfilm (COM).

Crosfield were developing a laser device, Lasergravure, for engraving gravure cylinders. Some of the difficulties that had been encountered in the initial commercial application of lasers were being overcome; health and safety aspects had improved; equipment incorporated automatic cut-out if mishandled and regulations were well documented. Lasers were more robust and compact than previous

models. More accurate and reliable methods of changing the path of the laser beam had superseded mechanical methods in many instances.

A brief explanation of the working of lasers was given.

In telecommunications, five developments were observed; facsimile, teletext, digital techniques, packet switching and optical communications. The first two topics were covered elsewhere in the report. The potential of space satellites and cable TV in telecommunications was also noted.

Several advantages of packet switching were noted; efficiency could be improved by a factor between 3 and 100, it enabled the connection of terminals that operate at different speeds and error correction techniques could be built-in.

The enormous capacity of optical communications was indicated. A bandwidth capable of carrying 100,000 million bits/sec was possible compared with 72 million bits/sec of microwave and only 60,000 bits/sec on telephone voice channels. There had been enormous technical improvement in optical fibre communications. Prior to 1970 losses over optical fibres were measured in thousands of decibels/km but these had been reduced to less than 1 decibel/km.

In addition to the high capacity, optical channels possessed other advantages; freedom from interference phenomena such as crosstalk and powerline induction, optical fibres were much lighter and easier to handle than cables, links with lasers and holographic memory offered exciting possibilities.

There was a trend to greater use of digital techniques. This was made possible by the presence of digital computer processing but the increased use of digital techniques could be ascribed to the advantages of digital over analogue methods. The following advantages were offered; greater immunity to interference, voice and data could be merged in one channel, errors could be detected and corrected. Perhaps as a result of its greater use digital transmission and multiplexing was becoming cheaper than equivalent analogue methods.

The computer and microprocessor were seeing greater application in the graphic arts. The application of computing techniques to typesetting had been successfully achieved in 1962 using hot metal composition. Since then there had been greater use of photocomposition due to its superior interface with the computer. This had been a factor in the decline of hot metal composition.

The cost and size of computers had been decreased dramatically in 20–30 years. Three types of computer could be distinguished mainframe, mini-computer and micro-computer. The low cost of the microprocessor was noted. However, it was pointed out that the development cost for each application could be up to a thousand times the cost of the chip itself. Microprocessor development could be achieved in-house or by consultancies specialising in this field.

Large companies could afford to develop microprocessors in-house but it was better for smaller companies to employ outside consultancy.

Computers required memory for two purposes; to record the programs which ran the computers and to store data. Data storage was usually provided by magnetic media in three forms; tape, rigid disc and floppy disc.

Experimentation was continuing to improve memory facilities. Two possibilities receiving widespread attention were charge coupled devices (CCD) and bubble memory.

A1.3 Electronic Composition

Chapter 5 of the report examined developments in composition. A review was given of the equipment available for composition including, where appropriate, a description of the technology used. This was followed by an assessment of technology and likely trends. This assessment was developed and expanded in 28 trend statements or hypotheses together with their implications.

The introduction of electronic equipment was making it difficult to

differentiate between composition and graphic reproduction. Therefore the chapter focussed on data capture, processing and formation of pages, computer storage of full pages or their output in camera-ready form.

Keyboards would continue to be the principle means of in-putting data. The standard typing keyboard or Qwerty layout was used by most suppliers. Some suppliers could supply a 90-key Linotype layout as an option. These keyboards were not designed ergonomically. For example the Querty layout allocated two-thirds of the work-load to the left-hand. An alternative layout was the Maltron keyboard which had been designed to speed up the input of data by better grouping of the most commonly used characters.

Further developments in VDUs included the introduction of portable models. All VDUs incorporated a CRT display. Experiments with liquid crystal and plasma gas discharge technologies were proceeding but these were not competitive with CRT displays.

Optical character recognition (OCR) was well established, particularly in the USA, as a method of converting copy to machine-readable form without re-keying. Errors could arise particularly if the copy was unclear or improperly oriented. There was a decline in OCR use a means of input to newspaper typesetting systems, but it was likely to continue to be used in specialist applications e.g. directory publishing since it offered a cost effective means of capturing large volumes of data.

