An Evaluation of the Usability of Human-Computer Interaction Methods
In Support of the Development of Interactive Systems

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Abstract
In the course of this research project the output of four Task Analysis (TA) methods were investigated, explored and evaluated to ascertain whether they could support the Requirements Analysis (RA) phase and so contribute directly to other activities in the development life cycle for Interactive MultiMedia (IMM) systems. The research discusses the success and failure factors particular TA methods. The problems of an IMM systems development life cycle are linked to the weaknesses of the Requirements Analysis phase and in particular to the incomplete support of TA methods and techniques used within the Requirements Analysis phase. The outputs of the selected TA methods are evaluated according to four factors, which are represented as an Evaluation Framework (EF). Each factor represents specific criteria and features that TA methods should cover in their processes and outputs. The findings show that TA methods have a number of weaknesses in the support of and the contributions they make. Therefore questions and recommendations are considered about how the methods can be improved in order to obtain better requirements.

1. Introduction
The impetus for the research study came from the growing importance of Task Analysis (TA) methods in the success of the overall IMM systems design and development life cycle. This was coupled with the perceived limitations and insufficient contributions of Task Analysis methods to support the Requirements Analysis phase in order to capture the new requirements, distinctive features and characteristics, domain, context and environment of IMM systems. The initial aim of the research was to investigate, explore and evaluate existing TA methods for use and application within the IMM domain and environment, in terms of both theoretical background and practical application. The objective of this research was, therefore, to evaluate the capability of TA methods. The nature of Task Analysis is such that it was felt to be most appropriate to do this in an applied context. Thus, in this project a variety of TA methods have been used to assess the adequacy of a proposed design for a World Wide Web (WWW) site/systems within a particular IMM context. The domain and environment chosen was one which will help a group of research students conduct their doctoral programme as carried out at the University of Salford, UK. This was because the range of problems that arise in using TA methods often only becomes evident when the methods are used in anger. Thus in order to allow a realistic examination of TA methods, the results of the application of these methods, together with their input into the later design activities, have been analysed and compared, both to each other and to a defined schema with its set of special characteristics and criteria. These characteristics and criteria have been represented within a framework that consists of four factors. The purpose of the framework was to assess the capability of TA methods, and to consider Task Analysis in a general way within the IMM context. In this way we were seeking to provide general guidelines, as well as identify aspects and issues to be considered in TA methods themselves, with regard to what they can offer and what they might contain in their final analysis output.

Most of the descriptive efforts in HCI have focused on developing user and task models that can be used to analyse, predict, or explain the performance of users with different interface and system designs, but do these models really provide the necessary descriptive capabilities? The question addressed by this research is simple in its expression but daunting in the work required to answer it. The main question that this research effort is trying to answer is:

Can the output of Task Analysis (TA) methods support and contribute directly to the Requirement Analysis (RA) phase of the development life cycle of IMM systems?

In order to understand the relative contributions of each method and technique to the success or otherwise of a design, one needs to know how well each fare in real design settings. The main question is related to a number of sub-questions that have to be answered, and these are:

• How does IMM systems design and development differ from that of traditional software systems with respect to the Requirements Analysis process?
• Why do current IMM information systems require a frequent need to redesign the system?
• How is the Requirements Analysis activity, and in particular Task Analysis, a very important process in designing IMM information systems?
• What can and does each Task Analysis method and technique describe and contribute?
• What decisions and analyses remain outside the scope of any method or technique?

2. Background and motivation

The current emphasis on user-centred design for interactive technologies [18] and [3] places great emphasis on understanding the user in attempting to develop more usable artifacts. To this end, design teams are urged to perform user and task analysis at the earliest stages of product development and to consider the nature of the users' cognitive and physical pre-dispositions and abilities. These user characteristics are correctly seen as important in constraining the available design options and, if attended to, increasing the likelihood of producing a usable application.

