Task analysis and information inputs for research in the human sciences

TASK ANALYSIS AND INFORMATION INPUTS FOR RESEARCH IN THE HUMAN SCIENCES.

by

Carol M. Breadmore

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Supervisor: T.A.Whitehall, B.Sc., M.I.Inf.Sci.

To my parents :

Ronald and Cynthia Breadmore

C O N T E N T S

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Abstract

Researchers in two research groups closely associated with the Human Sciences Department at Loughborough University of Technology were interviewed, using the task analysis technique, in order to find information inputs to their work. The sources and channels associated with these inputs were also identified. The technique aims to reach information needs as opposed to demands made on particular information services, and involves obtaining task analyses representing the way professionals proceed in their research and then using these to obtain instances of information input to the tasks identified. Obtaining a task analysis of the piece of work the researchers were actually doing proved to present the most problems. It was not possible to relate the inputs obtained to any standard task analyses generated from the study, so the inputs were related to individual reationalized tasks. A method for future work is suggested in which the researcher would be presented with individual "tasks" to organize. This would help the respondent by being explanatory without imposing a chronological order on the tasks, and would prevent the respondent from adding extraneous details to the task analysis. The task analyses can provide information inputs — to professional work by acting as aide-de-memoires for the researchers, and can also be useful to sort inputs into groups because they show what type of research is being conducted. The inputs themselves would be useful to people planning or attempting to justify information services for particular groups.

Aims of the Study

The aims of the study are in two main areas:

1) To try out the technique of task analysis for obtaining information inputs to professional work, as an alternative to other methods which have attempted to reach information needs.

2) To identify information inputs into the work of researchers and to attempt to relate these to task analyses of different types of work generated from the study. It is also intended to identify the channel and source associated with each information input.

CHAPTER 1

Background to the study - information flow research

> "It may be reasonably estimated that, over the past thirty years, some 1000 papers on user behaviour and the use of information systems have been published."
>
> (Crawford 1978)
>
> Systematic studies of information needs and uses have become truly international phenomena. (Lin and Garvey 1972). Studies of user behaviour have proliferated and diversified.

Use studies no longer concentrate on science and technology. The scope has extended to include users in a wide variety of disciplines, among them psychology, education, policy-making and law. It seems that almost everyone's needs are now being surveyed - senior citizens, urban populations and minority groups.

Information flow research published before 1948 relied upon reference-counting methods to identify most-used books and periodicals, but this was studying communication artifacts, not people's behaviour. The Royal Society Scientific Information Conference of 1948 gave impetus to the study of actual people's behaviour. (i.e. scientists' information gathering and disseminating behaviour). (Paisley 1965).

Information seeking habits

An early but important piece of work was J.D.Bernal's survey of the use of scientific information (Bernal 1948). Bernal's findings indicated that applied and pure scientists had different needs, and

that work activity (i.e. title, status) was a factor that could affect use made of libraries and other sources of information. He put forward the theory that different identifiable user groups exist, with different and identifiable patterns - both in their needs for information and in the way they go about obtaining it.

Barber (1966) says that the main variables influencing scientists' behaviour are: subject field, type of work, availability of library stock and services, and previous experience of library use. Type of employer could probably be considered as a mixture of type of work and availability of library stock and services.

However, the importance of subject discipline as opposed to other factors seems to have been overplayed. Flowers (1965) found general similarity in information seeking and using habits of physicists and chemists. Chemists do regard abstracts more highly than do physicists and this is hardly surprising when one considers the high quality of Chemical Abstracts. Physicists use more reports and again there are specialized Government interests in physics and engineering so one would perhaps expect this. Line (1968) suggests there are differences between the social sciences and the pure and applied sciences which may affect their information needs. (e.g. methodological disputes are much commoner in the social sciences, and each discipline is much less clearly defined). Skelton (1973) however, says that on the whole scientists and social scientists do not differ to any large extent in their information seeking behaviour. It is suggested that there is at present a difference between scientists and social scientists in their willingness to delegate literature searching.

The difference seems however largely due to the fact that information officers are simply not available to academic researchers, and that if they were available, social scientists would use them as they are already used in industry by scientists.

Slater and Fisher (1969) conducted a large questionnaire survey of the use made of British technical libraries. A rough profile of the library non-user was drawn by comparing personal statistics of respondents with published data on scientific manpower in Britain. The non-user is more likely to be in industry than academe, and more likely to be an engineer than a scientist. Differences in information needs were found to be greater between different branches of science (physics v biology) than between scientists as a group and engineers as a group. Urgency of use was greater for non-technical users than for others and greater for engineers than for scientists. Engineers consulted more documents. Library staff assistance was used more in industrial and professional society libraries than in academic or public libraries. Work activity and employer/library group appeared to be more potent influences on user behaviour than discipline.

Therefore, the type of service provided and the work activity has a strong influence on user behaviour. Herner (1954) says the most probable explanation for the extent to which workers in pure and applied science use technical literature, lies in the fact that the pure scientist is generally given the opportunity to seek the best and most original answer to his problem, while the applied scientist is usually in search of a workable solution - not necessarily the best or

most original solution - but one which will make whatever he is trying to develop work. Generally pure scientists survey their literature critically and exhaustively, while applied scientists give a relatively small amount of their time to the literature, leaning more on verbal sources of information.

Wood and Hamilton (1967) looking at mechanical engineers found that the average engineer looks at between five and ten journals regularly (all English language and mostly British). The majority do not look regularly at any abstract journals and of those that do, less than half locate a useful reference more than once per month. As well as commercial journals and science journals, advertisements and brochures play a large part in the engineer's acquisition of information especially for his knowledge of competitive products. He also receives a large proportion of his information orally. A considerable amount of information is required outside the field of mechanical engineering. The type of activity is probably the most important characteristic, compared with both subject and industry in determining the pattern of a person's information uses and requirements. Those working in the production side of industry are less dependant on written information of the academic type and rely more on oral communication and on compilations of data such as handbooks, data sheets, etc. The small minority of engineers on the research side conform more to the pattern of physicists and chemists working in the same sort of activity rather than the mechanical engineer in general.

User needs cannot be deduced from studying how users use existing services, (i.e. from their demands) because the very service

affects perceived needs. Martyn (1974) points out that it is possible that the introduction of on-line remote access to a large number of major secondary services will markedly modify user behaviour, although it will probably not affect actual as opposed to perceived needs. This is because actual needs are more related to the task to which information is to be applied than to the device by which information is provided. As Hanson (1964) so rightly says, conscious needs for information are stimulated by the means of obtaining it. Much research has really been concerned with user demands rather than needs, as it is easier to study demand and then deduce need. (Slater 1968).

In a review of the research literature in 1965, Paisley suggests that there are two important reasons why so many "use studies" have been conducted. The first is a distrust (which in his view is well founded) of the findings of earlier studies. The second is the conviction that the scientists in this discipline, or in this association, or in this agency, are so unique in their information processing behaviour that only a new study will suffice to guide information policy.

The methodology of early investigations was weak and Taube in 1959, questioned the validity of the studies as guides to improving information services. However the criticisms have become more sophisticated along with the studies and Paisley in 1968 commented that although methodological defects still appeared in the 1967 literature, it might now be time to object more strenuously to poor conceptualization. Shallow conceptualization implied a failure to consider factors such as

the full array of information sources available, the uses to which information will be put, the background, motivation, professional orientation and other individual characteristics of the user, the social, political, economic and other systems that affect the user and his work and the consequences of information use, e.g. increased productivity.

Communication studies

Studies with a broader framework which place the scientist and technologist in their social setting have had important implications for people studying user behaviour, e.g. the American Psychological Association's project on Scientific Information Exchange in Psychology. This programme of research was intended from the first to encompass the full spectrum of communication rather than focusing on a limited set of media or functions. The approach adopted was that of viewing scientific communication as a large social system composed of a variety of formal elements (e.g. scientific journals) and informal elements (e.g. preprint exchanges) (Garvey and Griffith 1966). Informal systems of communication supplement the formal systems, such as libraries and information departments, to the benefit of the individual's work and personal prestige. Studies of informal information transfer have highlighted the importance of informal information channels. Studies simply of use of formal services give a very partial impression of need.

In science, Price has formulated the invisible college concept (Price 1963) - international groups of scientists who maintain close liason through informal channels. A pleasant way of gaining an

insight into the social nature of science is to read Watson's account of the discovery of the structure of the D.N.A. molecule (Watson 1968). Attempts to formalize an aspect of informal exchange - Information Exchange Groups - (IEGs) failed due to the resistance of the formal publication channels (e.g. Anon 1966). But studies of informal communication make one realise that scientists will get information even without aids such as the IEG's, although it might be slightly slower. After all, scientific information does not become genuinely public until its journal publication and quite often by this time is out of date on the research front, (Garvey 1972), so the research scientist has to use other methods of gaining access to current information. It is not however just a question of formal information demands only expressing partial needs, as studies with technologists have shown. The relationship between technologists and the literature is not the same as between basic science researchers and the literature. The strong traditional motivation to publish is lacking in technological work because the information is usually classed as private property. Even the technical report is often written to satisfy a contractual obligation (Passman 1969). The special restrictions placed on communication in research and development have been studied and Allen has come up with the concept of 'technological gatekeepers' or communication 'stars'. The stars provide a link between the internal information network of the laboratory and the scientific and technical communities outside the laboratory. The 'stars' act as 'technological gatekeepers' by making greater use of sources, such as literature and contacts, outside of the organization and then

disseminating the information gained to their less informed colleagues. (Allen 1968).

What is most important however, is how channels for information are chosen in project work, and presumably generally in information seeking. For information gathering methods in industrial and Government environments (regardless of the research orientation of the users), ease of use of an information gathering method is more important than the amount of information expected. (Rosenberg 1967). Allen and Gerstberger (1967) found that engineers use channels in proportion to accessibility and ease of use, but they accept ideas from those channels in proportion to technical quality. A study of an academic department and two R and D laboratories, demonstrated the relation between the physical distance separating people and their probability of technical communication. Communication probability declines very greatly as the distance separating people is increased. (O'Gara 1968).

If use of channels is affected by accessibility and ease of use then studies of use of formal communication channels which aim to deduce actual need are even more invalidated, because not only do they give a partial picture of actual needs for information but the relative use of the service as opposed to other channels, and the relative use of components within that service (e.g. patents, indexes) is more affected by random behaviour than by quality of service or quality of information thus obtained. People use the sources that they can reach (and make use of) easily!

Information use studies

It is obviously a more difficult prospect to show how information is made use of in tasks, as opposed to merely how it is acquired. It is impossible to identify all information inputs to a task, some of which may not even be on a conscious level. Martyn (1974) places the information needs of an individual into two areas. The first is a central core made up of information without which the individual cannot competently perform his professional role. Secondly, around this core, there is a large ill-defined area which contains an enormous quantity of apparently random information, much of it non-scientific or non-technical, acquired from formal and informal sources, even from casual note of the environment.

The first area has information that is prominent in the stage subsequent to project formulation (the development stage), but the second, shadow area has most effect in the creative stage. It provides the building blocks for the idea.

In keeping with this Pearson (1973) says that considerable attention should be paid to the role which non-specific information plays in the problem solving process and that there may be many occasions on which such information is likely to be of more value than that which is most likely to be available or to be requested by the individual.

Identifying information inputs to the creative stage of any project is going to be difficult. Maizell (1960) studied research chemists divided into three groups on the basis of "creativity" and the information gathering behaviour of the high and low groups was studied.

Assuming that supervisors' ratings do reflect on creativity, the most creative chemist does significantly more technical reading on the job than the least creative chemist. (i.e. the two groups contrasted). Technical information services offered by the library staff were only of moderate importance to the most creative chemists. Some of the most creative chemists used these services, but most of them relied in large measure on their own efforts.

Non-specific information inputs to tasks are unlikely to be remembered by subjects but it is still possible to get a great deal of useful information inputs to tasks, of a more direct nature.

Studies which touch on information needs, without going into any real detail, are becoming more common. Even studies which cover real needs to any degree combine them with sources and channels. (As indeed this study does!). It is indeed difficult to resist the documentalist's urge to know from whence and in what form people acquire information, and indeed this is interesting, provided one appreciates all the qualifications affecting this behaviour, and the fact that it only represents the present situation of information collecting.

Some texts deal with information as used by managers. The management process is rather different from research, in that it is even more difficult to compartmentalize. It is a continuous process and unlike most research projects, has not got a beginning, middle and end. It would probably not lend itself to task analysis as performed in this study.

An industrial organization was considered a 'closed' system but it is now accepted that it is an 'open' system which fully interacts with its environment. Its ultimate survival indeed depends on

this, together with internal operations and control. (Radley 1973).

Mintzberg (1973) studied managers by structured observation. There are a number of variables involved in the work of managers - the nature of the industry, the nature of the organization, the man's style and the needs of the moment, e.g. year end dinners.

Schoner and Uhl (1975) give an overview of marketing information for decision making. Information is divided into internal, (e.g. company sales and costs), external (e.g. customer behaviour and its explanations) and joint internal/external information (e.g. brand loyalty).

Some information need studies have been concerned with innovations in industry. van Houten (1966) studied fifty firms selected to represent the sizes, activities and geographic distribution of South African manufacturers. This study, conducted by interviews guided by a brief aide-memoire, addressed itself to the types of information required in connection with the installation of technical innovations in the field of electronic equipment or processes. Three basic types were identified - information to keep abreast of new developments, information required to decide on the introduction of new equipment or processes, and information required for solving unforeseen difficulties after introduction.

Myers and Marquis (1969) made a study of the background of technical innovations in firms in five different manufacturing industries. Data were collected chiefly through interviews with executives and technical personnel associated with innovations that the firms had regarded as important. Critical communications ("information inputs")

which led to the innovations were identified. 60% were found to have come from other persons within the firm, rather than from outside sources. In about four-fifths of the cases studied, the motivation to accept innovation came from an awareness of demand, rather than an awareness of new techniques.

Langrish (1972) looked at eighty-four innovations by industrial firms that had received the Queen's Award to Industry for technological innovation and from this sample, gathered one hundred and fifty-eight important ideas that were used in fifty-one innovations. One hundred and two of the important ideas were found to have come from outside the firms concerned. Of these, nine and a half (the half arises from assignation of one idea to two categories) were transferred to the firm via the technical, scientific or patent literature, eight and a half from personal contact in the United Kingdom, twenty and a half from a person joining the firm, twenty four by common knowledge deriving from industrial experience or education, and two and a half by conference in the United Kingdom. Other methods of idea transfer were also given.

Janning (1968) carried out an interesting study on the information needs of the ceramic industry. Panels of subject specialists were selected to represent the information needs of ceramicists in general. These panels represented various types of ceramicists, by product area and function within each product area, who were presumed to have differing information needs. The experts, working individually and through group action, defined the functions performed by ceramicists and the information needs associated with

these functions, listed appropriate sources of ceramic information and identified problems and needed improvements in the flow of ceramic information. Findings of these panels were validated by "task simulations" in which individual ceramicists were presented with typical technical problems. Following a specified format (task simulation forms) each ceramicist was asked to document all information acquisition and utilization functions involved in the solution of the problem. The ceramicist also evaluated the utility of the sources of information and noted problems encountered in their use. This type of task simulation represents a combination of the critical incident and diary approaches. It documents a "critical incident" as it happens and is not therefore dependant upon failures of human memory or inaccurate records. Janning's technique can be criticised on the grounds that it is not "real life". Nevertheless, if the problems are well selected, tasks can certainly be made "realistic". This method seems rather elaborate and perhaps a sacrifice of some information inputs by memory loss is preferable to the long "run-up" to the results. Also, will the ceramicist act typically in a simulation situation?

Engineering design has had some attention. Wolek (1969) reviews the evidence accumulated from case studies of engineering projects and states some conclusions regarding the information needs and practices of engineers. He describes the engineering project as progressing through two broad phases: a systems definition phase which takes five to ten percent of project time, and a prototype testing phase which takes the remaining time. During the second and far longer

phase, attention is centred on acquiring and evaluating experience with a working model of some sort and this model becomes progressively more "frozen" in design. It is not surprising therefore that information seeking among engineers should seem to centre around the immediate working group where the tests are made and where decisions are made concerning the freezing of the design. However, projects are not always successful with their choice of design and designs that meet immediate technical requirements can often be foreseen as predictably uneconomical or desirable for the future. Wolek concludes that engineers need better information services to provide them regularly with data on trends in the performance level of whatever it is they are expected to improve upon, and to provide them also with notification of the existence of alternative design concepts. With such a service the engineer would be better able to break away from an initial design concept, even when it is already largely frozen, in order to capitalize on a superior approach. Knowledge of the engineer's work helps in defining his or her needs for information.

Chaddock (1970) placed information used in engineering design into four broad categories: 'catalogue' information e.g. trade catalogues, price lists, standards, codes, specifications etc., 'Technical' information which covers a very wide range and comes from the current scientific literature, (personal contacts are important because what not to do is seldom recorded), 'Algorithmic' information which consists of routines or devices for performing a predetermined series of operations, (these can range from data sheets to computer programs) and finally, 'Graphic' information.

Kremer (1979) investigated information flow among engineers in a design company and he incorporated two separate critical incidents. One related to the latest purposive information seeking act and the other to the most recent discovery of a useful item of information not deliberately sought. For the former, he asks what was the information needed and why the information was needed (the questionnaire gives categories e.g. to define a problem). He finds out how much of the necessary information was obtained from each source consulted. (e.g. all, irrelevant, nothing etc). For the information which was obtained accidentally, similarly it was asked what was the information obtained and why it was important. (Various categories are given e.g. to find out about legal regulations).

Slater and Fisher (1969) in Appendix B of their survey of users of technical libraries, give specific examples of users specific needs for information, taken from completed questionnaires. Respondents are usually using their employer's library. A few examples given are:

- need for background information.
- prepare for and supplement lectures.
- data, equations, facts and figures for immediate use in calculations.
- new ideas and stimulation.
- help in planning a project, experiment or test.
- urgent problem, work held up pending solution.

Dubinskaya (1967) studied chemical scientists and technologists in six research and planning groups of the U.S.S.R., Ministry of Chemical

Industry. Distinctions between experimental personnel and developmental or planning personnel were noted in the areas of frequency and sequence of information sources used, choice of formal information sources and age of literature used. Information needs it was found could be related easily to the three broad types - current, specific and exhaustive.

An important piece of research on information use in tasks is the Auerbach Corporation's (1965), who had a Department of Defense contract to determine how Research, Development, Test and Evaluate personnel (RDTE) acquire and utilize technical and scientific information in the conduct of specific tasks associated with the work. Multi-variate analysis was employed on the interview data. The random sample was one thousand, three hundred and seventy-five scientists and engineers. A "critical incident" approach was used. The concept of a "chunk of information" was introduced and defined as the "smallest quantity of information required to answer a task-related question". The function of a chunk, the field of research it was drawn from, the source from which it was obtained, the time required to obtain it, depth of information it conveyed, and its value to the task were principal dependant variables tabulated against such antecedent variables as educational background, field of research, kind of task, task output etc.

> "... with minor exceptions, as the task characteristics change, there does not appear to be a significant change in the classes of information used to conclude the tasks".

> "...the high use of performance and characteristic and specifications data, and "how-to-do-it" information (design techniques etc.) does not appear to vary significantly with differences in RDT & E task characteristics".

Obviously the resources needed for this sort of excellent study are fairly large. But by concentrating on the characteristics of the information rather than the channel or source, this type of study gives a more complete indication of information "needs".

Rosenbloom and Wolek (1970) looked at scientists or engineers doing R & D work in industrial organizations, by questionnaire. Each subject was asked to think of the most recent instance in which an item of information, which they received from a source, other than someone in their immediate circle of colleagues, which proved to be useful in their work, and to answer questions with reference to that instance. They also considered circumstances leading up to the acquisition of information from that source. There are three main classes of circumstances which are termed "specific search", "pointed out" and "general competence". The questionnaire design excluded certain immediate sources of technical data, habitually employed in technical work, principally handbooks, because it was thought that people are unlikely to be able to remember "critical incidents" for sources that they use routinely. Each respondent was asked to check one of several descriptions to complete the sentence: "The information was applied to a task which could be characterized as an example of the...". Also identified was the stage of the work and how the information was useful within the stage and how it affected the work.

Science Communication, Inc. (1968) carried out a toxicology user study. A multipronged approach was used in this survey: a general user questionnaire, a critical incident technique, a "citing author" study and a "decision tracing" method.

In the "citing author" approach, key toxicology articles were identified and characterized with regard to their toxicology information content. A large number of authors who cited these key papers were queried by mailed questionnaires to determine how they became aware of these articles and to explain the relevance of the toxicology information content to their activities.

The "decision tracing study" was a novel one in which the investigators identified a number of decisions in which toxicology information was known to have played a very important role. (e.g. detection of the cause of methemoglobinemia in premature infants in a Bethesda hospital). These decisions were analyzed in great detail following interviews with the various participants, in order to determine the information flow patterns, problems and needs associated with decisions of five distinct types. The methods actually used to gather information for decision making and the time delay involved, were compared by hindsight with alternative procedures that could have been used, based on information known to have been available at the time the decision was made.

An interesting study is Strasser's study of the information needs of practicing physicians in North-eastern New York State (1978). This questionnaire survey with computer aided market analysis indicated that the areas of greatest need for improved information were new

developments in specialities and government regulations relating to health care. Speciality-related differences occurred with specific information needs and source use. Part of the investigation concerned perceived need of health care practitioners for improvement in the quality of their professional information. This was tested by analysis of "need to know" and "quality of present information" as rated by physicians for eleven subject areas followed by construction of an "index of perceived need" (mean value of "quality of present information" ratings minus mean value of "need to know" ratings). It is of course unrealistic to attach too much importance to the precise numerical values of these indexes and ratings. However, they do serve as a basis for comparing certain essentially subjective dimensions of information.

Mullings and Francis (1981) have produced a useful manual for the investigation of local government information needs. As usual the type of study they envisage covers sources and information seeking etc., but it also includes an element of information needs and uses. A questionnaire and interview schedule are given. The interview schedule asks which types of information, from a list, the respondent needs for his/her job and asks if any difficulties have been experienced in getting any of these types of information. The respondent is also asked to think of a problem related to work, and how he/she looked for the information that they needed, what information was found to be useful and how it was useful.