Voice input was at an early stage of development. Vocabularies were limited and a possible application to composition could be tabular setting but this had not been attempted.

A limited number of hot-metal line-casting machines were built in 1979 and the manufacture of this equipment was likely to end soon. Spares would continue to be produced for existing equipment but most machines in use in UK were likely to be at the end of their useful working life in five to seven years. Sales of monotype equipment, used mainly by commercial printers, were also declining.

Sales of direct-entry phototypesetters were increasing. The reasons for this were their relative low cost and simplicity of use. Between 1974 and 1978, 25 units were introduced to the UK market so that in all there were 32 models available from 11 companies. These machines were suitable for the small to medium-size printer and since they were quiet and clean could also be used in an office. All direct-entry phototypesetters employed 'second generation' technology; i.e. projecting an image of a master character onto the film and changing point size by an optical system usually employing a zoom lens. Setting speeds of up to 70 newspaper lines/min were possible.

The term 'direct-entry becoming inappropriate in some instances due to the introduction of off-line correcting terminals. Since these were also suitable for primary input some direct-entry phototypesetters were capable of forming the centre of typesetting systems. Manufacturers offering such equipment were AM, Compugraphic and Linotype.

The association of word processing (wp) and typesetting was growing in importance. Two manufacturers had introduced interfaces to enable wp systems to input directly to typesetters.

Various off-line terminals were available for capturing data for typesetting systems. Magnetic memory, in either casette type or floppy disc form, was replacing paper punch tape. Some of the more sophisticated terminals could also be operated on-line to the typesetter. Off-line front-end systems were distinguishable by being dependent on the command structure of the typesetter.

On-line systems were of two types; 'batch' systems (e.g. Miles 33, Imlac) or 'inter-active' systems (e.g. Ferranti CS7, Syntext, CCI). All on-line systems had powerful format and file management capability and possessed a command structure that was not dependent on the typesetter. This enabled more efficient use of the typesetter and in some instances work could be produced that was not normally possible e.g. multi-column work on a typesetter lacking reverse leading.

Batch systems accepted text and commands as a continuous stream. Editing and correcting were carried out prior to hyphenation and justification. However, inter-active systems continuously carried out hyphenation, justification and interpretation of commands, and displayed the result, providing the operator with a clearer indication of the final appearance of the text. Therefore, it was easier to handle complex work on 'inter-active' systems.
Newspaper typesetting systems could be classified as editorial or production systems. Editorial systems worked in 'batch' mode and incorporated very powerful file management capability. The primary function of an editorial system was to input and manipulate text quickly. Output to the typesetter was a secondary consideration and typesetter commands were usually inserted by format statements. The powerful file management capability meant that a number of other functions could be performed such as; direct input and sorting of advertisements, automatic acceptance of wire service copy, sales analysis and distribution planning.
Personnel operating an editorial system had a number of different job roles: journalists, editors, compositors, tele-ad operators, managers and data processors. In contrast, production systems were currently operated by compositors. These systems worked in either 'batch' or 'inter-active' mode. The emphasis was on the typesetting and page make-up function and file management tended to be less sophisticated than that of editorial systems.

The main function of off-line editing terminals was to correct work previously keyed-in on a simple keyboard. These terminals had formatting facilities and features such as; search, move paragraph etc. There had been little significant improvement to off-line editing terminals for some time.

Some on-line systems had special editing terminals with the features indicated above but in many systems editing was carried out on a standard terminal used for input and editing.

Proofing was carried out usually by line printer. This had the disadvantage of not giving an indication of the job layout. Matrix printers had been developed which showed the job layout.

Proof-reading was a labour-intensive activity and some systems incorporated a spelling check.

Phototypesetters could be classified by; recording technique, type of control mechanism or technology status. The latter method of classification was widely used. A similar method was used to classify computers. Equipment was categorized according to the historical link with the technology employed. First generation machines copied the steps in the hot metal composition process. Second generation equipment utilised a negative film master on a disc or drum and point size changes were made by means of an optical system. Third generation machines held characters in digital form and electronic methods were used to enlarge, reduce, slant or embolden. The current stage of development had reached a fourth generation with the introduction of the laser phototypesetter.

Direct entry and some 'stand-alone' typesetters still employed second generation technology.