The 1990s have witnessed the world-wide development and utilisation of Interactive MultiMedia (IMM) Systems, and the development processes for such systems have shown a number peculiarities that differentiate them from so-called “classic” software development activities. It is already clear that designers of IMM systems should be made aware of these specific features, constraints and peculiarities as early as possible in the development process. Although IMM design is related to traditional software design, many of its aspects are arguably different from those applicable to sequential media and computer-based instruction, as well as from hypertext [16]. The traditional software life cycles provided structure to the development of large software systems that were mainly concerned with data-processing applications in business. These systems were not highly interactive. Consequently, issues concerning usability from an end-user’s perspective were so that important [10]. IMM is inherently multidisciplinary in nature and differs in many aspects from the traditional software development. Developing a usable IMM system involves a complex set of design activities and processes. However, it is widely recognised that the design of a product can only be as good as the statement of requirements for that product. This means striving for a requirements specification that is as unambiguous, complete and consistent as possible, so that progress towards the goals specified can be verified in the course of the design. Therefore, future IMM systems will have to be carefully matched to the work environment, expectations, characteristics and tasks of the target users if they are to be successful. This in turn suggests that such issues will become progressively more central to the life cycle of IMM systems’ design and development.

Since the aim of Human-Computer Interaction (HCI) is to produce designs that fit their expected context of use, in order to support people so that they can carry out their activities productively and safely, it is becoming one of the most important issues in information systems development. [8] describes the goal of HCI as being to “develop or improve the safety, utility, effectiveness, efficiency and usablity of system that include computers”. The study of HCI helps to determine how this computer technology can be made more user friendly [22]. These goals are extremely important and relevant in considering IMM systems to support learning. HCI research and design practice has long recognised that IMM systems are of little value if they do not support users in performing their work tasks [11]. HCI is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them [1]. The relevance of HCI is rapidly increasing, giving rise to a growing number of users with a wide range of skill levels making greater demands upon IMM systems in a wide variety of contexts. The discipline of HCI is now widely recognised as a valid partner in design methodology, and the concept of Task Analysis (TA) is often considered of central importance, although the exact meaning of the label varies widely depending on the design approach [23].

Given the increasing prominence of the role of TA and user modelling in systems design, the motivation for the research centres on the application and use of a number of TA methods in supporting the analysis and design of usable IMM systems. Its contribution is, therefore, to the emergent disciplines of HCI, Requirements Analysis (RA), Task Analysis (TA) and Interactive Multimedia (IMM) information systems. The author has chosen to study of the activities involved in Requirement Analysis with particular attention to the use of TA methods. This is because Requirements Analysis is a crucial area for the success of the whole IMM development process, since it is the only way to ensure that the final system will be appropriate for the users and their needs. In order to make TA methods capable enough to support the design and development of IMM systems, their context-in-use needs to be actively and effectively exploited. As such, the focus here will be on the use of TA methods to analyse the requirements for a proposed World Wide Web (WWW) site within an IMM environment. The WWW system was selected to provide a complex and interactive environment, context and domain that would help to explore and evaluate the support, contributions and capability of chosen TA methods.

3. Problems of the early analysis process

A profusion of notations, methodologies and techniques is documented in the literature of HCI, for example [9],
Many of these approaches have been used as techniques during the Requirements Analysis (RA) activity of the interactive systems development process in order to provide descriptive models of the work-task knowledge that people possess. From the literature review it was clear that most Task Analysis (TA) techniques represent a serious attempt by HCI researchers to help designers to develop more usable systems. It has been generally accepted that Task Analysis may substantially contribute to the design of usable products because it focuses specifically on the end user. Task Analysis investigates users’ characteristics and the task world of which they are a part, and the information gathered should be recorded in a task model that captures the relevant aspects. The literature on requirements engineering contains little in the way of either theoretical guidance or empirical case studies relating to the specification of requirements for IMM information systems [13]. The lack of capability of HCI techniques (in particular TA methods) means that the development costs are often high, and that the quality and usability of the resulting systems are frequently low, with the capabilities of new technologies being only poorly exploited. Although specifying the requirements of the new system to be built is one of the most important parts of the life cycle of any project, its support in practice is still insufficient [7]. The emphasis in systems development has traditionally been on building systems that meet specific functional requirements, without a sufficiently detailed understanding of the cognitive and physical capabilities and expectations of the intended users, or a clear view of the context within which the system will be used. In addition, although basing initial concept design on an understanding of users and their tasks has been advocated for some years, confusion still reigns as to what this means in actual practice. Some authors claim that the required clarity resides in traditional approaches to TA [10], but not only are these approaches infrequently used [4] and [15], other researchers question their adequacy and usability [20]. The biggest problem is often not in simply applying the technique, but in communicating the results produced to a client or to other members of a design team. If the results of Task Analysis are not communicated well, then their value to the development process rapidly diminishes. The criticism of current TA techniques is that they do not specify how multimedia development may be taken through from analysis specification to detailed design specification. Existing TA techniques need to capture:

- the requirements in their original format (e.g., graphics, text, audio, video),
- the context of the interaction and interactivity style and level,
- the context of the stored information content and type,
- the delivery environment and technical constraints,
- the corresponding limitations that should be placed on multimedia output,
- the navigational structure of the system.