Caplan et al (1975) looked at the use of social science information in the formulation of Government policy. The study is

largely based on five hundred and seventy-five self-reported instances of the use of social science information by two hundred and four upper-level employees in the executive branch of the federal Government (U.S.). The authors distinguish between "scientific" matters which bear on the internal logic of the issue and pertain to the gathering, processing and analyzing of objective information to arrive at an unbiased diagnosis of the problem and "extra-scientific" matters which bear on the external logic of the policy issue and pertain to political, value-based, ideological, administrative and economic considerations. Caplan et al found that the political implications of research findings appear to override all other considerations in determining utilization. The study also distinguishes between micro (immediate and administrative level policy) issues and macro (nationally significant) issues. Of the five hundred and seventy-five instances of the use of social sciences information, Caplan et al found that only rarely did such information play a role in influencing "macro-policy". Applications usually involved organizational - administrative policy issues. At the macro level, policy is not determined by concrete, point-by-point reliance on empirically grounded information, but on an aggregate of scientific and extra-scientific knowledge from a variety of services. On the micro level, the respondents appeared to rely almost exclusively on the agency sources of information, whereas on the macro level, sources were electic and independently acquired by the policy maker - through the media, findings from the social sciences or other influences. On the microlevel, the purpose for which information is gathered can usually be

specified in advance and it is usually possible to trace the utilization process as a set of sequentially linear and predictable input-output processing steps. The study indicates the inappropriateness of applying the model of 'hard' information used in the physical sciences to Government policy decision making. (Soft knowledge is non-research based, qualitative and couched in lay language. 'Hard knowledge' is research based, usually quantitative and couched in scientific language). Although hard information is easily detected, the most persuasive effects of social science information on policy making occur in the context of soft information use.

The degree and kind of information used were also found to be influenced by three basically different information processing styles. Respondents with a "clinical" orientation showed an ability to analyze both the scientific and external value-based components of policy issues. Those with an "academic" orientation focused on the internal logic of issues. Respondents who had an "advocacy" orientation tended to ignore issues of internal logic and to deal primarily with the extra scientific, particularly the political aspects of policy issues.

Studies of information use, as opposed to demands for information, bring us closer to a realistic picture of information needs. In the next chapter an alternative method for studying information use will be considered.

CHAPTER 2

METHODOLOGY

The researcher wished to try out task analysis as a way of elucidating information inputs to research, as an alternative to other methods which have been used to attempt to reach information needs. This involves obtaining task analyses or models representing the way professional workers proceed in their research, and then using these to obtain instances of information input to the tasks involved.

Information used in tasks should provide a more realistic basis than information collecting behaviour for assessing user needs because by concentrating on the client's work rather than on his use of existing sources and services, we are not relying on relatively random behaviour. If the librarian knows the information required, he or she can provide the most useful source for it. Information inputs to tasks can also be a useful justification tool for the information officer. (Whitehall 1980).

The method used, interviews, is the one recommended in most of the critiques of users' needs. (Voos 1969). The advantages of interviews over questionnaires are that the interviewer can gauge the respondent's mood, (serious or jesting), determine whether he or she understands the questions and probe as necessary for detail. The limitations of an interview study are that the interviewer is relying on the respondent's ability to recall his behaviour and report it without embellishment. There may also be interpersonal difficulties, and

a simple inability to answer ill-conceived questions. (Paisley 1965).

Task simulation such as that performed by Janning (1968) seems a promising technique for obtaining information inputs, but involves a great deal of setting up. Similarly studies on the scale of the Auerbach Corporation (1965), need considerable time and resources. However, using task analyses as a means to obtain information inputs is an improvement on simply concentrating on the latest information seeking act or accidental acquisition of information which would give just a few inputs for each individual, or asking individuals questions about the latest use of various categories of information which imposes the researcher's own structure on the inputs "discovered".

Task analysis in this study was intended to provide the interviewee with a 'shorthand' description of a fairly large piece of work (i.e. a piece of his recent research) which would provide him with a useful aide-de-memoire for the recall of information inputs. The method provides detail of information used in the research, but also incorporates a time perspective. A task is seen as a stage out of which the individual moves, therefore the technique of first producing a task analysis model would not be so applicable to professional work which does not have identifiable stages.

In a study by Amir (1977) scientists and engineers doing research work and some others engaged in product development were interviewed to try to find out how they put information to use in their work. However, the technique was different as in this study, two models (basic research and product development) were presented at the interviews in order to elicit opinions on how research proceeds and to obtain a model

of the research process from the interviewees, but the models themselves were not used to obtain critical instances of information use at the different stages in the research. Instead questions were asked concerning how information is used in the research and how it affects the research and these information inputs were classified by whether they were useful at the beginning, during, or at the end of the research.

Methodology of the present study

Researchers in the Human Sciences and Advanced Technology Research Group (HUSAT) and the Institute for Consumer Ergonomics (ICE) were chosen for the interviews. These research groups are closely linked with the Human Sciences Department at Loughborough University of Technology (see appendix 1 for details of the research groups).

Letters inviting cooperation were sent to individuals conducting research at HUSAT and ICE. (The wording is reproduced in appendix 2). Letters to HUSAT also asked the individuals to give details to the secretary of HUSAT of when they were available for interview. The interviewer then contacted the individuals and arranged times for interviews.

It was felt that two shorter interviews would be more preferable to the respondents than one longer interview. Interview I was concerned with arriving at an agreed task analysis of the interviewee's current piece of research. Interview II was concerned with eliciting information inputs to the tasks identified, and an attempt to identify the channels and sources used.

Interview I schedule

The name, department, date of interview, the approximate time at the start of the interview and the approximate time at the end of the interview were recorded.

A preliminary explanation was offered - "Hello....., I am Carol Breadmore doing M.Sc. Information Studies. I'm doing a dissertation concerned with information used in the research process. To study this I am interviewing research staff in the Human Sciences Department. One tool used in studying information inputs to research is task analysis. This breaks up the research process into several components. I'd like initially to concentrate on this. One can then see the information inputs into each component".

An opportunity was given for clarification - "Would you like to ask any questions?" The following questions which related to the subject background of the researcher were then asked:

Q1. "I would like to record some details of your subject background. Firstly could you give me your official job title?"

Q2. "How long have you held your present post?" (years).

Q3. "Would you tell me the subject of your first degree/ qualification?"

Q4. "Have you any higher degrees?" (If yes) "Could you tell me in what subject/s?"

Q5. "Have you any professional qualifications?" (membership of Institutes etc.).

The questions now concentrate on the actual research. "I'd now like to concentrate on any research activities".

Q . "Are you engaged in, or have you recently been engaged in research?" (This is basically a check question).

Q7. "Would you give me an outline of past projects you have been involved in?"

(One interviewee made the excellent suggestion of asking individuals for their Curriculum Vitae, if they had one spare and were willing to part with it. It cut down on writing time considerably when a C.V. was proferred.).

Q8. "Would you like to give me an outline of the subject of your most recent research?"

Q9. "I'd like to show you two different models of the research process i.e. two different task analyses of the research process".

(These were adapted from Whitehall(1980)and were intended to give the interviewee some idea of what was required. They represented basic research and industrial product development. They are reproduced in Figures 1 and 2).

"Does either represent the way in which you proceed in your research?" (This question was for the initial interview, "Which do you consider comes closest to your own research procedure?" but it was realised that this invited a negative response).

If respondents stated that neither represented the way in which they proceeded or that each project was different, they were then asked to draw a model to represent how they proceeded in their current research.

The schedule concludes: "Thank you very much for your cooperation. I may wish to interview you again on another occasion. Would this be convenient?" (It was not always appropriate to say this as sometimes interviews I and II were arranged at the same time).

The last sheet of the schedule was left blank for the interviewee's model but in practice it was easier to use a separate sheet and some people preferred to use their own paper. In between

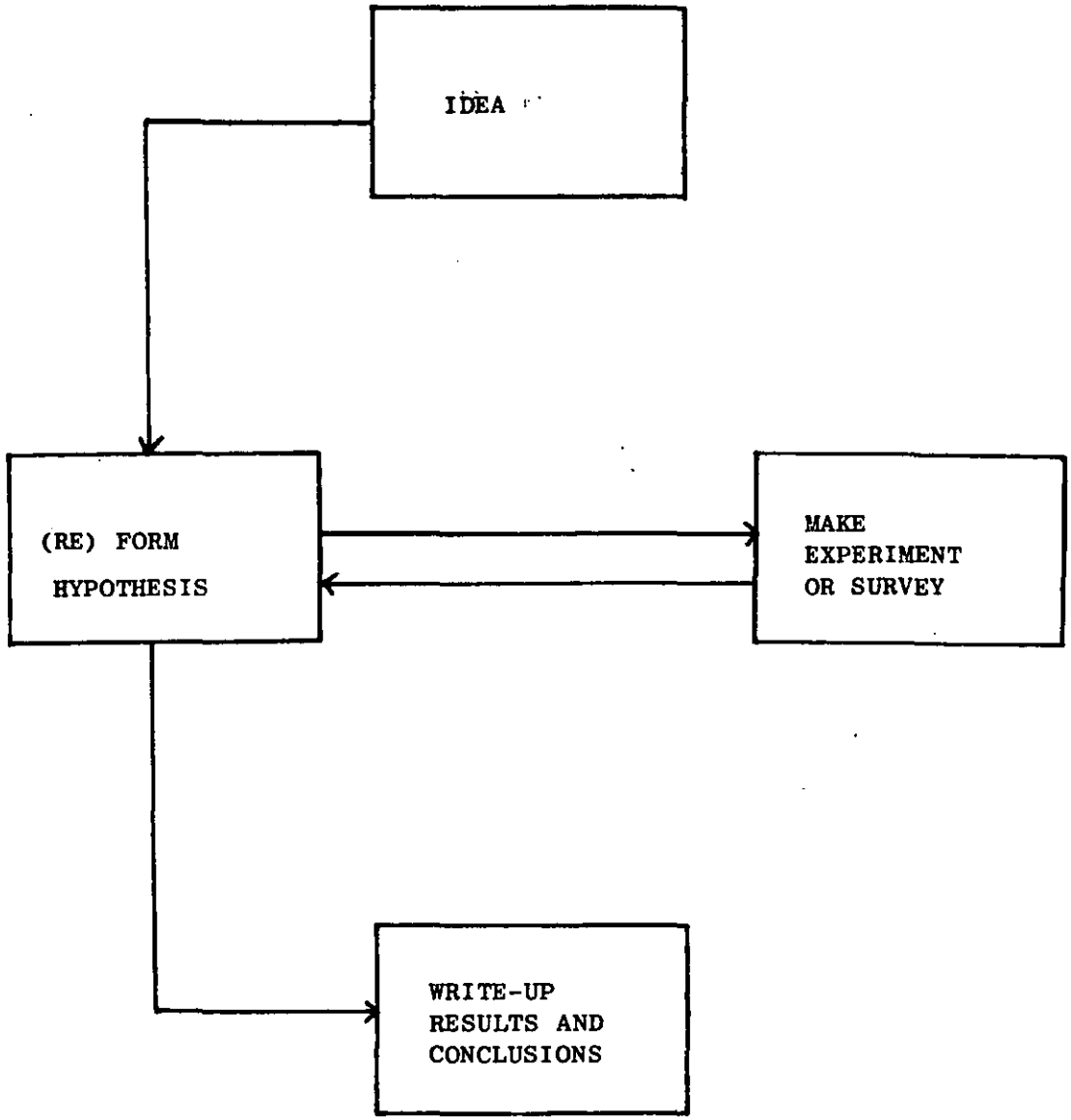

Figure 1 Model 1. (Basic research) (adapted from Whitehall 1980)

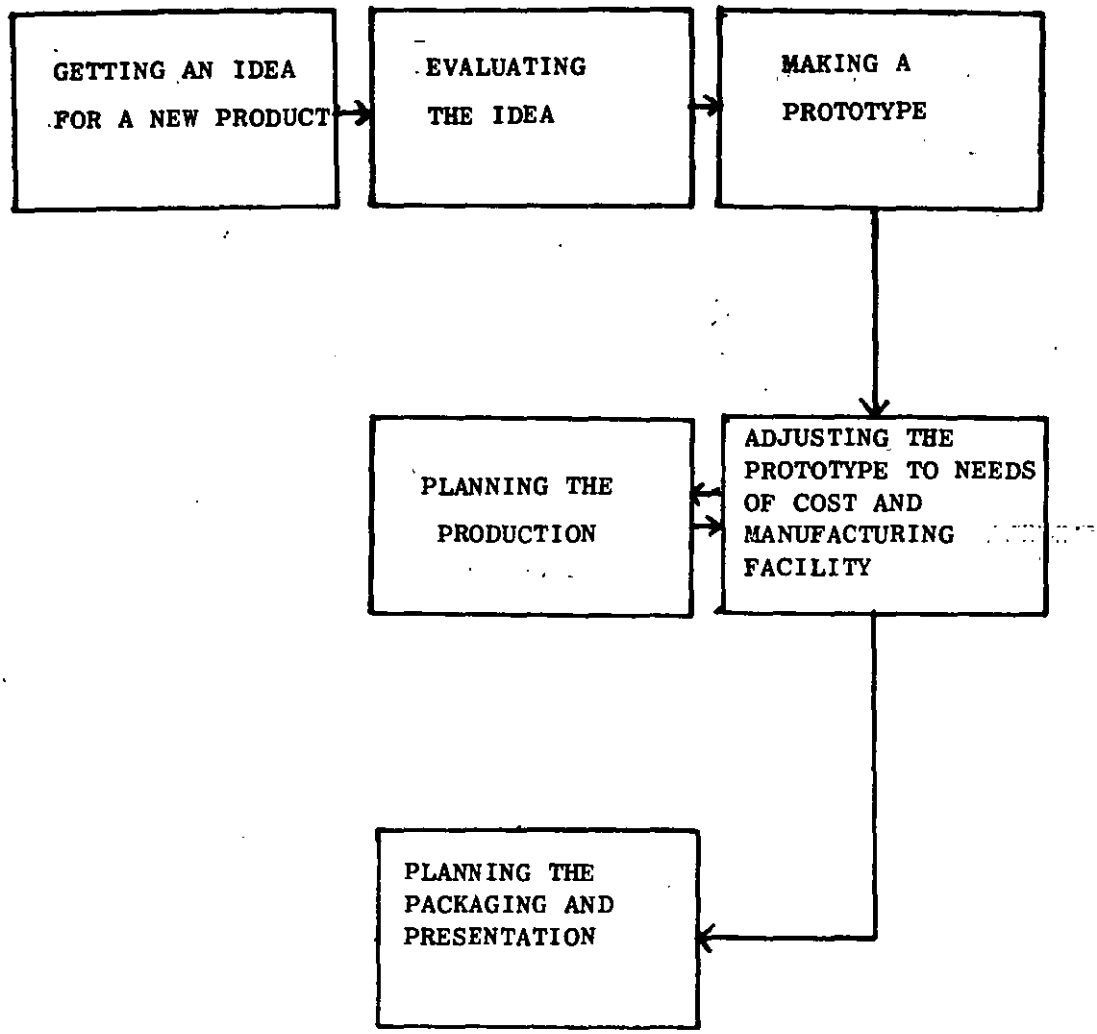

Figure 2 Model 2. (Product Development).
(Adapted from Whitehall 1980)

Interviews I and II, the model produced in Interview I was drawn out by the interviewer, firstly so that the interviewer could look at one copy and the interviewee at another and secondly so that the interviewee could object, if he or she wished, to the rendering of the model by the interviewer.

Interview II schedule

The model agreed upon in interview I was used as a tool to elicit information inputs in interview II. The name of the individual and the approximate time of start and end of interview were recorded.

The preamble was as follows - "in the previous interview we arrived at a model of how your research progressed. This model was .....(the relevant model was produced). I'd now like to concentrate on what information is actually used in the various tasks. I'd like you to look at the model we agreed upon previously....."

Again the interviewee was given an opportunity to clarify any points he or she wished to. "Would you like to ask any questions?" Then -

Q1. "Taking the first task, can you remember when you were doing your research on .....(the appropriate current work is named from interview I schedule) needing information?"

It was explained that information was meant in the broadest sense irrespective of source. It was also attempted to get the person to start from the point where they were first involved in the project and not to tell the interviewer about events prior to the interviewee's involvement. The interviewer probed to get specific information inputs as opposed to generalizations. It was also intended to define the inputs

in the interview e.g. method, property etc. Examples of information inputs to basic research and product development from Whitehall (1980) were taken along to the interviews. (see appendix 3). These inputs were not generally shown to avoid bias in the inputs given by the interviewees except in cases of extreme difficulty, to give the interviewee an idea of what was wanted.

Q2. "Can you remember where the information came from?"
(The schedule gives examples; was it from your own experience, a colleague, an external contact, an external collection e.g. a library? The objective was to locate the channel used to obtain the information input).

Q3. "What form was it in?"
(The schedule gives examples; was it a handbook, reference book, abstracting service, periodical, directory, information bulletin, report, memo, proposal or was it oral? The objective was to locate the source of the information).

Questions 1, 2, and 3 were repeated for each task, in which the individual had been involved, identified in the model from interview I.

The interview process

Because of the nature of the information required from the individuals probing and explanations are necessary, and this tends to make the interview process very open-ended. A "critical incident" technique was employed in the interviews. The researchers were asked to concentrate on a particular piece of research, and on actual instances

of information input to this research. This technique aims to avoid the generalizations interviewees are prone to make. The technique also helps the accuracy of the interviewee's memory. Lancaster (1974) states that the technique has been shown to have great value. Although people are notoriously unreliable about what they do generally, they usually can remember one specific, recent incident quite accurately.

Three of the people originally contacted were not interviewed because they were not conducting research as such. (One was a computer programmer and two were involved in research but not involved in directing it). Of the remainder, five people were not available for interview.

Interview I (obtaining the task analyses) took about thirty-eight minutes but could take anything from fifteen to eighty minutes. Interview II (obtaining the information inputs) took slightly less time being about thirty-three minutes, and varied less in length, although it could take between five minutes and sixty-five minutes.

In total twenty-four people were interviewed. It proved difficult to assign the interviewees to subject background categories because some had changed direction through higher degrees. Fourteen people had some ergonomic training. (see appendix 4 for a description of ergonomics).

Of the remainder, seven had some psychology training and one each with a background in production engineering, mathematics and sociology. A number was assigned to each interviewee to preserve anonymity. (see appendix 5 for details of interviewees).

Chapter 3 describes the results of the attempts to obtain a task analysis from the professional workers interviewed and the problems associated with this part of the study.

In Chapter 4 the information inputs obtained in the second interview are reported and an attempt is made to relate them to task analyses of different types of work.

CHAPTER 3

Task analyses of the research process

1. The problems of obtaining a task analysis

The main aim of the first interview was to obtain task analyses from the researchers which could be used in the second interview to obtain specific information inputs.

The interviewees felt, with only one exception, that Model 1 (basic research) and Model 2 (product development) did not represent their current work. Obtaining a task analysis of the piece of work the respondents were actually doing, presented many problems. (see appendix 5 for details of the projects discussed and appendix 6 for the interviewees' diagrams).

Some people seemed concerned about having to produce a model at all. As one respondent pointed out, "it's very difficult to just produce a model without prior thought." Another respondent remarked that it can be difficult to gauge the level at which to pitch a task analysis, i.e.should it be detailed or general. There is also the danger that respondents might be tempted to fob off the interviewer with an over-simplified version of how they proceed. Model building in general can be a surprisingly emotive subject -

> "This model is very broad and could be very much more detailed. The research process is too big to tackle".

> "The problem with models is that they are a generalization and problems are always particular".

> "Any model that the researcher produces is unlikely to be generalizable to its full extent to any other research. The strategy for dealing with the problem is therefore a function of the problem and the researcher's own discipline".
>
> "The order of the research model is not rigid, it depends on getting hold of people etc.".
>
> "The model will only represent this particular study and I don't approach research with a standard model".
>
> "The model gives no insight as to how the process is done, merely what is done. i.e. purely descriptive".
>
> "Models may be useful as starting points but not to be followed rigidly. Too much structure may be wrong".

One respondent also pointed out the confidentiality problem. If they were working for a manufacturer they might not be free to discuss the project.

Deciding what was the current research to be discussed could be a problem. Some of the researchers were involved in several projects simultaneously. In this case, the project which took up more of their time was generally chosen. (One researcher was involved in a large project with about seven separate sub-projects involved, and insisted that none took up more time than the others. In this case the interviewer chose a project for the respondent to produce a task analysis, as it would have taken too long to produce a diagram for each). Some respondents were not presently engaged in 'research', for example, they were doing consultancy work or acting as an information officer or being in between projects, and in this case the most recent piece of research was discussed. This could have taken

place some time ago : eighteen months, for example. An advantage of this situation was that the researcher could describe a completed piece of research, a disadvantage is that the respondent may have had memory problems.

A definite disadvantage of this technique is that respondents often have to predict into the future, and guess about the past history of the project. Researchers were not always present from the beginning of a project. For example, one respondent replaced someone who left two-thirds of the way through a project. Similarly rarely had researchers just finished a project when interviewed. Any tasks identified by the researcher which have not actually been experienced obviously are not well grounded in reality.

Some of the projects discussed were team projects. These represented a difficulty in that different people may take on different areas. As one researcher commented you "could fit different people in at different points in the model". It might be more difficult for people engaged in team research to produce a task analysis for the overall project. Collective research with different research teams collaborating may present similar problems.

It is also difficult for a researcher involved in a large project with several related parts to draw a task analysis for the project. One respondent was involved in a five stage survey, in which the different parts were at different stages. In this case the diagram was describing, in effect, more than one piece of research. Deciding the cut-off point for "a piece of research" is difficult, when people are involved in large-scale research. Yet for the purposes of

elucidating information inputs to tasks a macro-description of a large-scale project is an unhelpful simplification.

Getting the individuals to describe the project that they were actually doing was difficult. Some of the models contain alternatives which indicate that the individuals are providing general ideas about how their sort of research proceeds. Some go even further and generalize totally!

Activities which can be considered information inputs are confused with 'tasks' in some of the diagrams. There is difficulty in deciding exactly what a task is. Obviously a 'literature search', or 'information from the rest of a field' and 'evaluate results in the light of sponsor's requirements' are not tasks but are 'identifying possible sites' and 'getting agreement of sponsors' tasks?

Some diagrams contain information flows from one task to another, which complicate them beautifully but do not aid the usefulness of the task analyses for elucidating specific inputs, as opposed to generalized information flow.

One respondent produced several diagrams of which the most detailed was used for the second interview.

Presenting Model 1 (basic research) and Model 2 (product development) did give the respondents some idea of what was expected but obviously not enough idea. The models 1 and 2 encouraged the respondents to pick up words from them, irrespective of whether they truely described their project e.g. "hypothesis" and "product". (For examples see Appendix 6 Models 4, 8, and 23). They also

provided an opportunity for many generalized criticisms of the models themselves, which do not contribute much to investigating what the respondents actually do themselves, and are not therefore reported here. The Model 1 (basic research) and Model 2 (product development) have already been validated by people actually engaged in these activities. (Amir 1977, Whitehall 1979). However, in so far as the models provoked a response they were successful.

There are improvements which could be made on the method used in this study to reduce some of the problems encountered in the first interview. If people were alerted, prior to the interview, that they would be required to produce a model describing their current research, the diagrams might be obtained more readily and also be more careful and therefore more faithful, representations of their research procedure.