A major objective of systems supplies was the development of electronic full page make-up. A number of systems were already available for automatic pagination of books. However, it was difficult to provide an adequate display of the page when setting a mixture of text and graphics, due to the limits of resolution of the display screens. An alternative was to provide a mock-up of the page with text indicated by lines and graphics by spaces or boxes. Display-ad terminals were available which provided a high level of interactivity for the manipulation and positioning of graphics. However the application of similar techniques to general page make-up of newspaper and magazines was still under development. Only three suppliers offered this type of equipment and installations were experimental. These systems had not established wide acceptance in the market place because they were expensive and doubts were expressed regarding speed advantages over paste-up methods and the efficiency of copy fitting programs and command structure.

A major objective of the report was the identification of trends. 28 trend statements were refined for composition.

1 There will be a decline of hot metal composition

2 OCR will continue to be used but in special applications only

3 Keyboards will not change significantly

4 Voice input to phototypesetting systems will not be in common use within the 10-year forecast period

5 CRT will be the main method of display on terminals but the method may be replaced for full-page display

6 Electronic composition will continue to grow rapidly

7 Large computers will be replaced by micro-computers and mini-computers in electronic composition

8 Cost of random access memory and other memory will continue to decrease

9 There will be a move to inter-active on-line working

10 There will be increased use of digital storage and handling of text and graphics

11 Paper tape will be phased out in off-line systems, being replaced by magnetic memory

12 There will be increased use of distribution intelligence, either built-in or in some systems achieved by a fully inter-active on-line working

13 Lasers will be increasingly used for input and output of text and graphics

14 Facsimile use in newspapers will increase

15 Graphics output will be a standard optional extra on the top range of phototypesetters

16 The upper range of typesetters will be slave devices

17 All phototypesetters except for cheaper direct-entry, will be laser or CRT, with digital fount storage

18 There will be increased use of direct-entry equipment

19 Output of lower cost typesetters will become increasingly sophisticated and equivalent to present day small on-line systems

20 The end result of composition will not only be a silver halide film or emulsion. It will be one of several media

21 Full page make-up by electronic means will be increasingly available

22 Copy-to-forme systems will become increasingly available

23 There will be further developments of interfaces between word processors and typesetters

24 There will be little change in proofing methods

25 Equipment manufacturers will not standardise to enable easier interfacing

26 There will be no revolutionary changes in electronic composition equipment, but this will become more reliable

27 There will be increased use of telecommunication links in information publishing

28 Increasing use will be made of electronic storage of information to provide reproduction in a printed form on request, ie print-on-demand

Each statement was supported by statistics and references and implications drawn.

A1.4 Graphic reproduction and platemaking

Chapter 6 of the report was concerned with graphic reproduction and platemaking. A review of the equipment and technologies was first given. This was followed by an assessment of technologies which was developed and expanded in 21 trend statements or hypotheses in a similar manner to the work for Chapter 5.

Optical design had reached a level of development where a lens system could be supplied for any graphic reproduction purpose. However, one advantage was that each lens system was task specific. An interesting development was the introduction of a graphic reproduction zoom lens by Canon.

Quartz-halogen and pulsed-xenon lamps had largely replaced carbon arc lamps as light sources for cameras and enlargers. In contact printing, point light sources were used for small/medium contact areas and banks of fluourescent lights for large contact areas. The introduction of new photographic materials for daylight working and proofing necessitated light sources of spectral distribution within or near the ultra-violet region.

There were approximately 200 models of cameras and enlargers for graphic reproduction available in UK. The main trend was to the provision of electronic control of equipment; illumination levels, lens aperture and focal length, fitter selection and exposure time could all be set automatically. The advantages of automatic control were that the operator was freed from routine tasks, results were more consistent and productivity/profitability were likely to improve.

The high cost and predicted scarcity of silver had resulted in the adoption of silver recovery methods. It had also been a factor in the development of alternatives to silver-halide photographic products. These were up to 50% lower in cost than conventional material. In addition they were easier to handle and could be processed automatically, without the need for a darkroom.

The number of scanners used in colour reproduction was growing. In 1977 it was estimated that there were over 160 in UK. In May 1979 the number of Magnascan Scanners alone was 125.

A wide range of plate material was available and varied according to the printing process employed, nature of the product and, to some extent, individual preference. A variety of substrates were used depending on run length; paper, paper and plastic, polyester or metal. Run lengths ranged from less than 1000 for direct-image paper plates up to one million impressions for anodised aluminium and tri-metal plates. Pre-sensitised plates were becoming increasingly popular. There was continued interest by a number of manufactures in the development of a waterless lithographic plate.

Photopolymer materials were replacing metal in letterpress and rubber or rubber substitute in flexography. Flexography had also seen the introduction of direct engraving of rollers by laser. The direct engraving of gravure cylinders was more difficult and it would be some time before this could be achieved. Crosfield were hoping for a breakthrough in this area after working for eight years on a direct engraving project.

Light sources for plate-making were similar to those described for cameras/enlargers although the selection of optimum source for a particular purpose could be more difficult. Plates could also be exposed by laser and four companies were manufacturing laser plate exposure systems. These were claimed to offer advantages over conventional methods of increased speed and saving in material and labour costs.

There was increased use of automatic plate processors which offered

the advantages of simplicity of working, consistency of results and material cost savings. These could either be separate from, or attached to, the plate exposure unit.

The distinctions between many of the individual stages in composition, graphic reproduction and plate-making were being eroded. New equipment often merged one or more individual stages. For example, copy-to-plate systems could produce lithographic plates from paste-up without photographic intermediate. Similarly gravure cylinders could be engraved directly from scanned paste-up. The computer-to-plate concept was feasible although no systems were on the market. Some manufacturers were known to be experimenting with the type of equipment which would eliminate many more intermediate stages together with associated job skills. Further ahead were print-on-demand systems which would eliminate the use of plate/forme.

Trends had been identified and were refined as 21 trend statements.

1 There will be little improvement in lens systems

2 Cameras and enlargers will increasingly be operated by push-button control

3 Processing, particularly for the small department, will be achieved in a clean, safe manner with little darkroom working

4 The search for non-conventional photographic products will continue with increasing success

5 The use of dry processing of photographic materials will increase

6 Improvements will be made to light sources for exposing photographic materials and plates

7 Cameras and enlargers will continue to sell well

8 There will be increased use of scanners

9 There will be more use of colour simulation

10 Digital processing of graphic data will be increasingly used

11 Zinc and magnesium will decline in use for economic and ecological reasons

12 New developments in lithographic plates will all be commercially successful

13 There may be standardisation of litho plate dimensions

14 Photopolymer plates will be increasingly successful in newspapers and in flexography

15 Plastic and other coatings for gravure cylinders will be perfected with image formation produced either photographically or by laser engraving

16 There will be increased use of filmless systems

17 Computer-to-forme systems will become available by 1985

18 There will be increased use of lasers in scanning and plate production

19 There will be increased use of colour in all applications of the graphic arts

20 The increase in HASAWA regulations will peak soon and be followed by a period of stability

21 Facsimile transmission in graphic reproduction will increase

Statistics and references were given in support of each statement and implications drawn.

A1.5 Conclusion

The trend statements given in Chapters 5 and 6 of the report were first identified in the literature and then refined in discussions with colleagues. The statements were then tested in a number of interviews with representatives of leading suppliers and users in UK and West Germany. Material was also gathered in a number of search conferences which utilised a type of brain storming technique. Thus the trend statements were confirmed by experts within the printing industry.

Several themes recurred continuously. There was the constant trend to automation. Computers were not just being used as control mechanisms, however, they also had an important role in the digitisation of information. Once converted to digital form it was easier to process, record and distribute information. As a result of these trends some of the traditional craft-oriented skills were becoming eroded as machines embodied these functions. Eventually printing and printers could become merely associated with output of printed matter instead of being closely involved with publishing as it had been for four centuries.

APPENDIX 2

SUMMARY OF CONTRIBUTION TO SPEECH INPUT PROJECT

A2.1 Introduction

The development of Report B (Blunden et al, 1980) was described in Section 1.4. Holloway worked as co-author and editor on this multi-client study, also liaising between the sponsors and NPL who were responsible for researching and assessing the current state of technology of speech input systems. The report contained eight chapters:-

1. Executive Summary.
2. Present theory and technology.
3. The current players, products and developments.
4. Applications.
5. Present and future markets and trends.
6. Implications for the communications industries.
7. Patents.
8. Literature sources.