Deciding which project to discuss out of several alternatives is not an easy problem to resolve. Chosing the project which takes up most of the researcher's time is a fairly simple way to decide between projects, but biases the diagrams obtained as they will then tend to describe the larger pieces of research. What a respondent perceives as 'research' work may even vary, and this will affect which project he/she chooses to describe. Respondents may not even state that there are other current projects they are involved with, if they feel their involvement is small or that the projects are less 'important'. Perhaps the interviewer could alternate between asking for a description of the most timeconsuming project and a description of the least timeconsuming project, when this situation arose.

The problem associated with team projects could be partially solved by inserting a question into the interview schedule designed to ensure that the interviewer finds out whether the project is a team one, before the interviewee draws the task analysis. The interviewer could then ask the respondent to draw a task analysis only for those tasks in which he/she was involved. The more pervasive problem associated with actual experience of tasks in a current project (as opposed to generalizations from the researcher's experience) is where respondents have not completed a piece of work from start to finish. An improvement here would be to insert a question which brings out the start and end points of the researcher's involvement in the project, and ask the respondent to produce a task analysis only for the research procedure between these points.

A worker with a multi-stage project which incorporates several pieces of research again presents a problem of choice. Probably the best way to get around this is for the interviewer to establish whether the project is multi-stage and if it is, for the interviewer to pick a stage at random. Because the interviewer is relatively ignorant of the research, he or she is less likely to choose the simplest project for a task-analysis.

It would seem that the interview schedule would aid the task-analysis procedure more if it contained specific questions relating to the scale of the research and the researcher's involvement in it.

Having decided on the interviewee's actual involvement in the research and having pointed out that only those tasks the respondent

was involved in, should be described, then the likelihood of obtaining generalized models or generalized elements in the models should be reduced.

The technique would probably be simpler to use if, instead of presenting Models 1 and 2, the interviewer actually described what a task analysis is. For example, "a task is a stage of the work out of which you proceed", and then draw simply a series of boxes with a start and end point. This would obviate the respondent's criticisms of the Models, which do not aid the task analysis procedure. It would also prevent the respondents from picking up inappropriate words from the models to describe their research. The description of task analysis could include explaining what is not a task (e.g. literature survey) and how the task analysis does not include information flow from one task to another.

Obviously some sophistication of the method would improve the success of the first interview in obtaining task analyses. However, not all the problems which arose in the first interview could be pinned on the method. Some of the stated objections of the researchers were simply general objections to the concept of models, which might have been given even with a more sophisticated approach. The interviewer is doubtless aware that models are general, descriptive, and that researchers do not approach their work with a rigid stage by stage model. An experienced interviewer as opposed to a student, might have fared better with some of the respondents because of their expectations of, and therefore reactions to, the procedure. Also it is very tempting for academic researchers to criticize the research method of an interviewer rather than answer the questions!

2. Alternative task analyses models to Models 1 (basic research) and 2 (product development).

Except for one individual, who accepted Model 1 (basic research), all the other respondents produced their own diagram. This suggests the respondents are engaged in different types of work from either basic research or industrial product development and that it ought to be possible to generate some alternative generalized task analyses representing the types of work they were actually doing. These would have been useful as tools for similar sorts of studies and to display the inputs gained from Interview II.

However, for the reasons outlined above, many fell far short of being complete task analyses, or representation of one actual current piece of research. This makes alternative generalized task analyses very difficult to produce. For instance, the literature review (Appendix 6 Model 14) really only consists of one task, in the context of this study, therefore is not really suitable for task-analysis. The production of the training package (Appendix 6 . Model 7) is really a creative exercise rather than research in the traditional sense. The production of the 'handbook' is probably similar. (Appendix 6 . Model 1).

Some new patterns did emerge, however. The most obvious was the relative importance of the social survey as opposed to experiments in much of the work. This is to be expected in work involving the interface between human beings and their environment.

It was pointed out that Model 2 (product development) might represent a company's R & D programme into which an ergonomist might

be contracted, at various stages eg. 'evaluating idea', 'adjusting prototype', in order to adjust the product to human (ergonomic) needs. The device needs to be tested on its 'target' group (eg. Appendix 6 . Model 16). The ergonomist would not follow the whole route of Model 2, eg.plan production. Similarly, an ergonomist may get equipment to test and parts of Model 2 may be applicable. One model (Appendix 6 . Model 24) was for a product development but not an ergonomic product development. This respondent felt a few stages were missing from Model 2 eg. "trials of the prototype".

In the projects investigated there appeared to be less use of established theory than in basic research. The starting point was not necessarily the literature, but might be a problem the researcher wished to look at or was requested to look at by a sponsor; or it might be an area which needed investigating. Another difference that emerged was that a formal hypothesis is not necessarily formed before work begins, or may never be formed.

One respondent commented that when engaging in social (human) research, the field is so complex that you must only go in with broad hypotheses. You then try to build concepts from the data gathered. Analysis in Grounded Theory (Glaser and Strauss 1967) has to be based on the data gathered. (Appendix 6 . Model 23).

As already mentioned some of the projects discussed were large, consisting of different pieces of work or surveys and sometimes carried out by teams. This means that a representation of a straightforward single survey or experiment is inadequate to represent this type of large-scale research.

The research may also, even if not particularly large-scale, have several tiers involved eg. laboratory and then field trials or a survey followed by a more detailed study of a limited number of sites. These stages may over-lap.

Progress reports to sponsors often have to be made at intervals to sponsors in contract research, so that there is not just one write-up as in Model 1 (basic research). The write-ups need to be in relevant (to the sponsor) terms. The endpoint of contract research may be recommendations or specifications. These specifications need to be as basic as possible so that the manufacturers can then plan 'production, packaging and presentation'. The end point is not simply a continuation of knowledge, as in much basic research.

Many of the researchers seemed to feel the influence of the sponsors keenly. Convincing of the sponsor prior to the research is necessary and the writing of the proposals is important. The researcher wants flexibility but on the other hand the sponsor wants specification of what you want to do. This is difficult "because you are making commitments to things you don't know the outcome of". In the absence of a contract the researcher has more freedom in structuring the area of investigation and deciding what to look at. As one respondent put it, he was "not constrained by necessarily useful areas".

Although this type of social research does differ from that represented in Models 1 and 2, it has not been possible to generate alternative task analyses as was intended. The models obtained are only partly task analyses and are very different from one another. Some important influences on procedure seem to be the presence or absence

of a contract, the endpoint of the research being a device or information, and whether the initiation of the research is an awareness of a problem or an area that needs investigation. Because general models of the different types of work encountered in the study have proved difficult to construct, the inputs obtained in the second interview are referred, in the next chapter, to individual tasks.

CHAPTER 4

Information inputs to tasks, with associated channels and sources

The diagram produced in interview I was intended to enable the interviewer to obtain many inputs from the interviewee at one interview, but for a variety of reasons it proved difficult to get real information inputs to tasks. Of the twenty-four people first interviewed, twenty-two were available for a second interview. Of these twenty-two, one respondent had not been on his particular project long enough to require information inputs, apart from updating from his colleagues.

It was intended to classify the information inputs obtained (into e.g. method, property etc.), but this proved difficult. Obtaining a specific information input into a task and then identifying the channel and source associated with it seems difficult even when there is scope for extensive probing. People are apt to provide vague inputs, and are more willing to discuss channels and sources than information sought or used. It is necessary to attempt to move the respondents' attention from how they collected information, to the actual information gained and put to use in the work. The respondents may mistakingly think the researcher wants to know about libraries and other channels rather than information gained through them. Recording the information input, then the channel and then the source in an orderly fashion was not easy because people tended to jump in between these. The information obtained from the interview is not always easy

to interpret at a later date, as the respondents can give confused comments and make generalized remarks. Also it was realised that the method is highly interpretative because the investigator decides what are the information inputs and this can be a fairly arbitrary cut-off point. Another problem is that the information inputs obtained are difficult to relate to the tasks described in the respondent's diagram, as in some cases the inputs reveal stages not in the task analyses. Many of the diagrams obtained from Interview I were not infact task analyses at all, or did not refer to a specific project.

One respondent preferred initially to wrestle with the technique rather than answer the questions. "I don't like specific examples because the processes themselves are general. This will result in a lot of missed information and the information will probably be distorted because what people remember is not necessarily what is important. The examples will be the simplest examples perhaps, rather than the most important. I don't like the technique. This is a great simplification and a lot of important information is lost".

Another problem was that people call similar tasks by a multitude of different names. For the purposes of displaying, grouping, and structuring the information inputs, a list of dozens of tasks with one or two information inputs each is unhelpful. Because of this the tasks were rationalized and decisions taken on when differently named tasks actually represented the same task. In some cases an input needed to be assigned to a more appropriate task. For example, it was necessary to move an input from the "task" "literature search" to

the task it actually aided, namely "survey design".

Information inputs to separate tasks are listed in tabular form below, giving for each rationalized task first of all the class of input, then examples of this generalized input. Some inputs were already generalized, but in order for the specific inputs obtained to mean anything in general terms, they were made more general. However, it was difficult to identify similar inputs expressed in different words. Some people gave the purpose of an input and this can help clarify the nature of the input. Knowing what sort of research the interviewee was involved with can also help in identifying similar inputs. For example, is it experimental or survey work, and is there a hypothesis, or is it work involving the production of a product? It would seem then, that task analysis can be useful in sorting out information inputs into groups.

Research where a hypothesis is involved

TASK: Problem definition

Information input	channels	sources
Gaps in our present knowledge of the area.	Literature search supervisors	Computerized database, Abstracts, books, journal articles. Literature
Information from previous work on the problem		
e.g. check problems have not been looked at before - chair measurements have not been looked at for this population i.e.elderly and disabled.	Internal information officer	Literature search - no information found
e.g. other people's method of approach to problem	academic and industrial supervisors. Literature	undergraduate project Literature computerized database abstracts,books,journal articles.
e.g.results of previous work.		
e.g.work done previously in the area.	Literature search Colleagues University library	oral (texts (journals
eg. experimental results	own study	
eg.information to support a proposal to sponsors-information to support arguments. Reviewed work of CUSSR.	contact - Former director of CUSSR (Centre for the Utilization of Social Science Research) was in a University department.	Reports and lists of publications
Information about other groups doing similar work	Other people in the field (potential subjects of the study) told researchers about other research groups.	The research groups gave some initial unpublished reports.

TASK: Hypothesis formulation

Information input	channels	sources
Results of own survey		
Research where no hypothesis is involved		

TASK: Idea definition/Problem identification

Information input	channels	sources
Sponsors idea of problem	Discussions with sponsors.	Discussions
eg.sponsors opinion of researcher's perception of problem.	sponsor	written comments
eg.sponsors description of problem - lawnmower accident details	Dept.of Trade	Computerised database. Home Accident Surveillance System (HASS) monitors home accidents admitted to hospitals.
Context of problem		
eg.working practices, equipment being used.	Discussions with sponsors	Discussions
eg.background information	Literature search - Internal University library Other professional libraries	Government and EEC publications. Journals, conference proceedings and reports. Books looked at last because they are more outdated
	Interviews	Oral
	Postal surveys	Returns
	Phone calls	Oral
Previous work in the area.	Literature search - Internal University library Other professional libraries.	Government and EEC publications. Journals, conference proceedings and reports. Books are looked at last because they are more outdated
	Interviews	Oral
	Postal surveys	Returns
	Phone calls	Oral
eg.similar studies - accidents studies and design related improvement studies	Internal Ergonomics journals	Internal reports Papers in journals

TASK: Identify issue(s) which require(s) investigation (problem definition)

Information input	channels	sources
Other peoples perception of the problem	Safety officers	Oral
	prospective sponsors	oral
	Ergonomics information Analysis Centre.(Dept. of Engineering Production. University of Birmingham).	Literature search Ergonomics Abstracts
	National Technical Information Service. (NTIS) (American)	Literature search
	Sponsor's library. (Health and Safety library).	"
eg.suggestions for other writers -some suggested people's internal representatations might be important - a writer suggested cognitive models might be worthwhile studying.	Came across these papers while looking at another related area. Contact gave papers.	Fitter 1978. Moreton et al 1977 Bernard 1978.
Information on possible causes and effects to do with problem. eg.appraisal of characteristics of the signal and how these affected response rates.	Literature search - Libraries Journals Contact with external organizations known to have interest in the area.	
Results of own investigation. eg. Laboratory trial results fed into field trials. eg. Recommendations from previous project. eg. what was acceptable to sponsors eg.what was achievable in terms of the research groups resources.	Own study	-
		EEC reports
	Sponsors Discussions with sponsors	Discussions with sponsors Discussions

TASK: Plan Survey

Information input	channels	sources
Costs of doing survey		
eg. financial information to cost the project - researchers specify needs and these are costed out.	Finance office - university Finance office - Tavistock Institute.	The finance offices filled in the sponsor's costing forms.
eg. Quotations for printing questionnaire	Typesetters	Oral
People to contact about survey		
eg.who to contact to set up the field sites.	Formal channels (of sponsoring organization)	
eg.Information about organizations to whom questionnaires could be sent.	Internal (within the research group)	Oral and answers from an internal circular asking for information booklet - "OFFIX" user brief.
eg.results of an external organizations tests on products (results went into total assessment of chairs)	FIRA - tests furniture	Report and phone-calls.
eg.suggestions of things we ought to be looking at (chairs)	Carestaff of subjects.	Oral(interviews)
eg.information from manufacturers about their products - helped researchers to select a range of chairs. Gave researchers specifications about chairs - told them if they met certain criteria.	Manufacturers.	visits letters publicity material Phone calls
eg.information on British Standards - structural fatigue, flammability - helped researchers assess chairs and helped identify what needed to contact an external organization about.	British Standards body. Dept.of Environment	Relevant Standards
eg.information on the testing of stability of chairs.Helped decide what to look for in stability part of survey	Home Accident Surveillance System (HASS) Video survey of how people use chairs. D.H.S.S.(how tests chairs for stability)	Report Internal report Personal contact - D.H.S.S.reports.

CONTD:

Information input	channels	sources
Background on respondents		
eg. Background to the client situation	Industrial supervisor	Oral and written reports
eg.Relevant subject areas for questionnaire eg.Attitude statements for inclusion in questionnaire	Target group of survey	Discussion groups
eg.state-of-the-art - opinions of accidents and motorcyclists, present state of training for motor cyclists.	Target group of survey. Road Safety Officers Police Motoring organizations training organizations Royal Society for the Prevention of Accidents Research establishments.	Transcripts of discussion groups. oral and local studie done themselves. oral opinions oral Publicity material ar accident statistics References
Similar work eg.style of adverts and contents of articles for and letters by subjects ie.information and adverts available to motorcyclists.	Purchased sources	Current motoring magazines available t general public about motorcycling.
eg.current news on aspects of subjects - current news on road accidents.	Subscription	'Care on the Road'. Royal Society for the Prevention of Accidents (RSPA) publication.Newspaper
eg.How to organise the sample of subjects - how records are kept of motorcyclists and how could organize sample of motorcyclists through Driver and Vehicle Licensing Centre.	Driver and Vehicle Licensing Centre	Oral
Background information on problem	Literature search	Journal articles, laboratory reports an
eg.revealed lack of information on facial dimensions		military technical reports
	Military people Designers,manufacturers and users.	oral oral
eg.centiles of body measurements.in order to build a desired chair dimension rig.	Person who conducted the analysis	oral
eg.information on foam densities - chair comfort analysis of the previous Desired Chair Dimension Survey - in order to build chair rigs.	Dept.of Environment. (Dunlop (Literature Search internal	Written recommendatio Leaflets and samples journals results of computer runs

CONTD:

Information input	channels	sources
eg.background information so you know what you are looking for.		
eg.previous experiments with accident involved equipment.	Internal	Research reports
eg.information about products available on market.	Manufacturers. (design and marketing representatives)	Publicity material Oral
Information from pilot survey	-	-
Data-gathering methods		
eg.data-gathering techniques including measurement techniques	personal experience	-
eg.examples of the use of data-gathering techniques did not appear to work-because no significant statistical relationship between facial dimensions and leakage	literature search	-
eg.methodology	Personal knowledge	eg.reread Glaiser and Strauss
eg.names of practitioners in a field (in order to establish what would be a reasonable sample) - Survey of Who's who in the Social World - names and addresses	Personal contacts -	Personal contacts Organizational Development Network - membership directory British Psychological Society - membership directory
eg.methods that have been used - are they applicable to your study?	Colleagues Library	Texts on methodology and reports of other surveys.
Method of study		
eg.methods of recording activities of users of equipment (eg.lawnmowers)	Internal	Oral
eg.How to structure the user task	Internal	Oral
eg.method of approaching respondents - how to approach lawnmower accident victims	Past users of HASS (Home Accidents Surveillance System)	Oral (informal)

CONTD:

Information input	channels	sources
eg.how to approach subjects familiarity with field sites because used them for previous studies	Personal experience of other members of research team	Informal
eg,method of structuring questionning of respondents - how to structure questionning of lawn-mower accident victims	Past users of HASS	Oral (informal)
eg.ideas about the best way to go about the pilot study	Industrial supervisor	Oral and written reports
eg.content of structured and semi-structured interviews	Personal experience. Initially internal - then followed up at University library	References. Journal articles and books
eg.information necessary to form questionnaire	Previous experience Sources of a colleague	Survey report
eg.attitude measurement methods.	University library	(texts,surveys, reports, (standard reference (documents
eg.method for attitude testing - used method throughout the work.	Found by chance whilst doing the literature search	Market research text
eg.How to code data	colleagues university library	textbooks
eg.coding for analysis -eg.coding on the questionnaire	Computer centre	oral
eg.list of measurements to be taken	Produced earlier in project - internal	booklet
eg.How to take certain measurements	University library Professor Personal collection	textbooks oral past survey
Evidence that correct techniques are being used (Are you doing it the "correct way?")	colleagues library	texts on methodology an reports of other surveys.
eg.other peoples attempts at measurements.	Internal	Previous projects reports.
Criticisms of measure-ment techniques.	University library	Books
	External colleagues	papers sent off for or borrowed from external colleagues
	-	conference proceedings

CONTD:

Information input	channels	sources
Sponsors criticism eg.criticism of questionnaire. Adjustments were then made where necessary. eg.sponsors requirements	sponsors colleagues Some of target group of survey progress meetings	meetings discussions discussion groups oral

TASK: Plan experiment

Information input	channels	sources
Sites to carry out experiments eg.details of possible sites	tapped contacts	
eg.availability of equipment and facilities for trial	sponsoring body	discussion with
Availability of facilities	"	"
Techniques		
eg.Repetory grid technique eg.method of investigating a phenomenon - how to investigate intervals between bleeps	Personal knowledge/ education colleagues sponsors Internal University library	based on Kelly - 1955 oral oral Journal articles from literature search
Information about equipment used in trial eg.details of present system - more specific information on warning systems in use.	Sponsor	Internal reports Research reports from International Association of Railway Companies. Visits to tracksites to see warning systems in operation.
eg.technical information about equipment used in trial - collate technical information about equipment. Enabled one to provide facilities to operate the field study.	Sponsoring body	Oral technical brochures

TASK: Making the survey

Information input	channels	sources
Location of participants eg. where people live, was lunch available - will subject give me lunch.	-	routes,maps, file of names and addresses
How respondents are organized or interact eg. need to know how the company operates in order to fix taking the measurements. Need to talk to different people at different levels of the company.	Informal chats with company personnel	
eg. researcher went on course for managers/ social scientists in order to learn how to manage the process of interaction between the two types	course	-

TASK: Data Analysis

Information input	channels	sources
Statistical techniques eg.statistical measures - to use in comparing different measurer's results.	Professor	textbook
eg.method of analysis - program for drawing graphs.	Computer Centre	Manual on CALCOMP
eg.information on statistics tests.	Computer Centre, Professor, Human Sciences Department Internal personnel	oral textbooks references (textbooks (lecturenotes
eg.Datahandling methods statistical knowledge, computer techniques	Human sciences Department Computer Centre Personal knowledge	oral own self books

Information input	channels	sources
Computer operation eg.How to input data into the computer - how to store it, rearrange it etc. Basic computing. More advanced computing	colleagues Computer centre Human Sciences Department. Internal	oral (Manuals, reference (guides and oral oral oral

TASK: Draw Conclusions

Information input	channels	sources
Information, facts or hypotheses from other sources than survey, experiments. eg.other people's conclusions - what other people have discovered, "said", - in order to see if your results enhance their view or not.	-	The published literature
eg.Check factual statements incorporating new data not collected at time of the experiments.	Phone relevant body	oral. Body may follow up with written information.
eg.other people's reports on equipment under investigation - problems that face users with specific models of lawnmowers.	Internal subscription	"Which" (periodical) reports on lawnmowers.
eg.existing British Standard on product-existing standards on lawnmowers - to use as a basis for enlargement	British Standards Institution	Standards
eg.Background information for evaluating results - psychology of motor-learning and developmental psychology	Own experience. Undergraduate Course	Bartlet 1958 Piaget 1962 (cognitive learning theories)
Opinions from research group or supervisor	supervisor own research group	oral oral

TASK: Report writing

Information input	channels	sources
Guidelines on writing/structure		
eg.structure of report made by other cooperative research group.	other cooperative research group	report
eg.sponsor's guidelines for reporting - check on contents etc.	Sponsor	

TASK: Report publication

Publication costs		
eg.How to and costs of publishing in booklet form	Internal meeting	Member of research group's expertise
Formats		
- formats used in reports	Internal	Previous reports of research group

TASK: Develop idea for product

Information input	channels	sources
perceived need	-	-
Background in the area.		
eg.information about human performance in relation to a "product"		
eg.what weights people can carry all day.	Literature search done internally in Human Sciences Department.	Journal articles.
	Small experimental study by Human Biology colleagues.	experimental results.
eg.previous work in area.		
eg.information on visual presentation techniques- in order to choose what medium to use.	Audio Visual Service - University Department.	oral
Details of function required		
eg.evidence for perceived need - how companies select their employees now.	People initial reading	oral General texts. Occasional technical memos from people who employ controllers
Assessment of current products.		
eg.how the present lineprinters operate.	Locate manufacturers from journals etc. obtained externally or internally.	Journals and product magazines to find manufacturers. Manufacturers' literature.
eg.evaluation of existing techniques - selection tests available and how and when used.	Literature review. Distributor of psychological tests - Sent off for their catalogues.	Journal articles. Catalogues.
	People at field sites.	Discussion.
eg.other people's exercises and role - playing games.	Internal-colleagues who had worked in this field. External-sent off for information from other training agencies after seeing references to them in the literature.	Publicity leaflets

TASK: Evaluate idea

Information input	channels	sources
opinions on "mockups" some alternatives were discarded after discussion	people with 'educated' opinion	oral opinions

TASK: Design product

Details of existing products or components. eg.best type of electronic display to use - optimal colour,character size,from literature search choose some specific displays to look at experimentally	Literature search	journals
eg.optimum keysizes, key depression distances - choose some types to look at experimentally	"	"
eg.information on how to use the existing line-printer machine.	external contact	Handbook

TASK: Produce prototype

Backgroumd information on topic eg.information on electronic circuits	Personal sources, Library, Department.	Textbooks
eg.to develop computer simulation technique need programming information and help.	Expert - (external contact - Leicester Polytechnic).	Correspondence, oral, on computer discs.