There were four appendices:-

1. Phonetic terminology.
2. Signal processing.
3. Speech output.
4. Questionnaire to sponsors.

In addition to the liaison role indicated above, Holloway was

involved in an exchange of ideas with the NPL team and contributed about 20pp to the report, mainly in Chapters 1, 4, 6 and Appendix 4.

A2.2 Technology Status

The NPL research showed that voice input systems for computer - controlled equipment had been commercially available for nearly ten years. Early systems were restricted to isolated word recognition, typically distinguishing 10-50 words and achieving 98% or higher level of performance. Systems had to be 'trained' for each user by repeating each word a number of times. Over the years equipment had improved in performance and fallen in price. Improvements included shorter gaps between each word, some connected word recognition and input over telephone.

There were few products on the market. The market leader in number of units sold was Threshold Technology Inc. (TTI). This company sold the first commercial speech recognition product in 1973. Since then TTI had sold around 500 units of its standard product which was available in a variety of models offering vocabularies of 60,180 and 370 words at prices ranging from £7,000 to £42,000. A newer range of products offered a QUICKTALK TM feature that shortened gaps between utterances and effectively doubled the input rate.

Nippon Electric Company (NEC) offered a more expensive product (£37,000) with a 120 word vocabulary. This could recognise sequences of up to five words without gaps. In training mode words had only to be spoken once in most cases.

Dialog Systems Inc. offered speaker-independent equipment with a vocabulary of up to 1000 words for telephone use. Interstate Electronics Corp also offered an isolated word recogniser.

Applications for the above systems included data input, particularly in quality control, and package handling.

Low cost word recognisers were also becoming available. For example, speech input attachments could be bought for personal computers and

voice - actuated toys and consumer products were coming onto the market. Japanese companies were taking a leading role in applying voice facilities to consumer goods.

Research was continuing at a number of leading centres. IBM was thought to have one of the largest current programmes on speech recognition with a budget around $1m per year.

A2.3 Speech input and the printing/publishing industries

There were three areas where speech input devices could be applied in the printing/publishing industries:-

i. machine control.

ii. distribution.

iii. text input.

The adoption of speech input devices for machine control in printing and publishing was likely to depend on their increased use throughout industry. There were technical difficulties in applying such devices to press machinery due to the high level of background noise. One possible application was in dark rooms for control of lights and equipment.

Distribution was a more likely application of speech input devices. Many TTI devices were already used in package handling and could be employed in newspaper dispatch rooms. Many book suppliers were using computer systems for ordering and dispatch and speech input controls for these systems would offer advantages in speed and ease of handling orders.

It was much more difficult to see the application of speech input to text capture in printing/publishing. First, there was the technical difficulty of designing a suitable system. A large vocabulary was essential and it would have to recognise continuous speech. Second, there was the likely union objection to speech input equipment, which would probably only be overcome by large incentive payments. Third, there were human factors. It would be very tiring to speak all day

into a machine.

A2.4 Future use of speech input systems

Two scenarios were suggested for the widespread introduction of speech input systems. One proposal was that continuous speech recognition could be applied only as an add-on refinement to large computer systems, since it required a high level of computing power. This type of system would lend itself to adoption in publishing where computing systems already have powerful memories and look-up dictionaries. Keyboards would continue to be used for editing and this would appeal to unions in that they would retain a bargaining point in negotiations with management.

The second proposal was that the falling cost of microelectronics could help to introduce speech input to a mass-market. A factor in favour of this scenario was the low cost of microphones compared to other transducers. The stored vocabulary of such equipment would be limited but a facility for spelling words could help to overcome this limitation. Manufacturers were seeking to create 'user-friendly' interfaces between man and machine and this favoured the introduction of speech-input devices.
An incentive for the development of speech-input devices lay in relative rates of keyboarding and speech. To achieve a rate of 80 words/min. on a keyboard required great skill and dedication but the average rate of speech fell between 80-200 words/min.

Once speech was captured in machine-readable form then data compaction techniques could be applied thus reducing the time and cost of telecommunications transmission. It would also be relatively easy to output in written form. Therefore, speech input could be usefully allied with electronic-messaging systems.

A2.5 Conclusion

Speech input was likely to be introduced as an industry-and society-wide phenomenon rather than specifically for text capture in the printing/publishing industries. Therefore, it would reinforce the trend of composition moving away from the printer and closer to the author.