TASK; Produce final product

Information input	channels	sources
Standards of presentation		
eg.red light when its on, rather than when its off.	Internal	Laboratory work books

Significant information inputs to the work of the researchers

The "idea" is influenced in contract research very much by the external support given it by sponsors. The influence of the sponsor on the whole research procedure can be strong as the work needs to be oriented to the demands of the sponsor, and written up in terms relevant to the sponsor.

The external environment is more important generally, in this type of social research. The research needs to take into account the environment in which it is conducted, as well as previous work in the area and the background information which is required in basic research. Information on data-gathering techniques and tools e.g. questionnaires, technical information concerned with equipment and products, organizing the field sites and the sample, statistical techniques and report writing, are all important.

Channels and Sources

When looking at information collection, rather than at inputs to their work, it became clear that people do not necessarily have a systematic information collecting behaviour. "It's difficult to order your information collecting strategy because different things happen at different times for different projects and you do things when you can". This does not mean that respondents are unaware of information needs. "We are continually looking out for information - our "antennae" are out continuously. As you get near to closure, you hope your "antennae" don't pick up anything!" Serendepity can play

an important part in information collection. "Most of the critical information for obtaining the design of the apparatus was from serendepedity i.e.talking to people who just happened to know something. 90% of what people tell you turns out to be useless".

Finding out about an area can include visiting people as well as conducting literature searches. Contacts (internal, external and sponsors) are generally important channels. "A lot of our information has been by word of mouth". External specialist organizations and information centres are used. Internal information collections such as the research groups own collections, and the University library are also used. Other University departments (including the computer centre) and manufacturers are contacted.

Much information is transmitted orally but also used are journal articles, internal and external reports, conference proceedings, textbooks, catalogues and publicity material from manufacturers, Society membership directories, magazines for the general public, correspondence, technical brochures, statistics, British standards, manuals, lecture notes, computer discs and laboratory work books.

There appear to be some correlations between the type of information being sought and the channels and sources used. Some types of information are inextricably linked with a particular channel. For example, the context and background of a problem, details associated with the situation being investigated, and the sponsors' guidelines and criticisms, usually come from the sponsoring body. The information is often oral but may involve other material such as reports. Similarly the opinions of one's colleagues and supervisor must come from

the individuals themselves. Some types of information although not inextricably linked with a particular channel, are nevertheless linked with the most obvious channel to consult. For example, finance offices for costing surveys, manufacturers for current product details (e.g. in the form of catalogues), and typesetters for quotations for printing of questionnaires. In some cases the information being sought can be partially met by internal sources (internal to the research group) but needs to be supplemented by an "external" source. For example, basic computing information can be obtained internally from colleagues but more advanced computing information can be obtained for example, from the Computer Centre, in the form of discussion and manuals. Some information needs can be met by largely internal sources, such as information on methods of study and report publication. Some needs however, are more dependant on external sources, such as backgroumd information on respondents. These external sources can include contacts and "experts" in a particular field as well as formal information services.

The information needs of the researchers are met by a range of formal and informal channels, with the informal channels playing an important part in the process. Some of the information needs are specialist, for example, "the context of the problem" and the "background information on respondents" and will vary greatly from project to project. Some needs are more general, such as "report publication" and "computer operation".

CHAPTER 5

Conclusions

The task analysis technique has been tried out, (as an alternative to other methods used to reach information needs) to find information inputs to professional work. The technique was intended to encourage respondents to concentrate on information used in tasks rather than on demands made upon channels and sources, which are affected by random behaviour.

The technique did supply ample information inputs but was not simple to apply in practice. Obtaining task analyses from the respondents, in order to use them later to obtain instances of information input, proved to be the major difficulty. For one thing, it was difficult to obtain a task analysis of the piece of work actually being done. In place of showing Model 1 (basic research) and Model 2 (product development) to describe what a task analysis actually is, an alternative method is suggested, which would obviate the general criticisms of Models 1 and 2 which were offered, and prevent respondents from picking up inappropriate words from the models.

It was not possible to produce standard task analyses for different sorts of work from the diagrams produced in the study as many fell short of being complete task analyses or even of representing a particular piece of research, and they were all very different from each other. It was decided therefore to relate the inputs to a list of the individual tasks provided by the respondents. This presented difficulties

because the researchers used different names for similar tasks. Having one or two inputs to a "task" is of little use for grouping inputs. The tasks had therefore to be rationalized.

It is suggested that in future work the respondent would be presented with a pack of cards, each bearing the name of a task and the respondent would be asked to use these cards to construct a task analysis. This would prevent the respondent from adding extraneous details to the task analysis, such as information flow, and would prevent him or her from confusing information inputs with tasks. It would be explanatory without imposing a chronological structure on the tasks, and a choice of task names could be given. Another method would be for the interviewer to ask the respondent for the past history of the project and then to assign tasks to this description at a later date. This could be more timeconsuming for the investigator than the previous method where the tasks are identified in the interview.

Obtaining specific information inputs also presented problems. The comments of the respondents could be confused or vague, and they could be more willing to discuss channels and sources than information sought or used. However, where the interviewee tells how an input was used, the nature of the input is clearer. It would seem therefore sensible to ask for the purpose of an information input as well as for an example.

An argument in favour of encouraging the respondent to provide a task analysis is that because it shows what sort of research is being conducted, it can be useful to sort the inputs into groups - for instance research with or without a hypothesis, experimental work

versus survey work versus product development. The method is highly interpretative because the investigator decides when an information input has occurred, and so the more information he or she has about the input the better.

In order to overcome the problem of people wandering off onto channels and sources in the information inputs interview, it would be preferable to leave out questions concerning channels and sources altogether, and make it perfectly clear at the outset of the interview that the investigator is not interested in hearing about the use of formal documentation services such as libraries. This however would take some courage on the part of the investigator as studies of this type in the library and information field have traditionally involved forms and sources. If forms and sources were omitted, then some value of the information inputs for justification might be lost, as the link between input and a particular service would not be shown. Similarly one could not compare sources used presently by the researchers with sources known by the librarian or information officer to produce the "best" information. (e.g. up-to-date, comprehensive, more easily accessible etc.).

Summary

The inputs into the work of the researchers of the Institute for Consumer Ergonomics and the Human Sciences and Advanced Technology research groups have been described, and it can be seen that external influences are strong on this type of research, with the sponsor and the context in which the investigation is conducted being generally

important. Informal channels play an important part in fulfilling the researchers needs for information inputs to the research.

It would seem then that the task analysis technique can provide information inputs to professional work which would be useful to people planning information services for particular groups. Obtaining the task analysis seems to present the most problems but these may be partially alleviated by presenting the respondents with individual "tasks" to organize. Task analyses are relevant because knowing the type of research can help organize inputs, as well as the tasks providing aide-de-memoires for obtaining information inputs to the research.

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APPENDIX 1

Description of HUSAT (Human Sciences and Advanced Technology Research Group). Department of Human Sciences, Loughborough University of Technology

This research group is concerned with the interface between the Human Sciences and Advanced Technology. The research group was established within the Department of Human Sciences, Loughborough University of Technology, in August 1970. It had the following aims:

a) To undertake research studies and applications projects on the human aspects and implications of advanced technology.

b) To use the concepts and methods of advanced technology, where appropriate, in the Human Sciences.

The group aims for about 50% research and 50% applications work. In the past the main support for research has come from the Social Science Research Council (S.S.R.C.), the Science Research Council (S.R.C.), and other Government bodies, although in a number of cases industrial sponsors have provided funds for research. Funds for applications projects and consultancy work are provided by the relevant industrial or commercial organisations. The themes which have emerged to dominate the work of HUSAT are:

a) The potential of advanced technology to support the work of individuals.

b) The problems users of current systems have in realising this potential.

HUSAT seeks to influence technological systems as they are developed, by its balance between research and applications. The work of HUSAT can be grouped very generally into studies concerned with man-computer interaction, and studies concerned with job design and work organisation.

Another important function of HUSAT is the dissemination of the accumulated knowledge of the research group.

Description of Institute for Consumer Ergonomics (ICE) Ltd.

The Institute is a corporate autonomous body although it has close links with the Department of Human Sciences at Loughborough University of Technology. It was set up in 1970 by Loughborough University of Technology and the Consumers Association with the aim of improving standards of consumer products. Ergonomics is the study of the interaction between people and their working environments. This includes equipment with which they live and work, and the products and services that they use. Consumer ergonomics is the application of ergonomics to the problems that the general public as consumers encounter. The Institute derives its income solely from research contracts with external sponsors. The work can be classified into broad categories:

a) Consumer experience and requirements; information is collected on user's experiences and requirements in relation to consumer products by means of surveys and interviewing.

b) Consumer characteristics and capabilities;
These investigations are often preliminary studies that can provide basic data and criteria to be used in subsequent projects.

c) Evaluation studies; to examine what existing designs meet people's needs.

d) Design specifications; Ergonomics specifications are developed for new products to ensure that the users' needs are met.

Appendix 2 .

M.Sc. Information Studies,
Department of Library &
Information Studies,
Pilkington Library.

21st June 1982.

Dear

I am a post-graduate student doing a dissertation concerned with information consumed in the research process. I am interested in seeing if analyzing the research process into a step-wise model will help in assessing what information is used. I would like to conduct two, half-hour, interviews with you. The first interview would be concerned with a model of the research process, and the second with information actually used in the various steps of the model. I shall be interviewing various staff in the Human Sciences Department and hope to conduct enough interviews to get some useful results, which might ultimately lead to provision of more systematic information services.

I will be in touch to invite your cooperation and to arrange interviews at a time convenient to you, and would value your participation.

Yours sincerely,

Carol M.Breadmore.

Appendix 3 .

Information inputs to basic research (Whitehall 1980)

Tasks	Some possible information inputs to tasks
Idea	Details of other peoples' work in the area. (to stimulate ideas, to see what work needs to be done, to see if the idea is new).
Re(form) hypothesis	Current theories of a process. Information which contradicts the way we are thinking. Information which supports our ideas. An existing model. Concepts from another science or technology. Data from experiments.
Make experiment.	Methods, techniques, services available. Help with the analysis of data. Help with the interpretation of data.
Write-up results and conclusions	Support for the discussion part of the paper. Details of other relevant work. Methods of presentation. Full details of references to be cited.

Information inputs to product development (Whitehall 1980)

Tasks	Some possible information inputs to tasks
Idea for a new product	Areas in which product development is needed. Consumer need. Competitors product. Patent applied for or granted. Results of basic research. New techniques for production. Raw materials used already. Production processes used already. News of alternative materials for formulation. Company markets.
Evaluating the idea	Cost of developing the idea into a saleable product. Cost of alternative routes to the product. Consumer acceptance. Relevant legislation. Activities of competitors in the area. Price at which product would sell. Size of market for product.
Making a prototype	Has anyone solved the problem in another way? Results of basic research. Available materials and recipes. Available methodology. Design information.
Adjusting the prototype to needs of cost and production facility.	Alternative materials and recipes. Alternative methodology. Costs of raw materials. Costs of production.
Planning the production.	Available equipment. Design data for equipment. Alternative processes and their cost. Facilities available within the company. Information on where production plant might be situated.
Planning the packaging and presentation.	Packaging materials. Effect of air, water, time etc. on the product. Packaging methodology and equipment. Consumer expectations of the product.

APPENDIX 4

Human - Factors Engineering/Ergonomics

Despite minor differences in emphasis, the terms human-factors engineering and ergonomics may be considered synonymous. The term human-factors engineering is used to designate equally a body of knowledge, a process, and a profession. As a body of knowledge, human-factors engineering is a collection of data and principles about human characteristics, capabilities and limitations in relation to machines, jobs, and environments. As a process, it refers to the concept of designing machines, machine systems, work methods, and environments to take into account the safety, comfort and productiveness of human operators and users. Human-factors engineering, as a profession, includes a range of scientists and engineers from several disciplines that are concerned with man at work.

The terms human-factors engineering and human engineering are used interchangeably on the North American Continent. In the U.S.S.R. the term engineering psychology is preferred. In Europe, Japan, and most of the rest of the world, the prevalent term is ergonomics, a word made up of the Greek words 'ergon' meaning 'work', and 'nomos' meaning 'law'.

Because of its broad scope, human factors engineering draws upon parts of such social or physiological sciences as anatomy, anthropometry, applied physiology, environmental medicine, sociology, psychology and toxicology, as well as parts of engineering, industrial design, and operations research.

The basis of human-factors engineering - the consideration of information about human users in the design of machines, tools, jobs and work environments - has always been present. One of the oldest and most efficient of human implements, the scythe, shows a remarkable degree of human-factors engineering, undoubtedly reflecting modifications made over many centuries. It has an adroitly curved handle and blade and a peg grasp for the left hand. The need for a more formal approach to human problems appeared when machines became far more complex than they had ever been. Human-factors engineering was born out of a mechanized civilization. As a profession, human-factors engineering is very young. The first known course in engineering psychology was offered at Johns Hopkins University in 1947. In the 1970's, hundreds of educational institutions in the world offered human-factors programmes, most of them either schools or departments of engineering or in departments of psychology.

In the United States, the main professional societies are the Human Factors Society, the Society of Engineering Psychologists of the American Psychological Association, the Institute of Environmental Sciences, the Aerospace Medical Association, and the Man-Machine Systems Group of the Institute of Electrical and Electronics Engineers. Organizations outside the United States include the Ergonomics Research Society (with headquarters in Great Britain), the Ergonomics section of the Czechoslovak Committee for Scientific Management, the Gesellschaft für Arbeitswissenschaft (Association for the Science of Work; Germany), the Human Factors Association of Canada, the Japan Ergonomics Research Society, the Nederlandse Vereniging voor Ergonomie, the Nordic Ergonomic

Society, the Polish Committee on Ergonomics and Labour Protection, the Société d'Ergonomie de Langue Française, and the Societa Italiana di Ergonomia. These are, in turn, federated with the International Ergonomics Association (IEA), an organization (in 1970) with members in some 30 countries around the world. The principal journals in the field are 'Human Factors' (published in the U.S.), 'Ergonomics', and 'Applied Ergonomics (published in Great Britain) (The New Encyclopaedia Britannica, 1974).

Appendix 5. Details of interviewees

Job title and period of time in the position.	Subject background.	Project discussed.
1. Senior research officer. (3 years) No second interview (interviewee ill)	Psychology	Contract research. Compiling ergonomic information on a design topic for a manufacturer. (confidential)
2. Research officer (7 months)	1) Ergonomics 2) Pending - M.Phil in Production Engineering. Member - Ergonomics Society	Contract research. Team project. Aim to produce ergonomic specifications for the design of easy chairs and guidelines for chair purchase. Entered project 2½ years after its start.
3. Principal Research Officer (2½ years)	1) Mechanical Engineering 2) Ergonomics - Member - Ergonomics Society	Contract research. Track-side warning equipment for railway workers. Optimising the configuration of the "safe" to work tone. Had completed the work.
4. Research Officer (1 year)	Ergonomics - Associate of British Pharmaceutical Industries.	To establish whether sufficient variation in facial forms to justify production of more than one size of respirator etc. Generating ergonomics criteria to be produced in specifiable form.
5. Senior Research Officer (1½ years)	Psychology	Contract research Team research. Survey of attitudes, opinions and knowledge of motorcyclists. Was not involved in the setting up of the work or in forming the hypothesis.
6. Research Officer (7 months	Ergonomics	Contract research. Team research. Aim to say to what extent working with VDU is causal factor of visual discomfort of work. Entered project 1 year after its start.

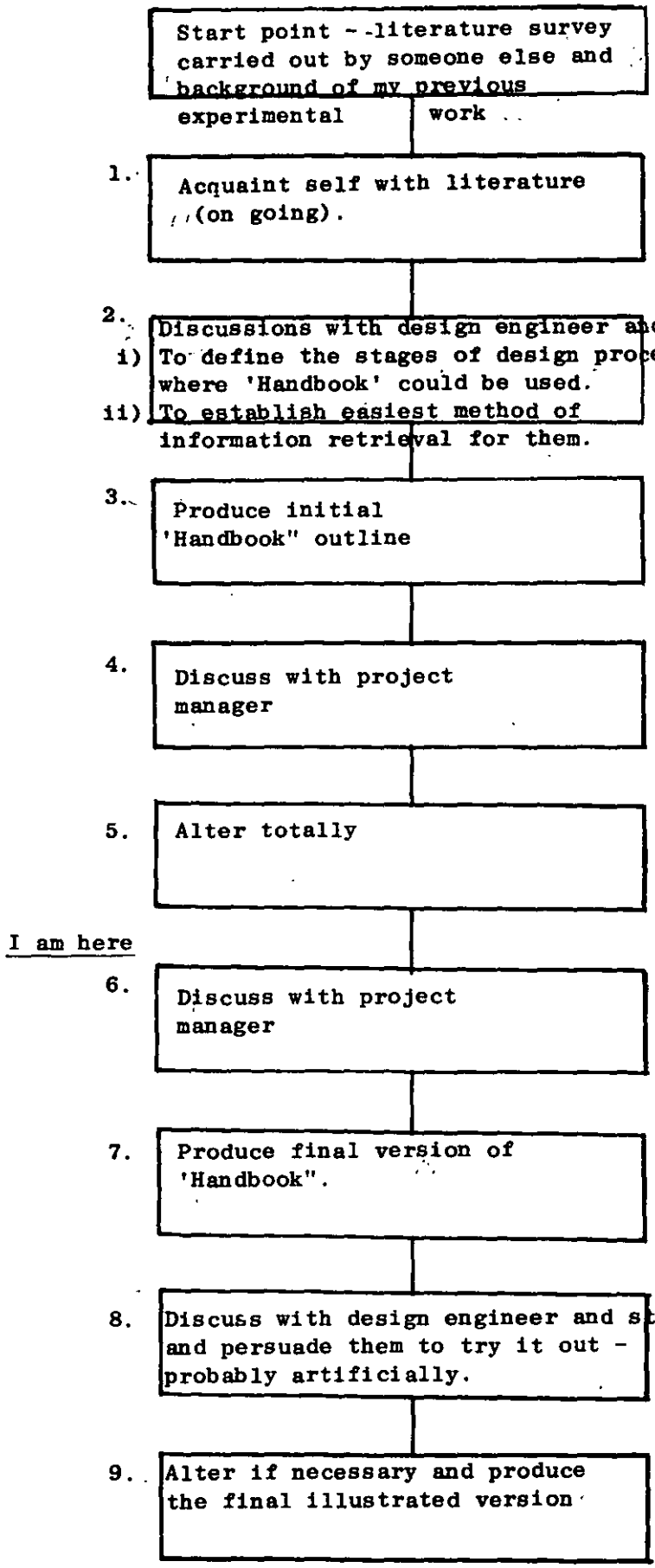
Job title and period of time in the position	Subject background	Project discussed
7. Senior Research Officer (4½ years)	1) Applied Zoology and Geography. 2) Ergonomics, Member - Ergonomics Society, Society for Research and Rehabilitation, Royal Society for Health.	Contract research. Team research. Creating a training package to teach ergonomics to instructors in skill centres. Aim of package is to get more disabled people through skill centres
8. Senior Research Officer (2½ years)	1) Human Biology and S.R.N. 2) Ergonomics. Member Ergonomics Society	Contract research. Team research. Aim to produce ergonomic specifications for easy chair design and guidelines for easy chair purchase.
9. Senior Research Officer (1 year and 5 months)	Ergonomics	Contract research. Team research. Aim to say to what extent working with VDU is causal factor of visual discomfort of work. Started on project after hypotheses had been formed.
10. Senior Research Officer (2½ years)	1) Psychology (with industrial psychology option) 2) Diploma in Training 3) Doing Phd at present. Member - British Psychological Society	Contract research. Developing job placement techniques for use in rehabilitating disabled workers back to appropriate work. Produce 6 monthly and annual reports for sponsor.
11. Senior Research Officer (6 years)	1) Production Engineering 2) Industrial Engineering and Administration Member - Ergonomics Society	Team research. Contract research. Researcher replaced someone who left $^{2}/_{3}$ rds of the way through the project. Survey of attitudes, opinions and knowledge of motorcyclists.
12. Senior Research Officer (4 years)	1) Psychology 2) Architecture and Building Science.	Contract research. Indepth investigation of lawn mower victims accidents to identify activities and lawnmower types implicated in accidents and see how those factors relate to existing designs.

Job title and period of time in position	Subject background	Project discussed
13. Research Associate (6 months)	1) Sociology 2) Information Studies (Social Science) Member - Library Association Institute of Information Scientists	Contract research. Looking at EEC Governments legislation about the disabled and any initiatives that they or private research groups are taking to develop microcomputer solutions to the problems disabled people face in work situations
14. Research Associate (1 week) No second interview (interviewee on holiday)	Psychology Member - British Psychology Society Pending - Institute of Management Services.	Literature review to produce guidelines for systems design. (user command languages)
15. Research Student (2½ years)	1) Ergonomics 2) Studying Phd. at present.	Contract - idea came as a fixed specification. Reactions of naive users to word processors in their own environments.
16. Co-director HUSAT (half-time) (1year 3 months)	Ergonomics and Cybernetics. Member - Ergonomics Society	Development of Microprocessor-based handbilling machine. HUSAT called in by a company to be involved in its design and development. Produced technical specification.
17. Research Associate (2 years)	Ergonomics	Researcher not involved in the proposal writing. Work organization implications of word processing. Trying to derive classification of work organization for word processing - then look at effects of categories you have developed.
18. Research Student (2½ years). Part-time research associate (2 months)	1) Psychology 2) Ergonomics 3) Studying Phd. at present.	Cognitive factors in the way people respond to computer use. (2 personality types - machine indifferent and machine oriented)

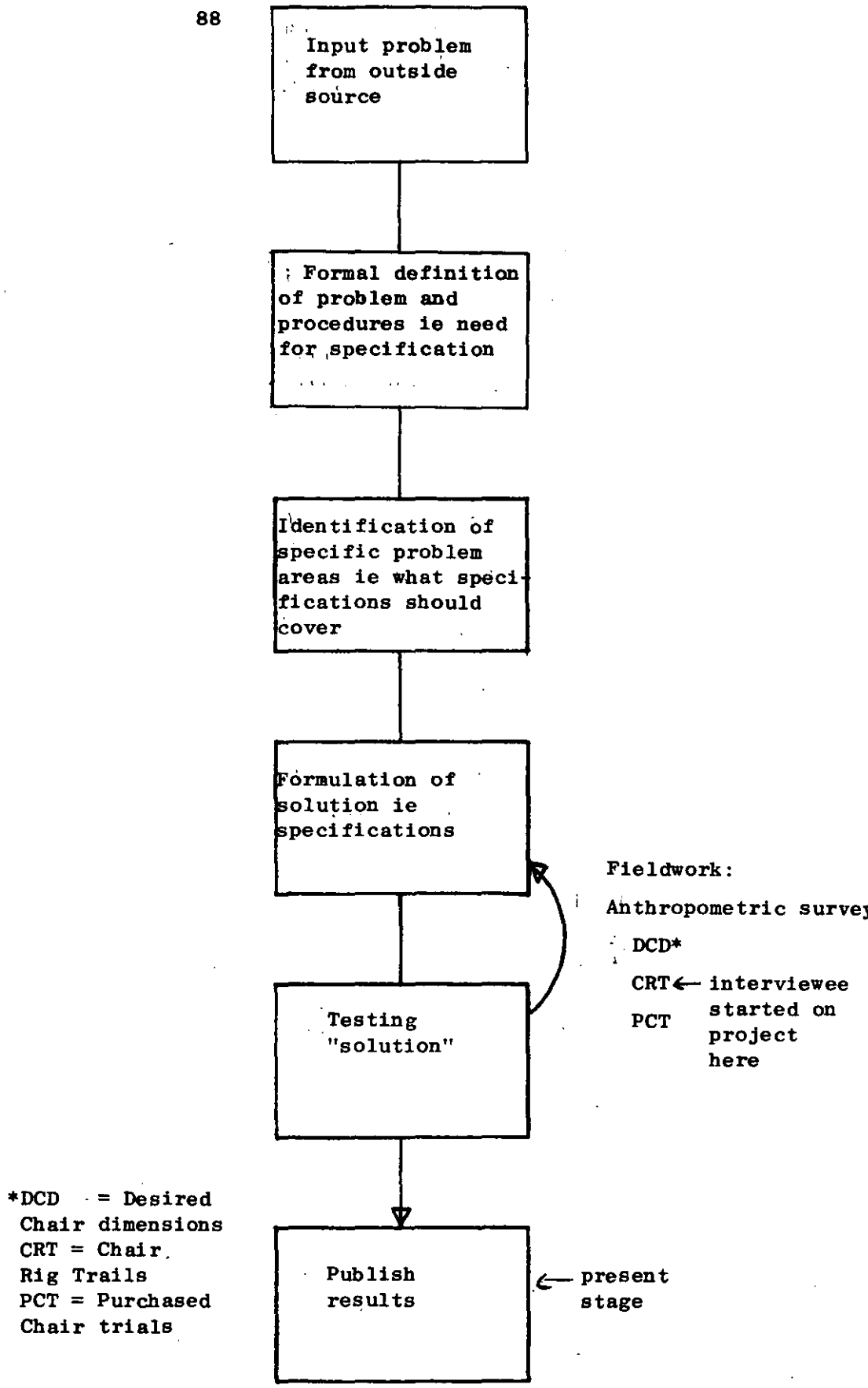
Job title and period of time in position	Subject background	Project discussed
19. Research Associate (1 year)	Ergonomics Member - Ergonomics Society	Contract research. State-of-the-art study - on the extent of the introduction of new technology. In collaboration with other research groups. 5 stage survey.
20. Research Associate - Information dissemination. (6 months)	1) Psychology 2) Phd.pending Member - British Psychological Society	Investigation of computerized selection techniques for control room personnel. Developing and evaluating a computer simulation. The work was completed.
21. Research Assistant/ Student (2 months)	1) Ergonomics 2) Studying for Phd. Member - Human Factors Society	What learning takes place when computers introduced into environments where people using them as tools.
22. Research Fellow (2 years)	1) Mathematics 2) Quantum theory Member - Ergonomics Society	Human factors evaluation of 3 year experiment into electronic journals and other communication facilitated by computer-based message systems. Includes about 7 projects. Model given for one project - " effect on working patterns".
23. Senior Lecturer (4 years) co-director of HUSAT (12 years)	1) Psychology 2) Manager-computer interaction. Associate of British Psychological Society. Member - Ergonomics Society	Studying the process by which social science consultants work with organizations. In conjunction with other research groups. There was a long gestation period to the idea. - getting the right sponsors. etc.
24. Research Associate (4 months)	1) Ergonomics and metals and Materials science. 2) Microcomputer systems.	Development of microprocessor cotrol for a scrap line printer. (The interviewee had conducted this research in his previous job at a microprocessor applications centre.)

APPENDIX 6

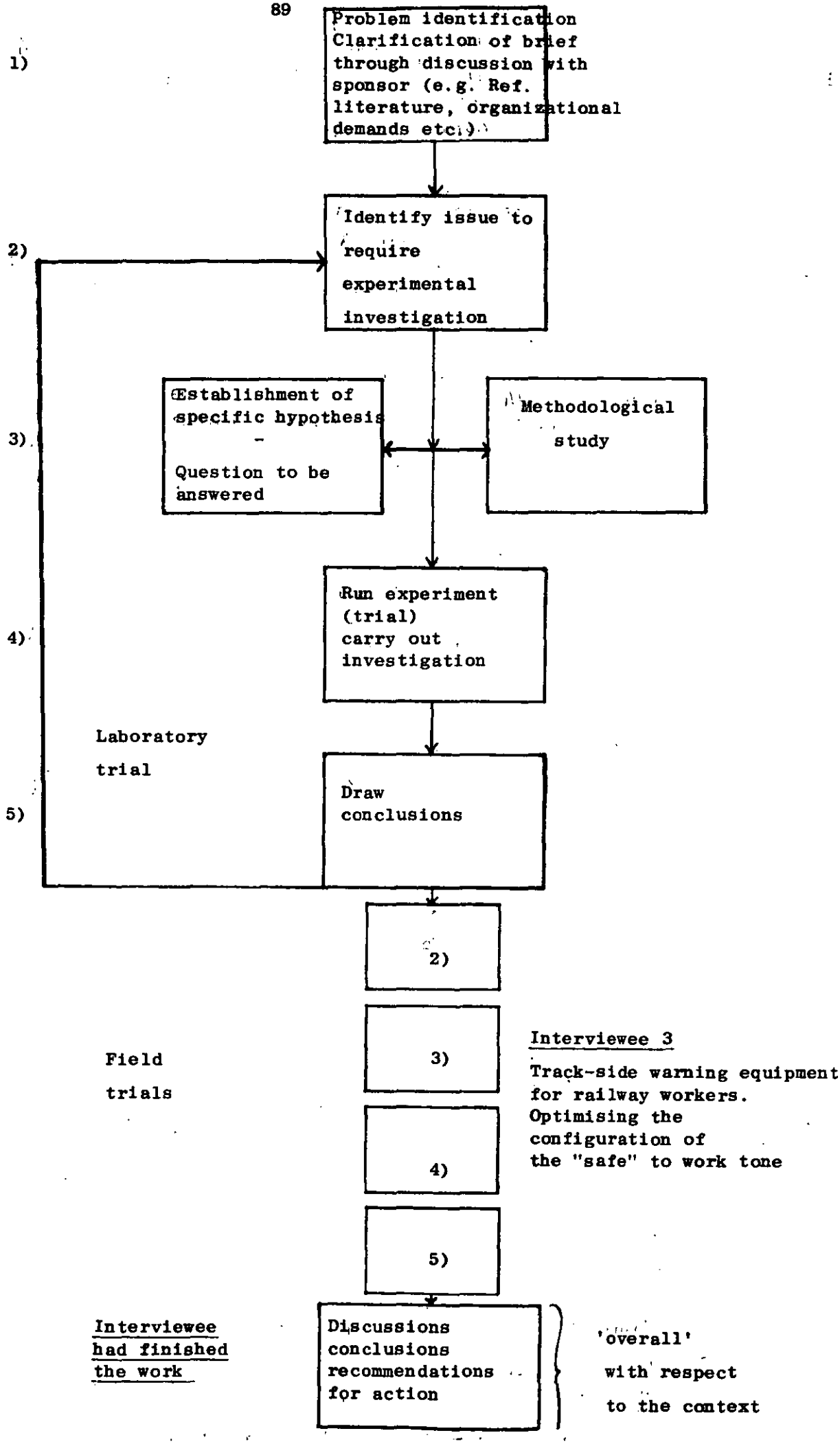
The interviewee's models of the research process

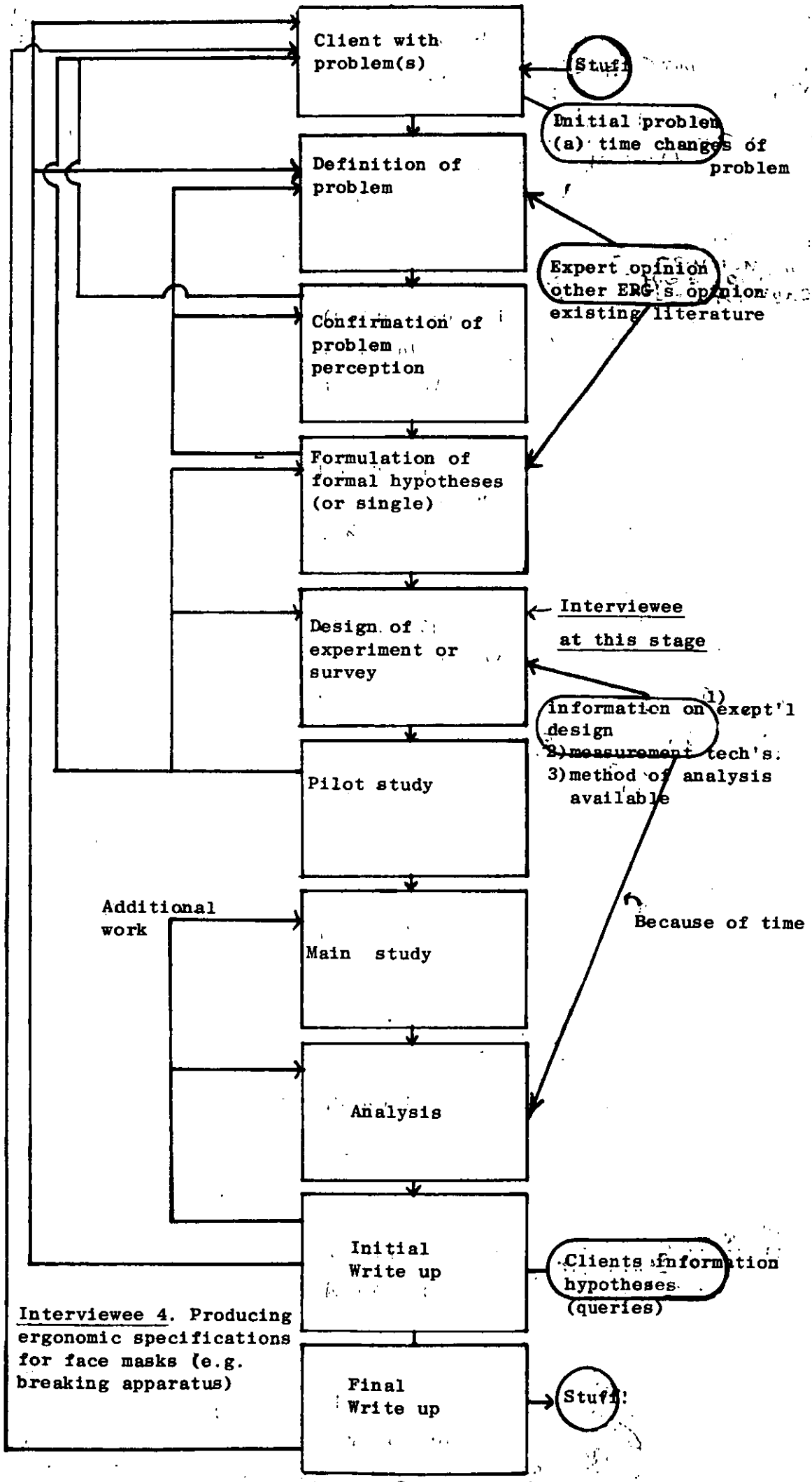


Interviewee 1. Compiling ergonomics information on a design topic for a manufacturer (no second interview).

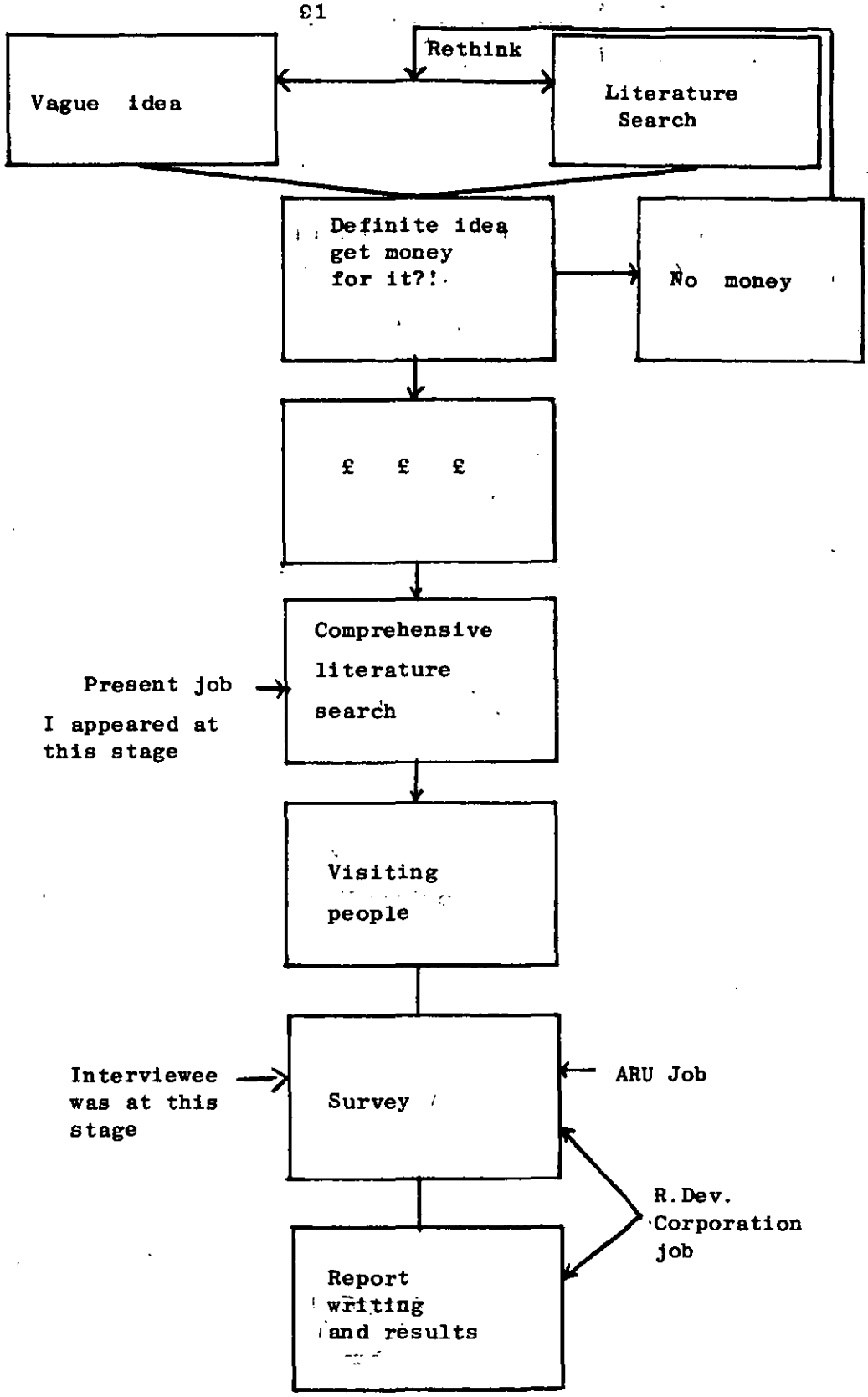


Interviewee 2 — Seating for elderly and disabled people. Producing ergonomics specifications for chair design and purchasing guidelines for existing chairs.

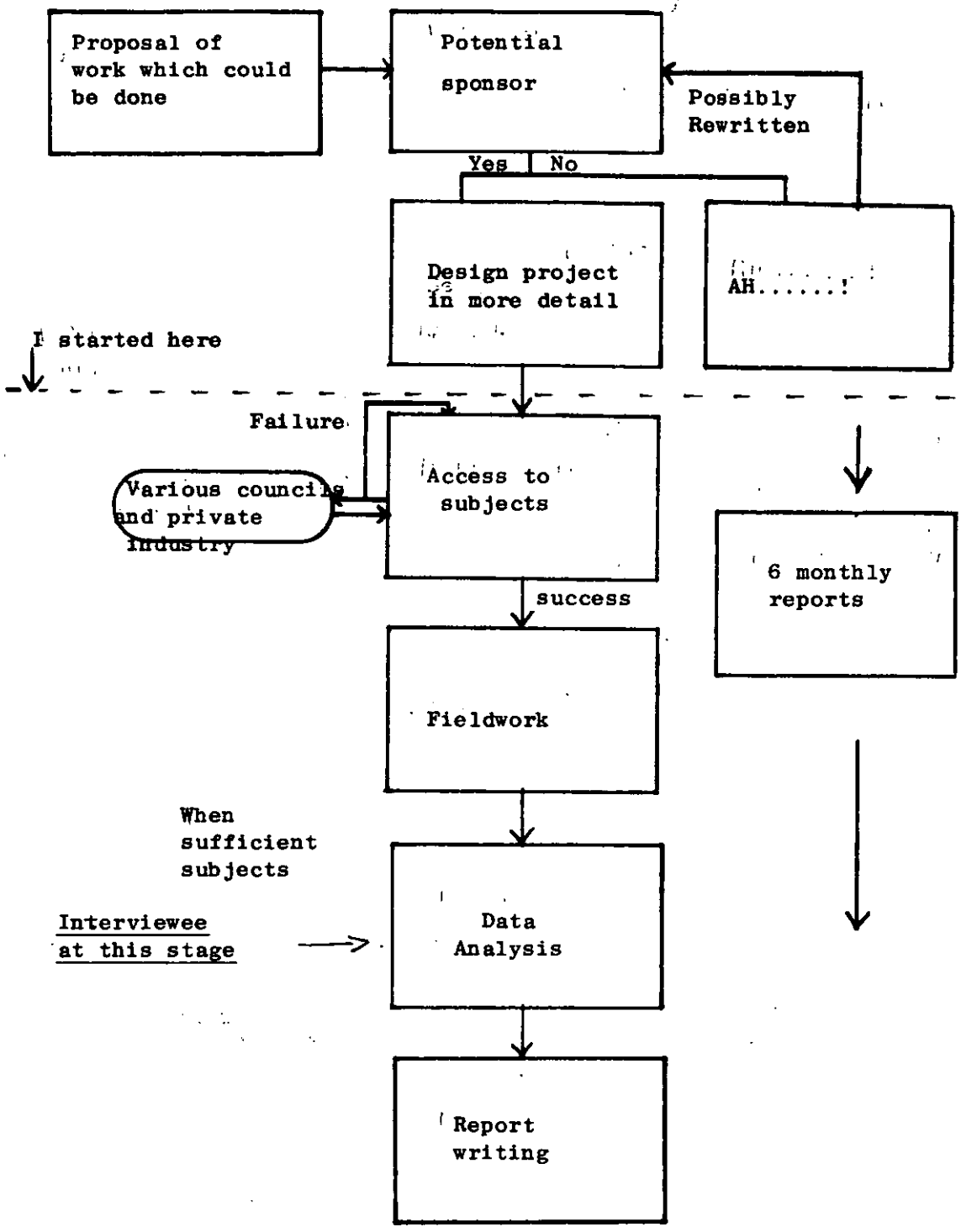

1)
Problem identification
Clarification of brief through discussion with sponsor (e.g. Ref. literature, organizational demands etc.)
2)
Identify issue to require experimental investigation
3)
Establishment of specific hypothesis
-
Question to be answered
Methodological study
4)
Run experiment (trial)
carry out investigation
Laboratory trial
5)
Draw conclusions
2)
3)
4)
5)
Field trials
Interviewee 3
Track-side warning equipment for railway workers. Optimising the configuration of the "safe" to work tone
Interviewee had finished the work
Discussions conclusions recommendations for action
'overall' with respect to the context



Interviewee 4. Producing ergonomic specifications for face masks (e.g. breaking apparatus)

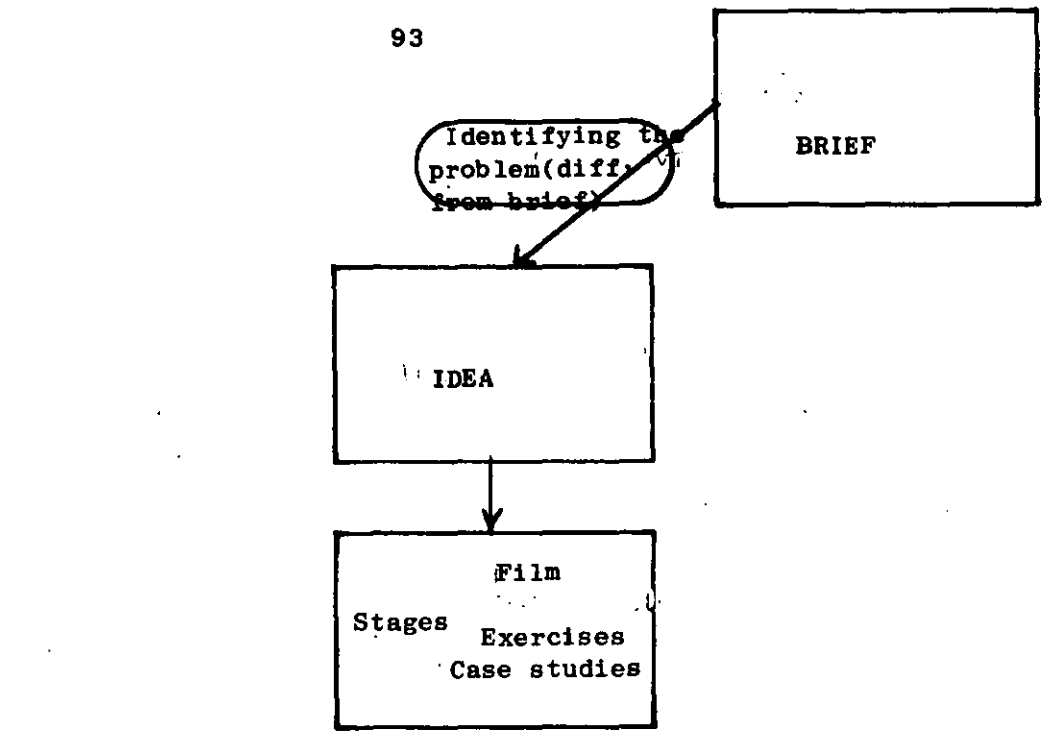


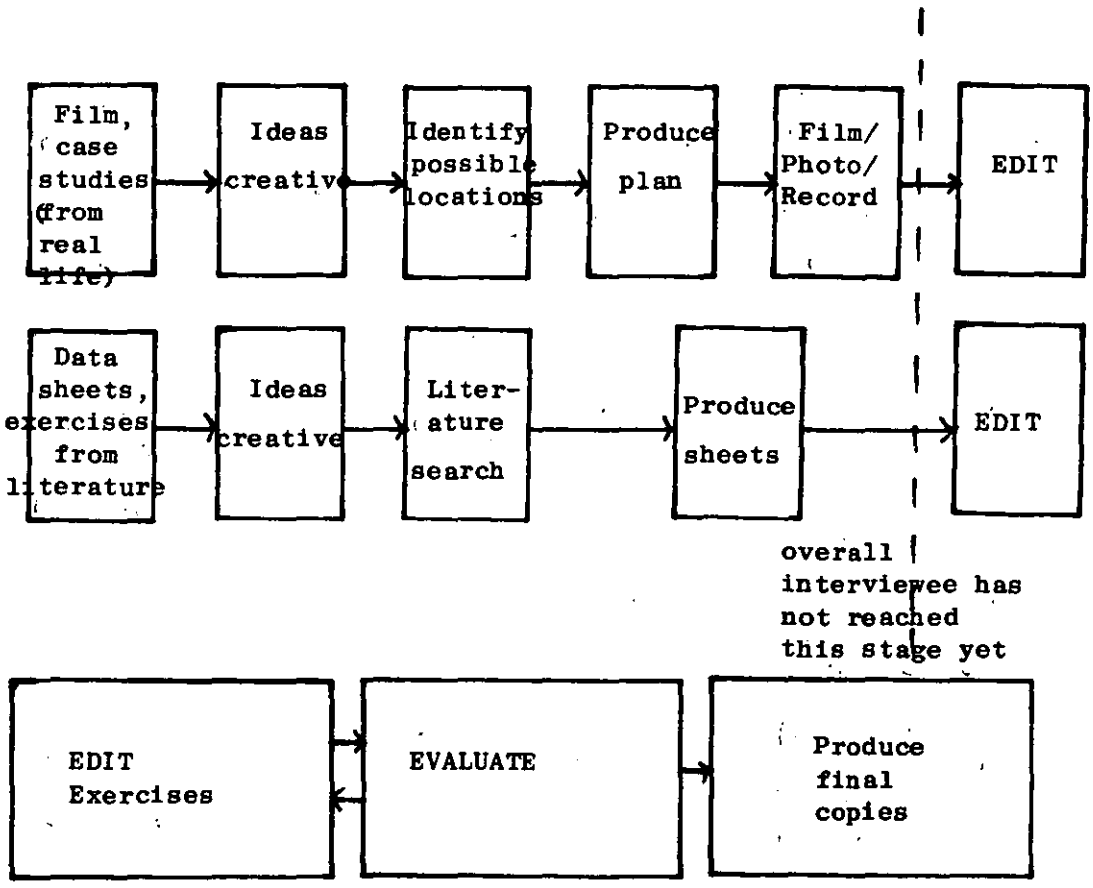
Interviewee 5. Survey of the attitudes, opinions and knowledge of motorcyclists.