APPENDIX 3

THE ELECTRONIC MERGING OF TEXT AND TONE

A3.1 Introduction

Appendices 1 and 2 summarised contributions to reports that were produced by project teams. In contrast to these, Holloway was solely responsible, apart from editorial advice, for researching and writing Report C of Section 1.4, "The Electronic Merging of Text and Tone." Responsibilities included; conception and format of the report, identification of leading suppliers and experts to be visited and drafting of promotional literature. The report, an on-sale publication of about 160 pages contained eight chapters:-

1 Executive Summary
2 Aspects of the Use of Digitisation in Graphic Arts and Potential for Text-tone Merging
3 Literature Study
4 Selected Companies and Products
5 Route to Plate/Forme
6 Case Studies
7 Technology History
8 Key Issues and Forecast

There were three appendices:-

1 Addresses and Contacts

2 Patents

3 Introduction in Digital Techniques

A3.2 Technology Status

There was no equipment on the market that could be described as an 'integrated text/tone printing/publishing system.' However there were many items of equipment that could form components of such a system and these could be classified:-

Page make-up systems, subsystems and terminals
Phototypesetters with graphic output potential
Scanners and electronic cameras
Planning and proofing aids
Platemaking subsystems
Electronic merging systems (film output)

In addition there was considerable expertise available in such areas as interfacing, system architecture and processing large quantities of data. Therefore, it was conceivable that 'integrated text/tone printing/publishing systems' could become commercially available within a few years. Such systems could only be developed because of the widespread application of digital techniques. The term 'digitisation' had been introduced to describe the use of digital techniques in the processing, storage and transmission of text and pictorial information.

Digital methods offered a number of advantages compered to conventional methods. Text could be rapidly and easily hyphenated, justified and even checked for correct spelling. Similarly illustrations could be processed for edge enhancement, contrast and local or global corrections to grey levels, colour and sharpness. Generally, digital techniques were associated with faster or greater volume of throughput. Digital signals were less susceptable to error than analogue signals and were more suitable for use in systems which involved remote output. Digital techniques made it easier to coordinate a number of separate tasks within a machine and helped to ensure a standard product.

The main disadvantages of digitisation were the large memory requirement and the risk of system failure. The large memory requirement added to systems' cost and detracted from speed of performance. The greater the number of separate tasks embodied in a system the greater the consequence of a system failure.

Generally speaking, electronic processing of text (composition) had reached a ligher level of acceptance than that of illustrations. A survey had indicated that there were 1695 installations of multi-terminal systems by American suppliers at September 1979. This facilitated the merging of text and tone by producing galleys to shape and size for paste-up. Some had the capability to produce complete pages of text with spaces left for the insertion of illustrations.

Illustrations could be output at the same time as text provided they had first been digitised and the phototypesetter had graphic output potential. Several companies had products capable of outputting a full page (up to newspaper tabloid size) of combined text/tone matter.

The digitisation of pictorial matter required an electronic scanning mechanism. The most widespread use of scanners in printing was in colour separation. A survey by the print union, SLADE, showed that by mid-1979 the number of scanners in use had grown from 854 to 2415. The survey covered most of the world but excluded Japan where there are estimated to be a further 1000 scanners. Not all scanners used digital techniques but the trend was for these to be incorporated. Scanning techniques were also being applied for monochrome material. The Autokon 8400 had been used in newspapers in place of graphic arts cameras.

There were a number of devices available for creating a plate or forme directly from a paste-up page. These were used in the production of gravure cylinders, flexographic rollers and litho plates.

Only one company, Information International Inc, marketed a system

capable of merging text and tone electronically. This offered electronic composition of text, full page make-up, digitisation of illustrations and output of full pages onto photographic film or paper. Output was limited to A4 size.

A3.3 Case Studies

The report reviewed digital graphic arts equipment and provided a description of 23 of the most sophisticated systems. In addition three case studies were included covering use in a newspaper, a colour separation trade house and a large general printer.

A laser platemaker was used in newspaper production at The Cambridge Evening News, a daily tabloid with a circulation of around 55,000. The installation of the laser platemaker was part of a carefully planned update of production methods. Within a few years these changed from almost nineteenth century vintage to among the most up-to-date in Europe. The first step was conversion of the presses from letterpress to direct lithography in April 1977. This was followed by the installation of the laser platemaker in July 1979, and photo-composition in January 1981. The newspaper was the first in UK to use a direct litho conversion and install a laser platemaker.