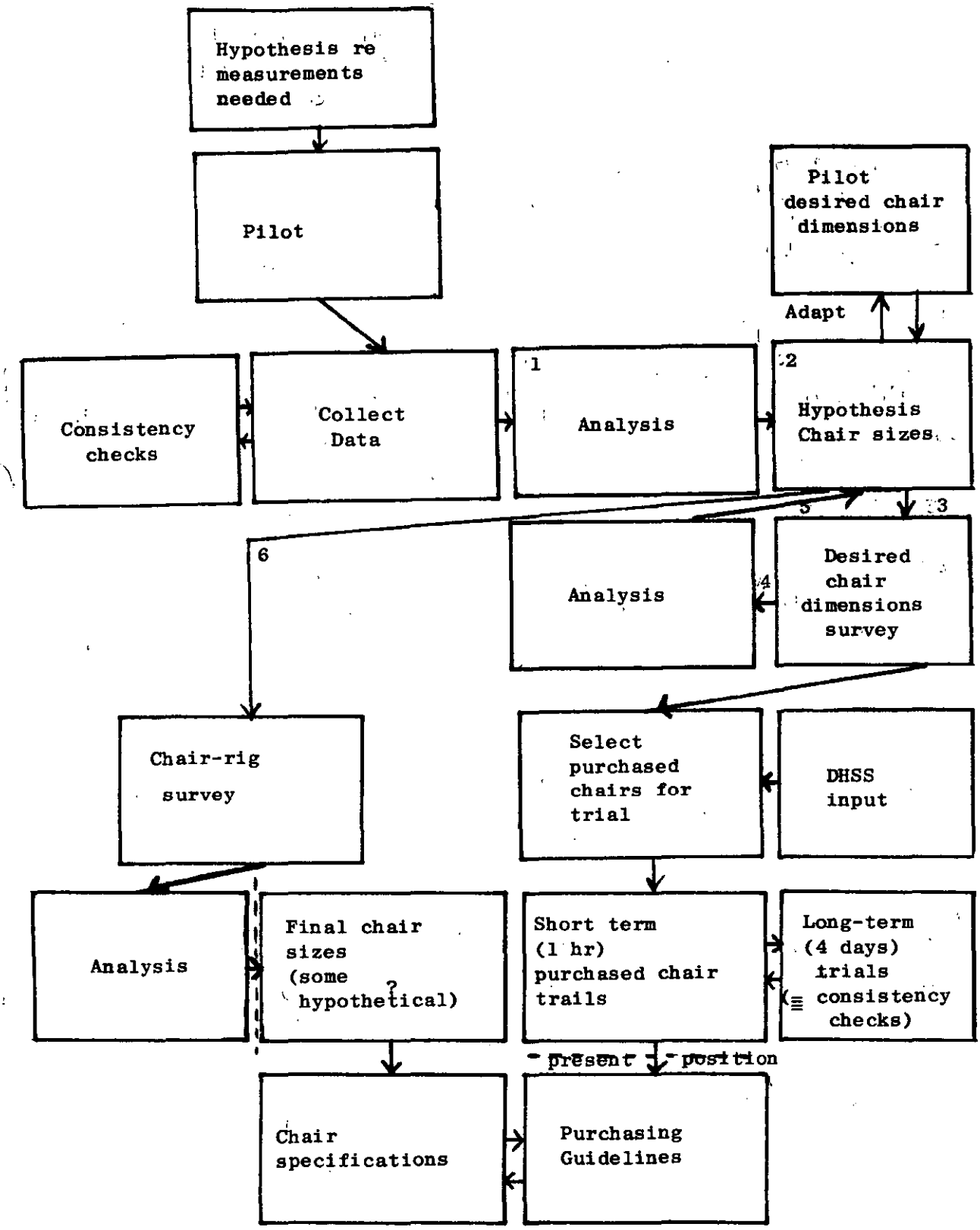
N.B. Personally not involved in negotiations for sites. Concerned with collecting data and preparing for analysis

Interviewee 6. Vision and clerical work. Aim - to find to what extent working with a V.D.U. is a causal factor of visual discomfort of work.



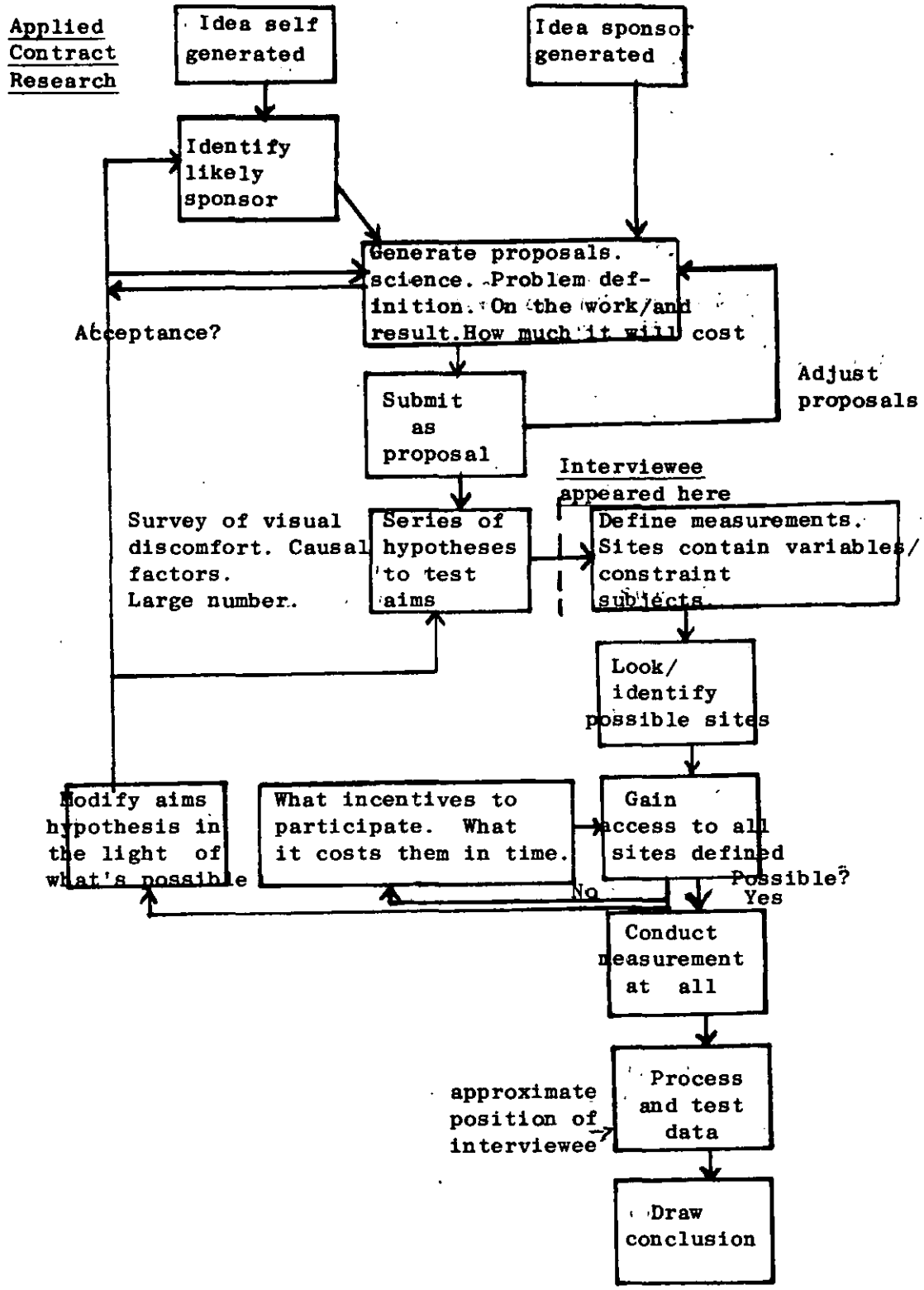


Interviewee 7. Producing training package to teach ergonomics to instructors in skill centres.

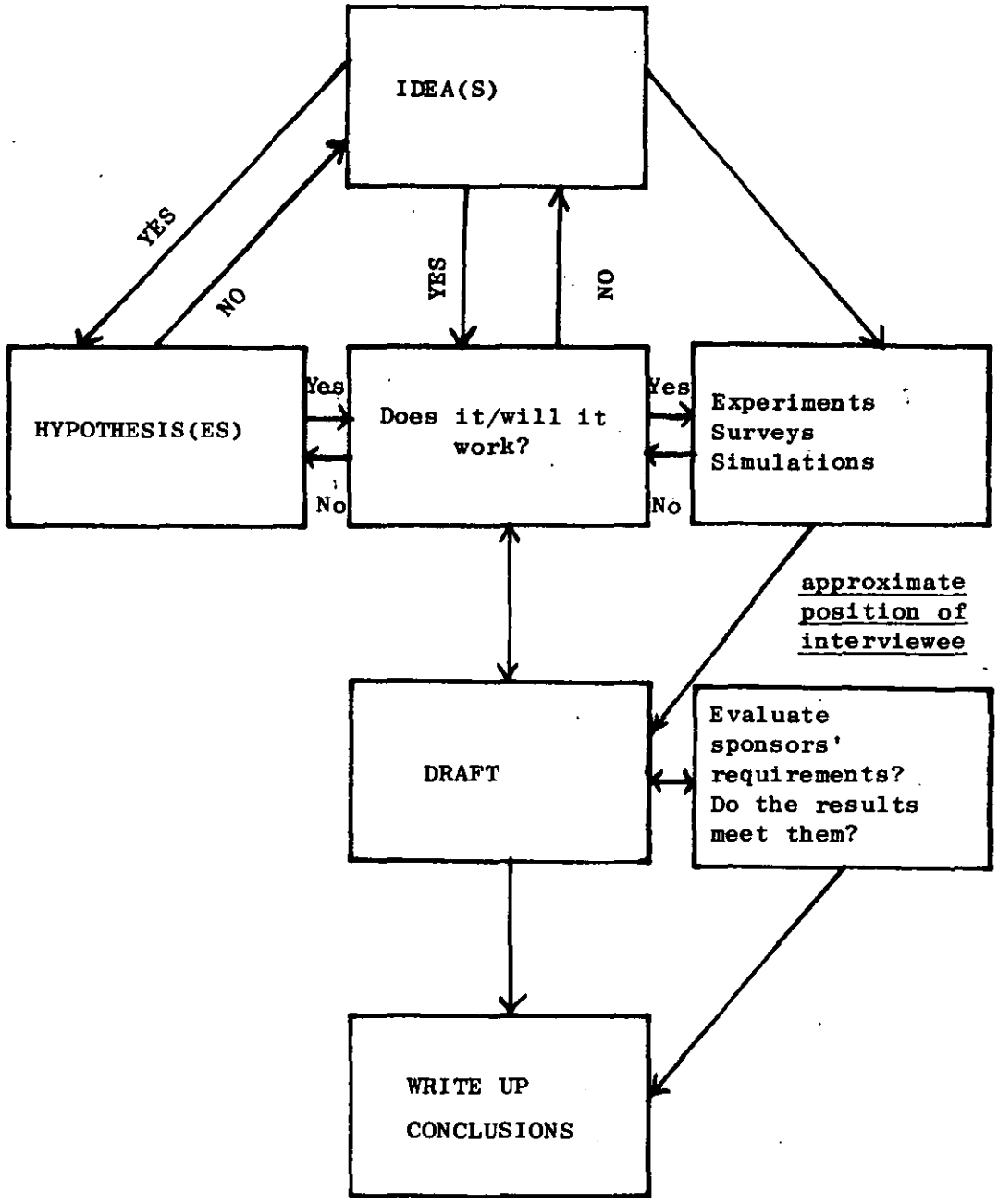


Only ergonomics trials, not rig building or technical testing

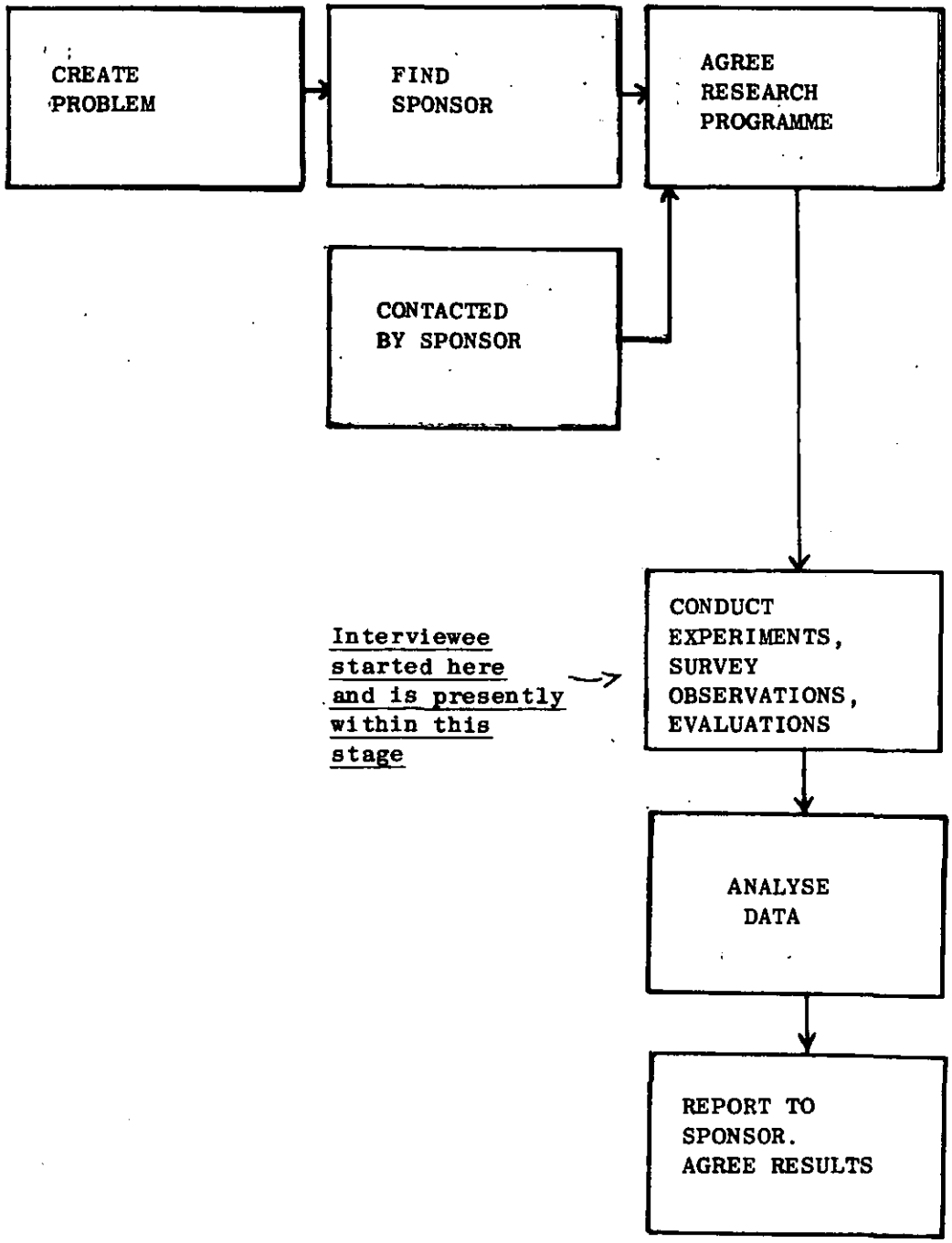
Interviewee 8. Seating for the elderly and disabled.
Aim to produce ergonomic design specifications for easy chairs and purchasing guidelines for existing chairs.



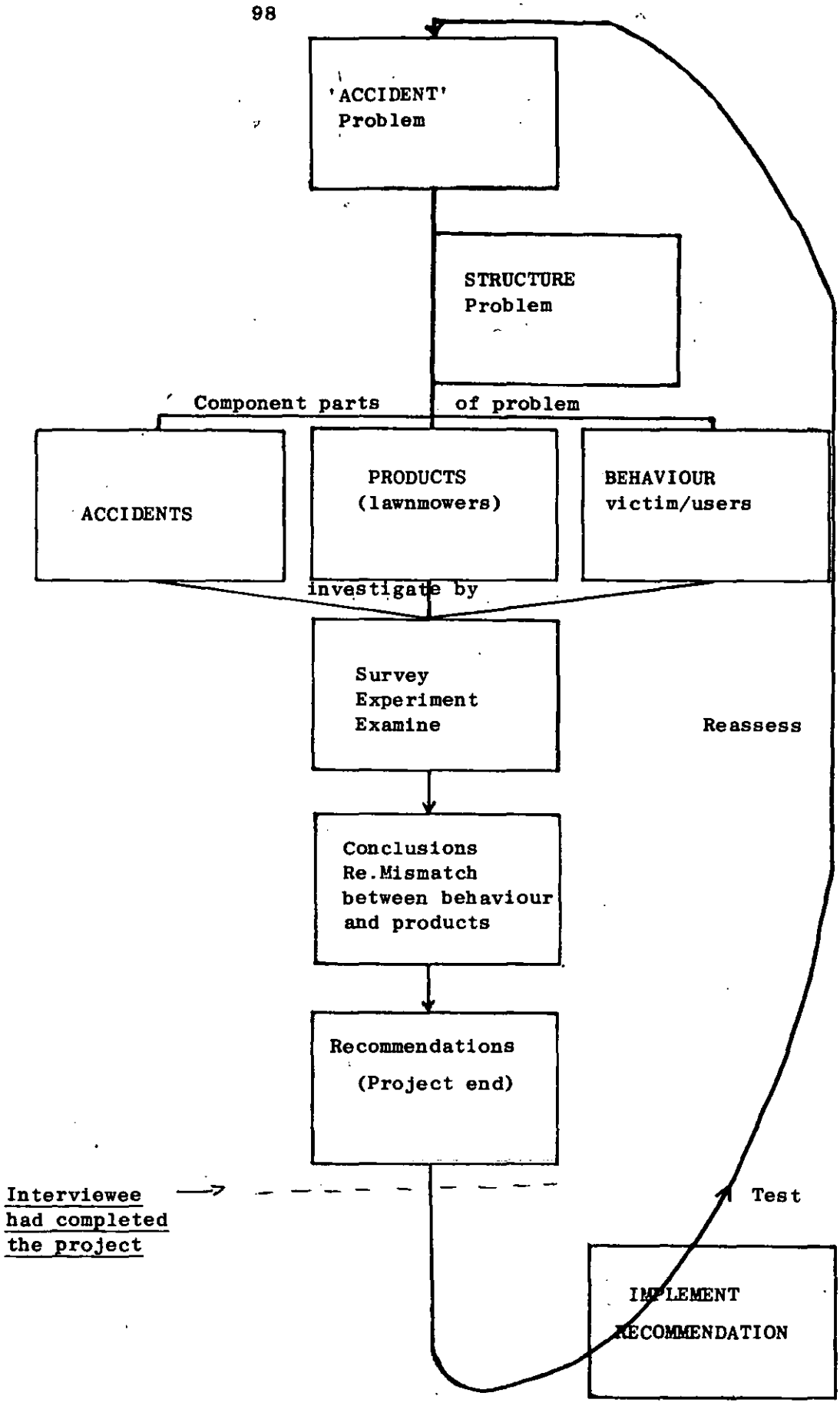
Interviewee 9. Vision and clerical work. Aim - to find to what extent working with a VDU is a causal factor of visual discomfort of work.