The laser platemaker had reduced the time to produce a set of plates from ten to five minutes. Savings of around £30,000 pa were obtained in material costs. The number employed in platemaking had been reduced from seven to four, three being retained for jobs in the press, proof-reading and composing departments. The four retained in platemaking had a higher level of job-satisfaction than in previous methods of either litho plate or stereo production.

The colour separation trade house had invested heavily in proven electronic equipment, including six laser scanners, a colour display monitor, a Cadograph. The Cadograph is a computer-controlled device used in pre-planning for the make-up of complex pages. The company was considering the purchase of an electronic page make-up system.

The company's high technology approach could not be justified on the cost-effectiveness of each piece of equipment. The main advantage

was the capability to produce a quality product consistently and quickly, thus reinforcing customer confidence. New technology did not reduce costs, although prices were competitive due to high throughput. For example, the proposed introduction of an electronic page make-up system was likely to double the cost per page. This cost could be justified however, if making this page could attract a further 20 pages of normal production.

The closest approach to an integrated text/tone printing/publishing system was studied at the general printer, Maury Imprimeur SA, France. This company had installed an Information International Inc system, AIDS. This system had been successfully employed in the production of technical manuals, magazines, catalogues and directories but the configuration at Maury was the company's first attempt to apply AIDS to the more complex application of general printing. The system, costing around £1.2m embodied nine mini-computers, a scanner, a phototypesetter, 18 terminals (two for page layout and the remainder for text input and correction), together with the necessary peripherals, founts and software. The system was designed for inter-active use but incorporated off-line entry from OCR and other text systems. The system output was between 700 to 1000 pages, approximately 1.8 million characters, per day. These were finished pages, including the positioning of artwork. Plates were made directly from the typesetting film.

In all three case studies companies adopted a similar approach which could serve as a model for the successful introduction of new technology. Each company formed a clear plan which took account of changes in production methods. Discussions took place with unions and employees so that working methods, wages and manning levels were agreed before the equipment was installed. The equipment was selected carefully, due consideration being given to its reliability and suitability, and the reputation of the supplier. A thorough training programme was initiated. One benefit of new technology lay in increasing speed and/or volume of throughput thus improving productivity. The high cost of equipment could be offset partially by material and labour cost savings. The major benefit of digital equipment was improved quality control and assurance.

A3.4 Key Issues and Forecast

The level of technology necessary for producing an integrated text/tone printing/publishing system had almost been reached. Equipment which could form the components of such a system was available commercially. A major obstacle was software development, although the success of Information International Inc in electronically merging text and tone showed what could be achieved. Market resistance could be a greater obstacle than any technological difficulty. Supplier companies needed a broad range of skills to develop integrated text/tone systems and it was worthy of note that there were a number of company mergers and cooperative agreements that would broaden the expertise of suppliers. Links were being established between text-oriented and graphics-oriented companies, and between phototypesetting and platemaking companies.

Printing was a diverse industry with many product sectors, each with different equipment requirements. It was difficult to say which sector would be first to use an integrated text/tone system. Newspapers were often leaders in the introduction of print technology innovation but it could be difficult to reach agreement with unions since these systems would cut across many demarcation lines. Full-colour printing was labour-intensive and time-consuming and there would be considerable benefits associated with an integrated text/tone system although technical problems would be considerable. Provided costs could be kept low the most suitable area of application would be to the small printer and in-plant market.

The first integrated text-tone systems to be introduced were likely to be computer-to-film systems like AIDS of Information International Inc. These could gain wider acceptance in the early 1980s. Meanwhile pre-press colour make-up systems could incorporate text entry. Computer-to-plate systems could be demonstrated and the first installations made by 1984/5. By 1990 there could be widespread use of computer-to-film systems and computer-to-plate systems could be accepted.

A3.5 Conclusion

Technical expertise had reached a level where the introduction of

integrated text/tone printing/publishing systems was only a few years away. These systems could be seen as the natural outcome of the widespread application of digital techniques. These techniques were associated with improved throughput and, in particular, improved quality control and assurance.

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