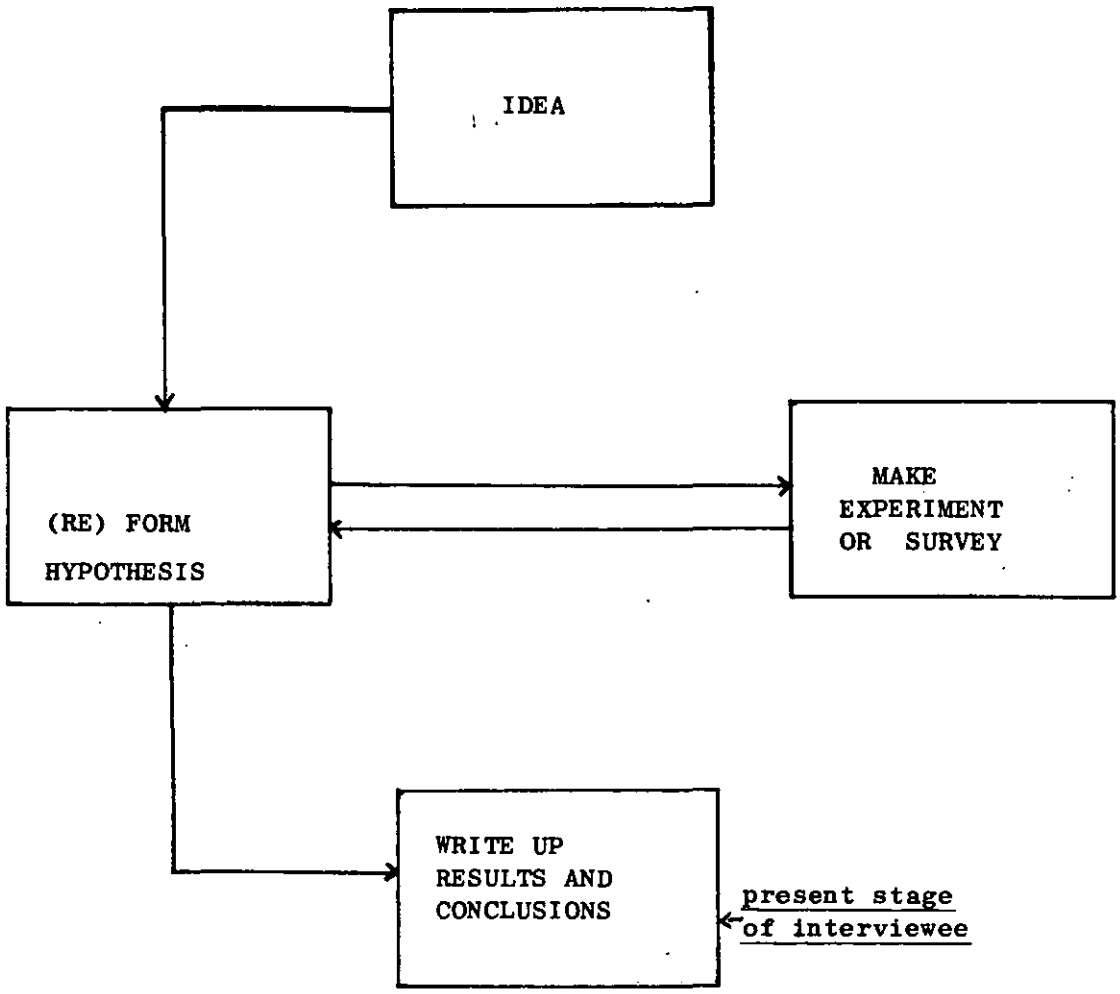
Interviewee 10. Developing job placement techniques for use in rehabilitating disabled workers back to appropriate work.



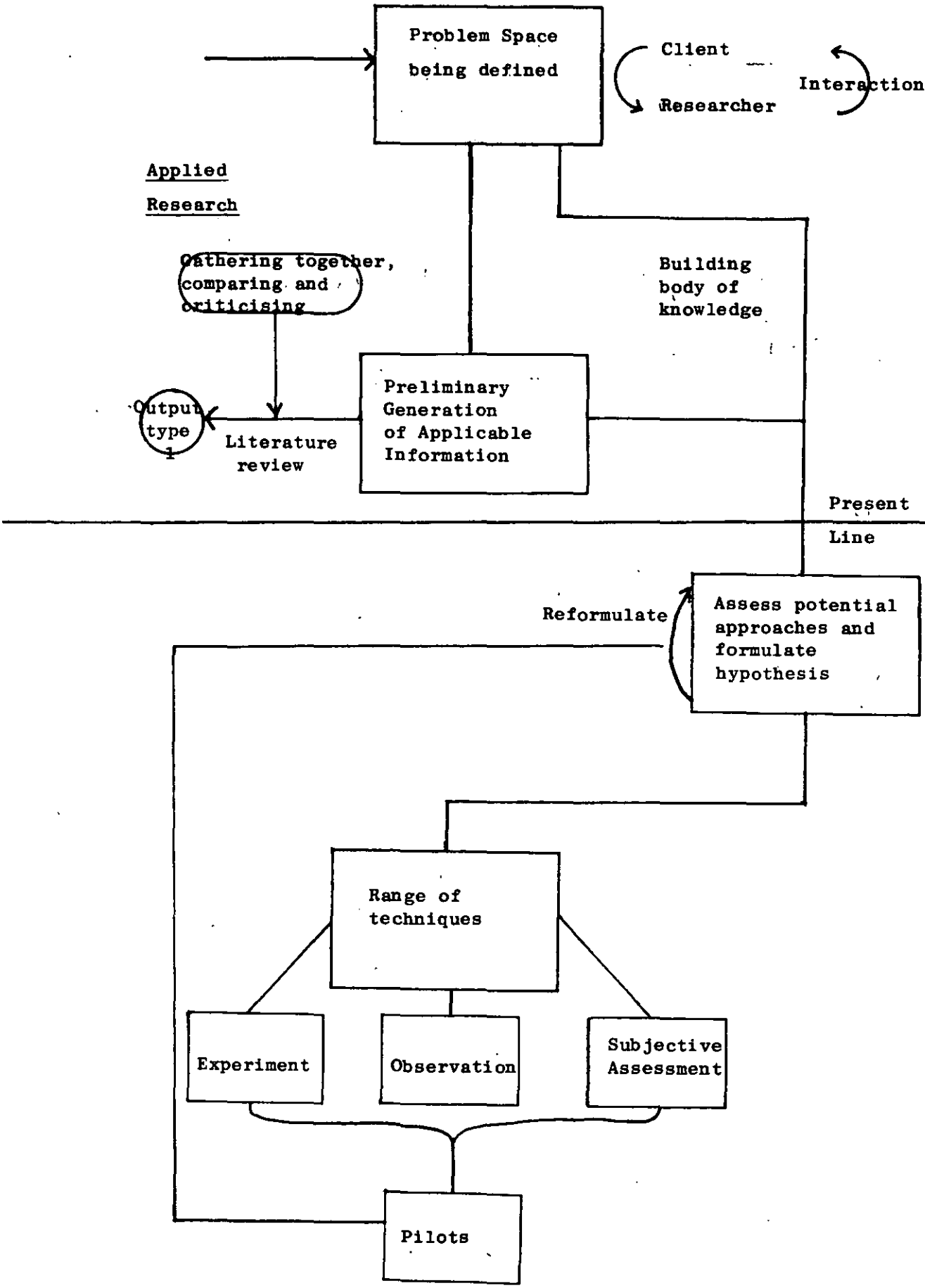
Interviewee 11. Survey of the attitudes, opinions and knowledge of motorcyclists.



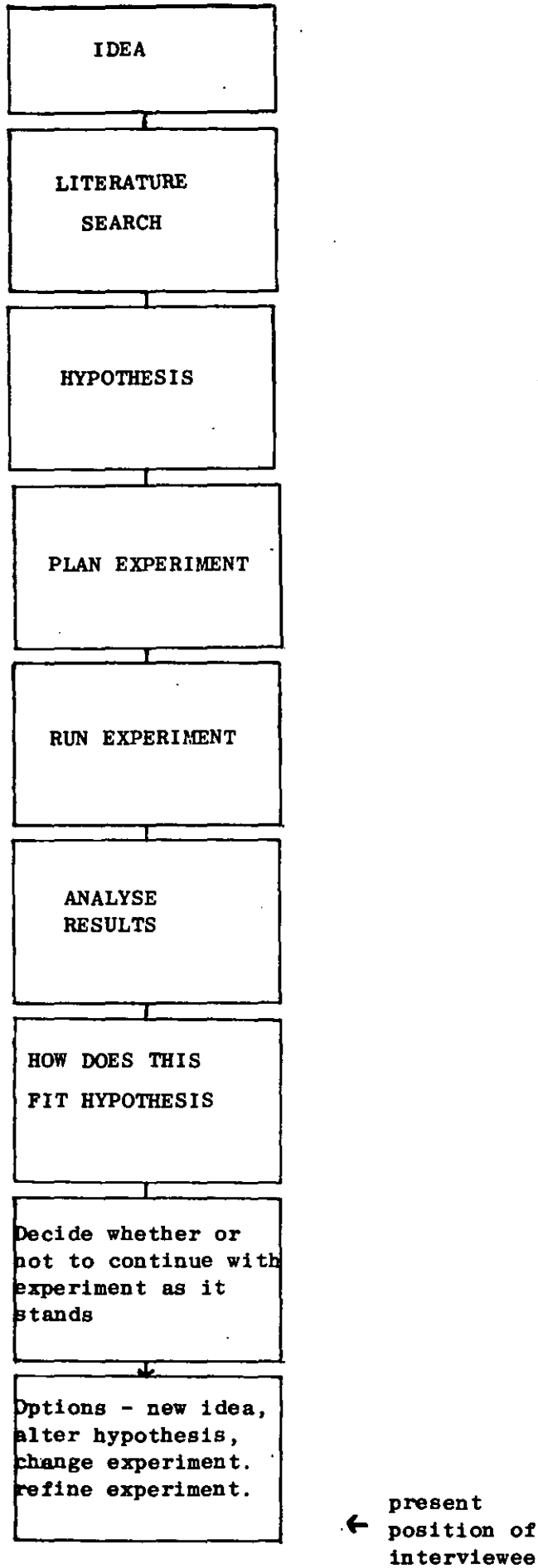
Interviewee 12. Indepth investigation of victims' accidents to identify with lawnmowers, what activites and what lawnmower types were implicated in the accident, and how these factors relate to existing designs.



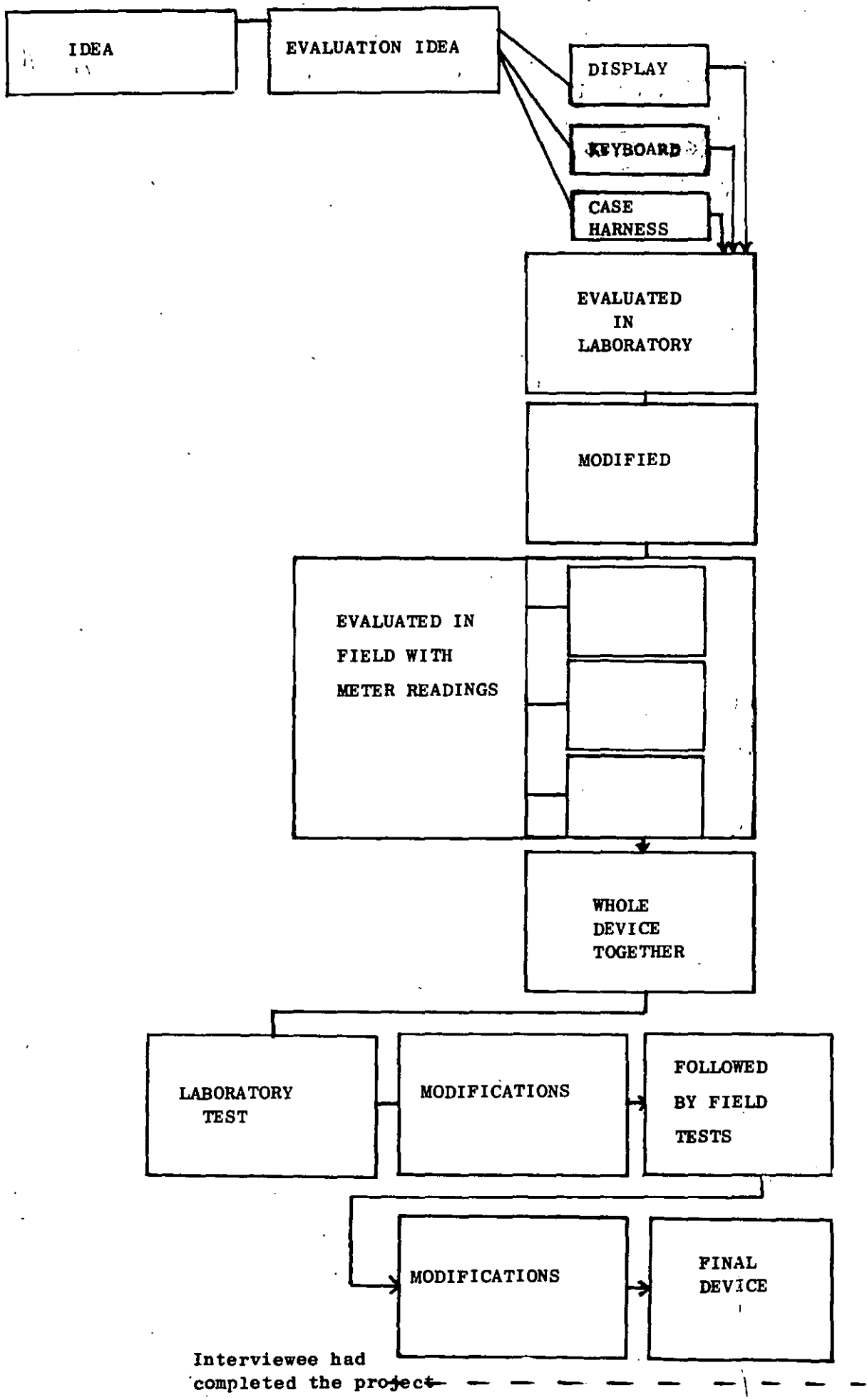
Interviewee 13: This individual chose Model 1 (basic research) reproduced here.(adapted from Whitehall 1980) looking at Government legislation in the EEC about the disabled and any initiatives that they or private research groups are taking to develop microcomputer solutions, to the problems disabled people face in work situations.



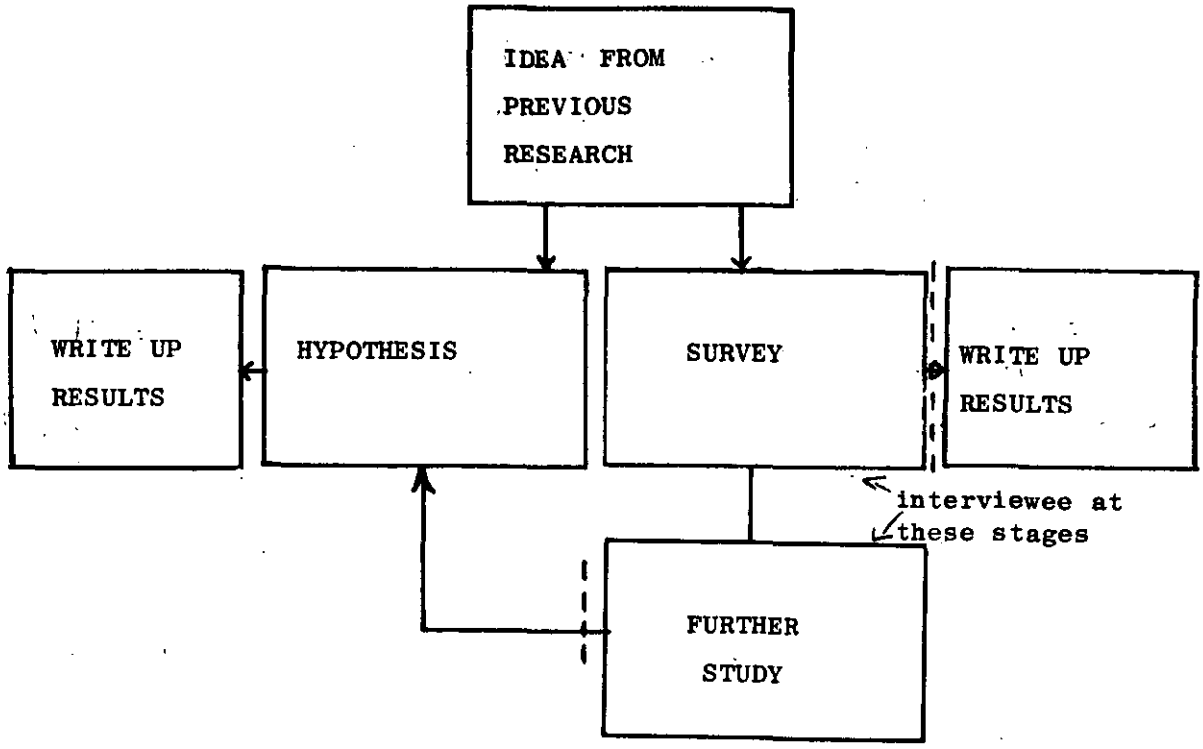
Interviewee 14: Literature review to produce guidelines for systems design (user command languages). (No second interview).



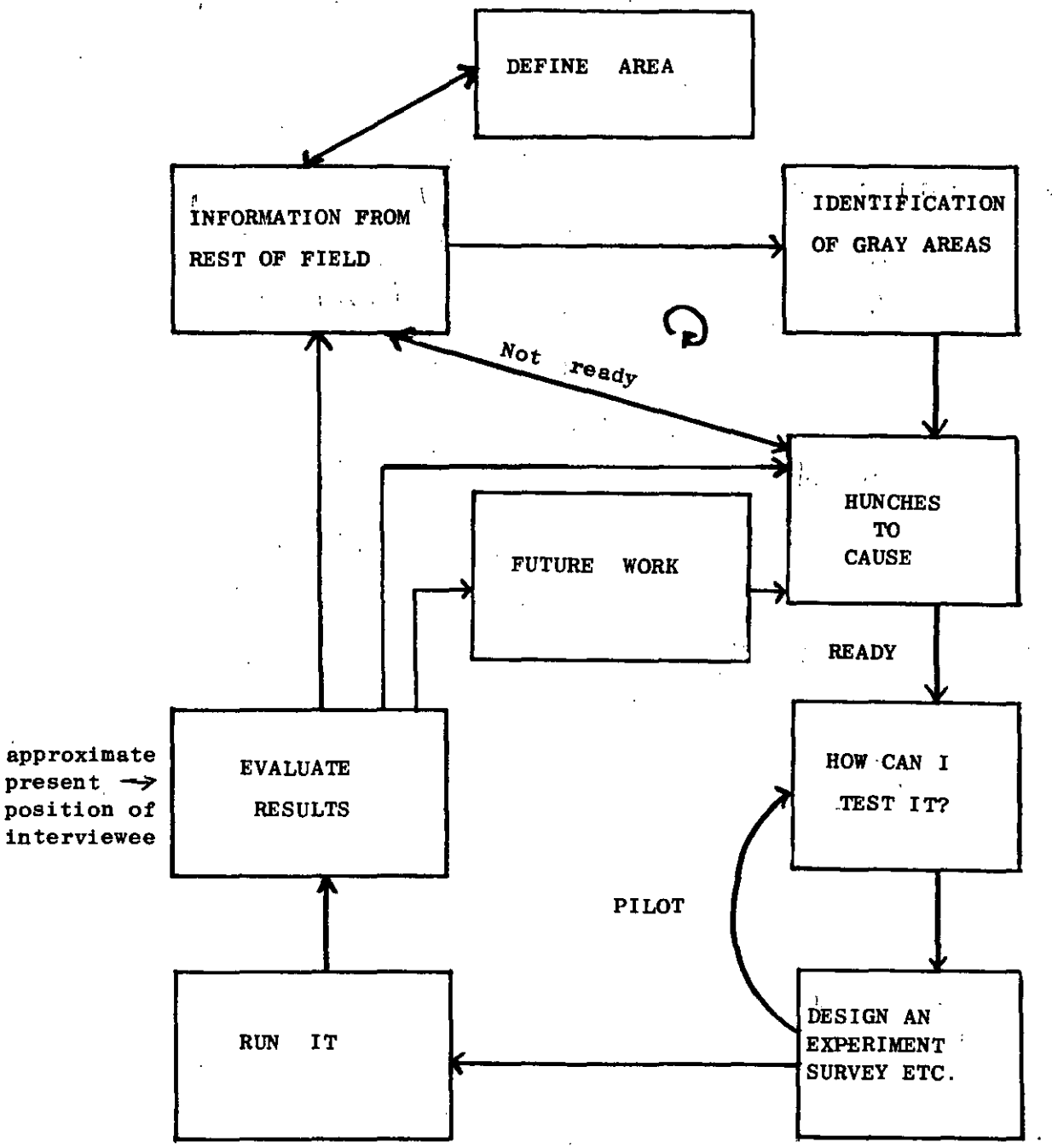
Interviewee 15. Testing the reactions of naive users to word processors in their own environments.



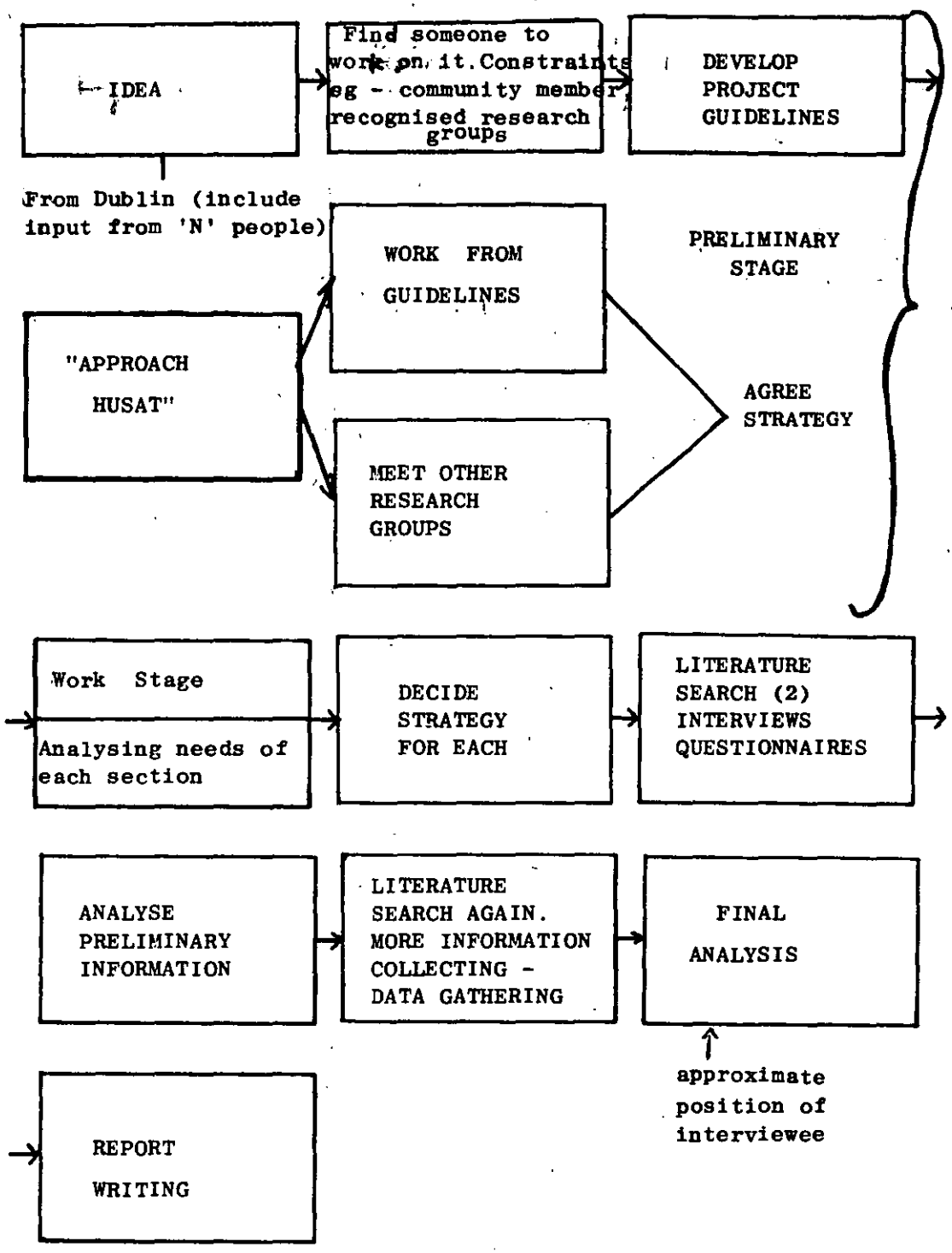
Interviewee 16. Development of a microprocessor-based handbilling machine



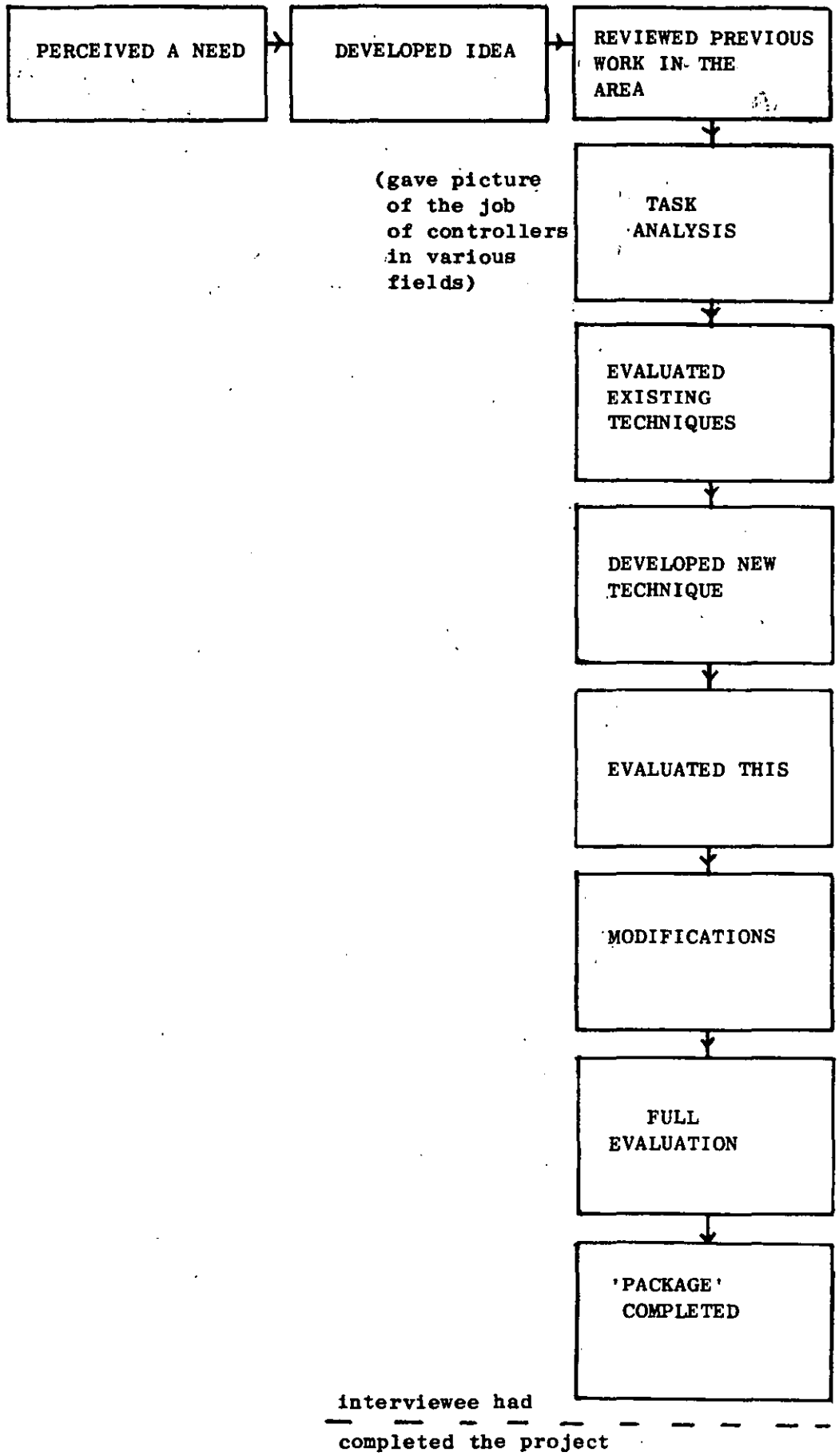
Interviewee 17. Work organization implications of word processing (2 stages - a survey and a more detailed study of a limited number of sites).



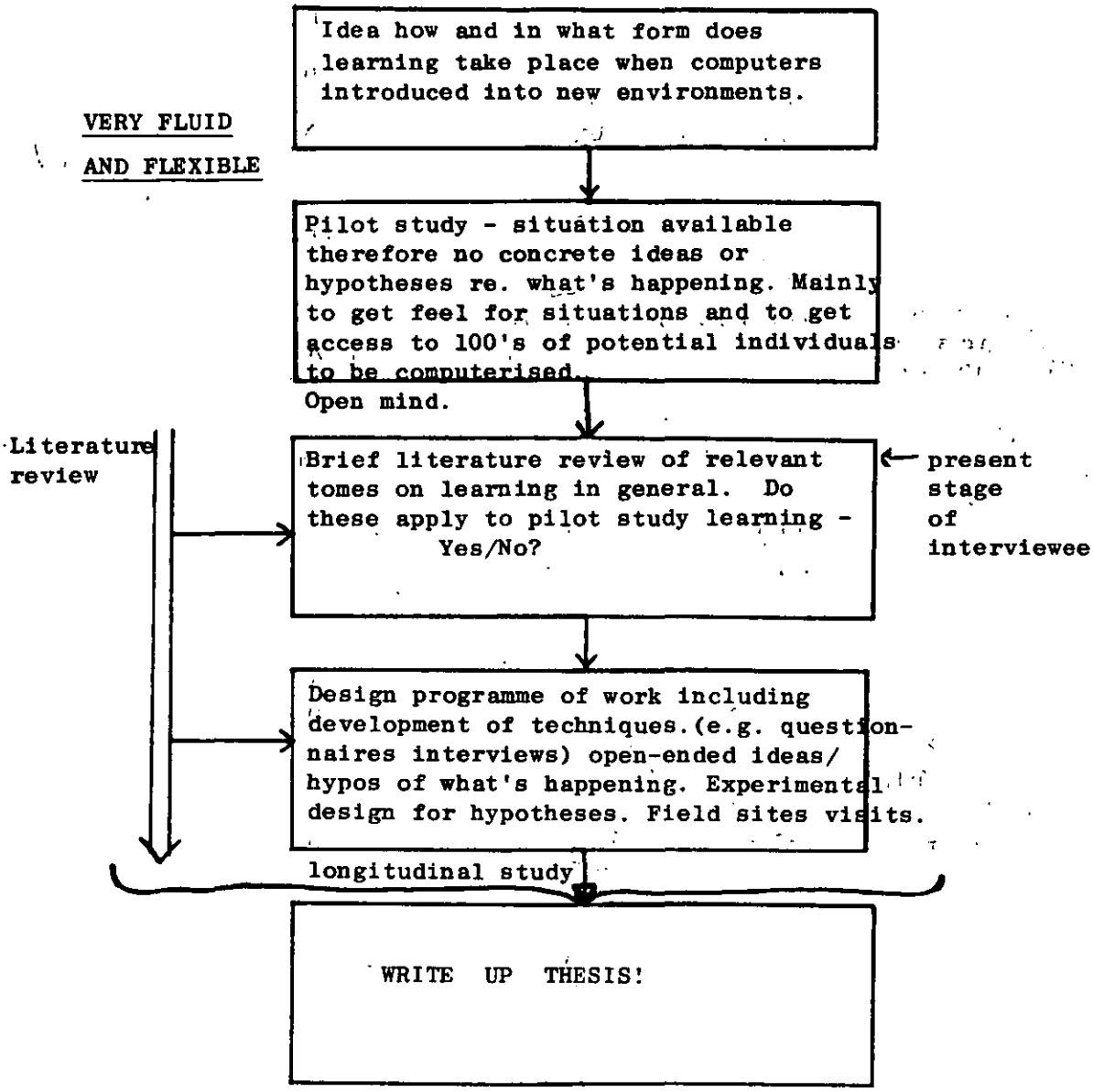
Interviewee 18. Looking at cognitive factors in the way people respond to computer use. (two basic personality types, machine oriented and machine indifferent).



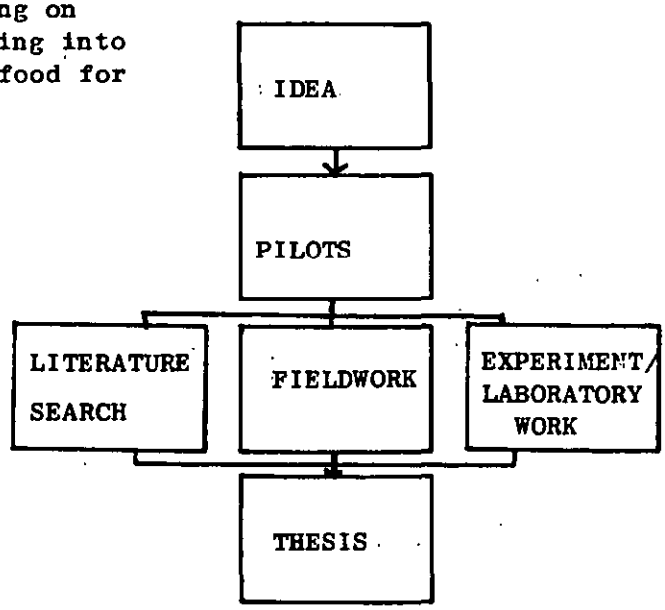
Interviewee 19. State-of-the-art study on the extent of the introduction of new technology, in collaboration with other research groups. Five stage survey of existing data.



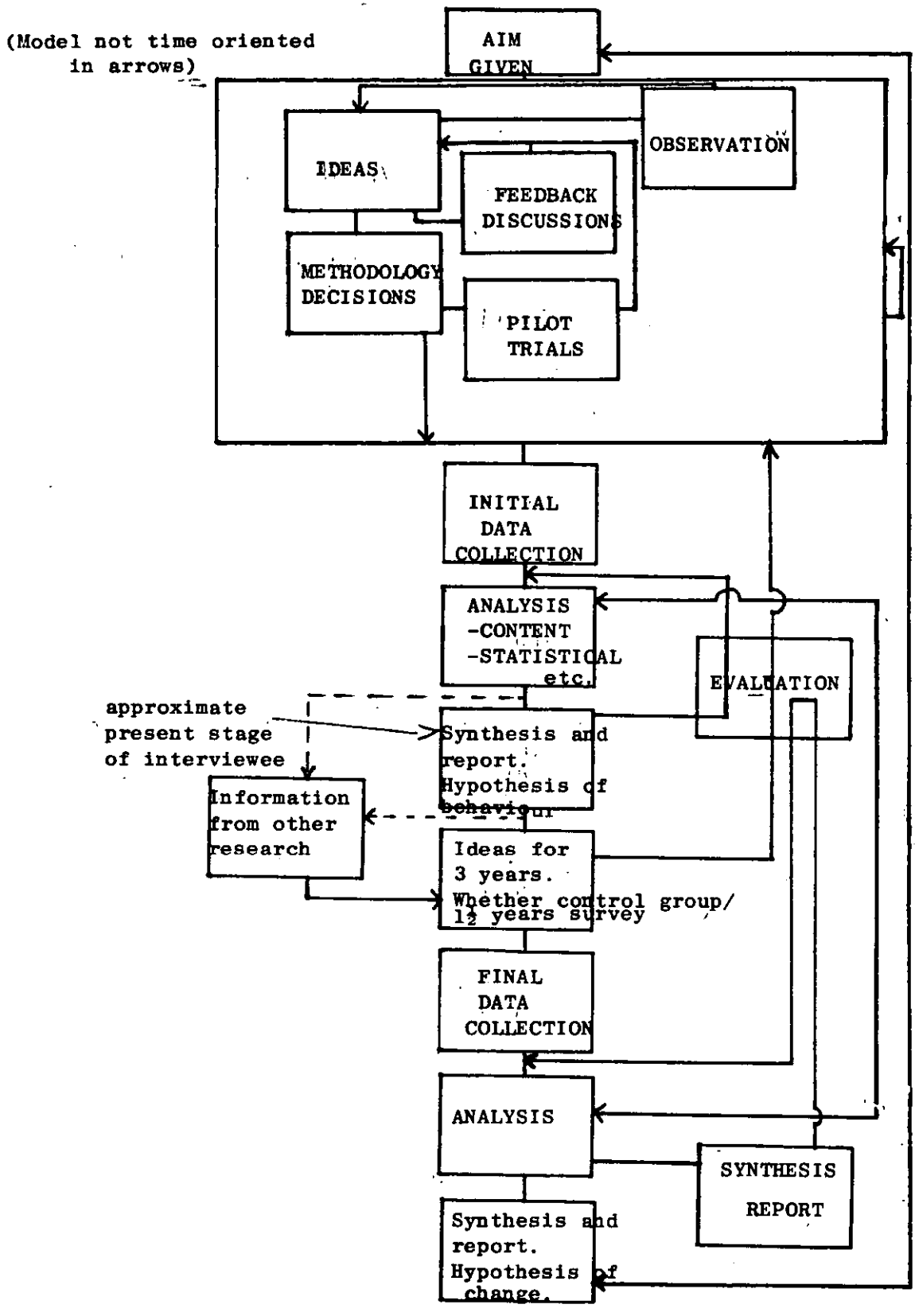
Interviewee 20. Investigation of computerized selection techniques for control room personnel. Developing and evaluating a computer simulation.



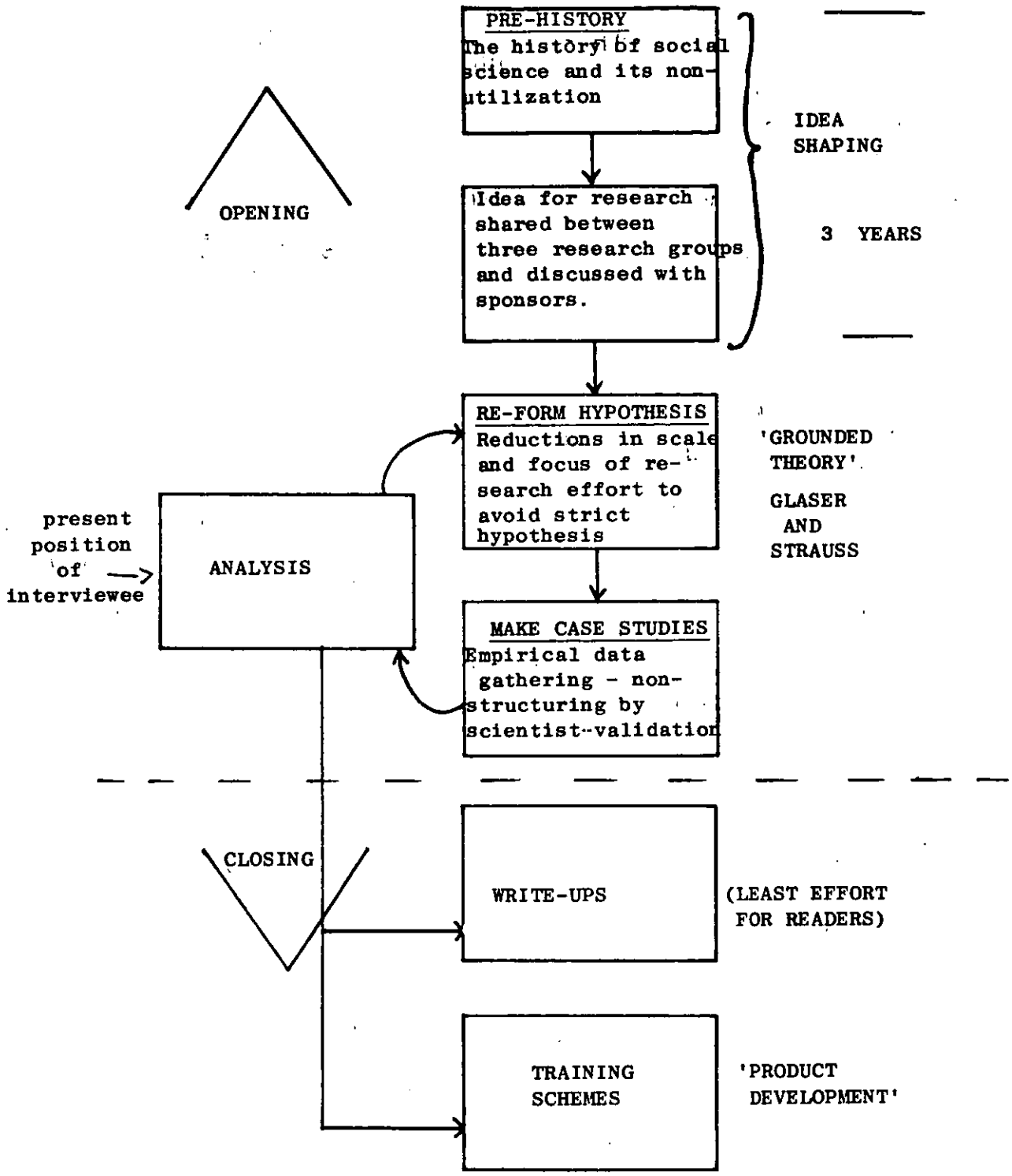
OVERVIEW, 3 things going on in parallel, each feeding into the other to provide 'food for thought.'



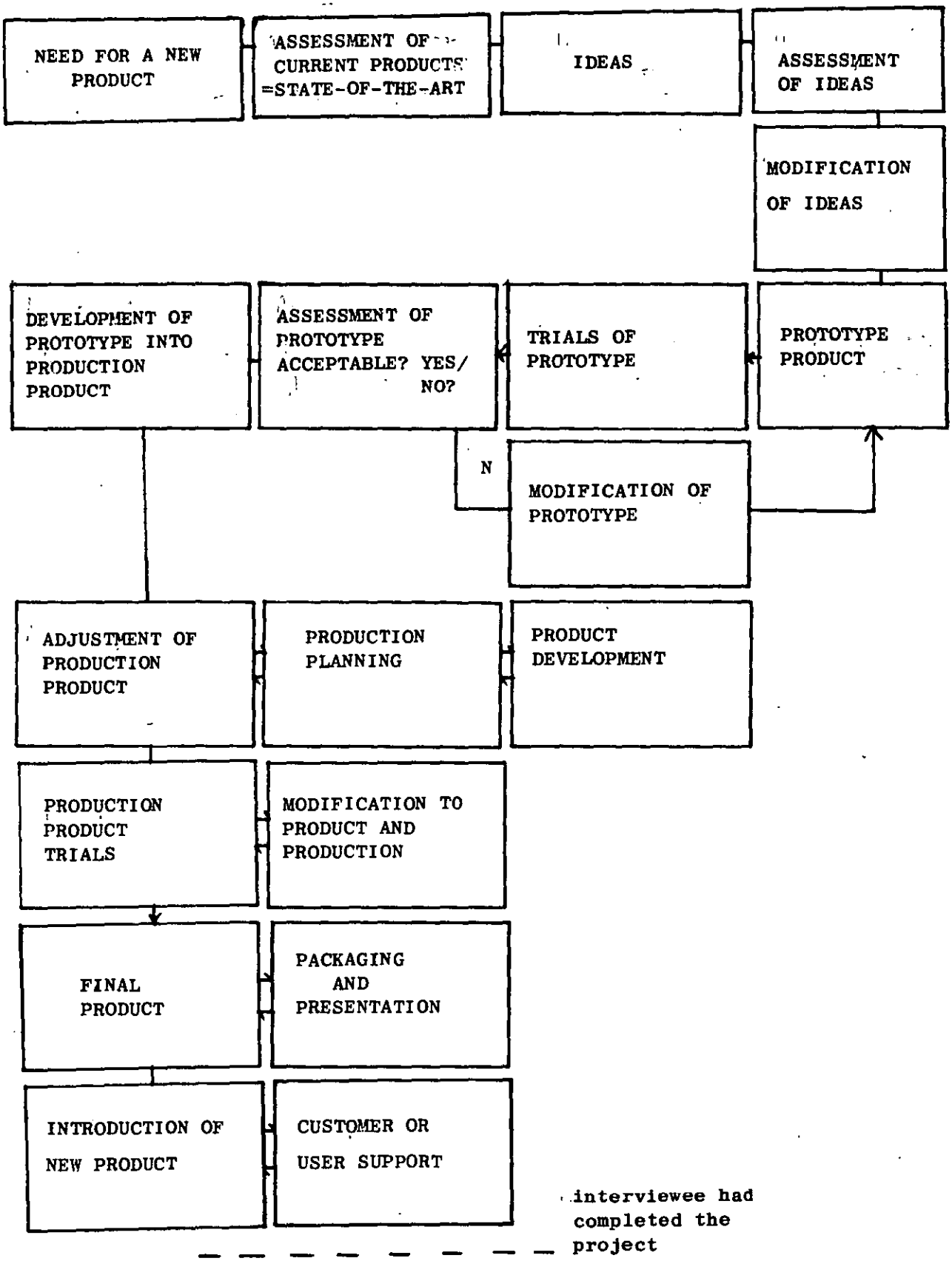
Interviewee 21. Investigating what learning takes place when computers introduced into environments when people using them as tools.



Interviewee 22. Human factors evaluation of a three year experiment with electronic journals and other communications facilitated by computer-based message systems. Model given is for one of the projects involved in this larger project - effect on working patterns.



Interviewee 23. An attempt to study the process by which social science consultants work with organizations.



Interviewee 24. Development of microprocessor control for a scrap line printer.