The refinement of these original requirements and the identification attributes associated with the requirements are outside the scope of most current methods, and therefore when they are dealt with it is often in an informal way.

4. The role of task analysis (TA)

Human-Computer Interaction (HCI) has a role in the design and development of all kinds of systems, ranging from those like air traffic control and nuclear processing, where safety is extremely important, to office systems, where productivity and job satisfaction are paramount, to computer games, which must excite and engage users [20]. An information system will be of no value if it does not contribute to the improvement of the work situation for people in the organization. Therefore, it is not enough to study the contents of the information system. The activities people perform in an organisation and how these could somehow be improved must also be examined. The fundamental idea of Task Analysis (TA) lies in a science-based and purpose-oriented method or procedure to determine what kind of elements the respective task is composed of, how these elements are arranged in a logical, or/and timely order, how the existence of a task can be explained or justified, what the driving force to generate it was, and how the task or its elements can be aggregated to another entity, composition, or compound. Task Analysis could therefore be a central activity in system design. Task Analysis helps ensure that human performance requirements match users’ needs and capabilities and that the system can be operated in a safe and efficient manner. As technical systems become more sophisticated and pressure to reduce manpower in them increases, there is a severe risk that unique human skills and abilities may not be used as effectively as they should, thus degrading the potential performance of a system. Therefore, TA as one of the main analysis techniques for human-machine systems design plays an important role in different project development phases.

A critical issue in the emerging area of IMM Information Systems is the ability of these systems to fulfill the information requirements of various user groups. The importance of the TA process is rapidly increasing with the growing number of users with a wide range of skill levels making greater demands upon IMM systems in a wide variety of contexts. Task Analysis is about examining the context and criteria in order to establish a solution, as well as about examining the context and criteria associated with goals in practical situations to identify how they are carried out or what problems are associated with their execution.
Therefore, TA is very useful to the extent that it helps us to improve the design or implementation of systems or, at least, to focus upon areas of poor human performance. IMM systems are designed to fulfill particular goals and should aid people to accomplish them. The way people accomplish goals is by executing tasks. Therefore, a task model can reveal much about the way in which tasks need to be organised within an IMM system. Therefore, a good picture of human task performance is very important for the design of IMM systems. Table 1 shows the relation between TA and RA. Task Analysis methods are expected to indicate, for instance:

- which tasks will be used often or only infrequently,
- to allocate tasks between multimedia system and the target user,
- which media or combination of media the designer must pay attention to,
- the main features of the interface and the structure of the content of the system, etc.

Both RA & TA have elements (concepts) in common which is to produce a definition:

- that can be used as a basis for realisation of a software system that delivers the behaviours and features required.
- that is sufficient as validation criterion for the system produced.
- to establish constraints to support later design decisions and extensions.

Table 1. Requirements analysis vs. task analysis.

<table>
<thead>
<tr>
<th>RA vs. TA</th>
<th>Requirements Analysis (RA) [abstract, partial task elements]</th>
<th>Task Analysis (TA) [real, complete, representative tasks]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Differ on “who/what” it is about</strong></td>
<td>RA about system’s needs, functions and specifications.</td>
<td>TA about real users and real tasks they want to do.</td>
</tr>
<tr>
<td><strong>Purpose/Aim</strong></td>
<td>RA specifies WHAT the system should do.</td>
<td>TA provides information about HOW it should be done. TA is concerned with how a user performs things “tasks”.</td>
</tr>
<tr>
<td><strong>Data collection techniques</strong></td>
<td>Observations, Interviews, Focus group discussion,</td>
<td>Observations, Interviews, Focus group discussion, Existing documentation,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>used</th>
<th>Existing documentation, Checklist, Questionnaires, Videotape, Survey, TA techniques,</th>
<th>Checklist, Questionnaires, Videotape, Task allocation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Particular strengths</strong></td>
<td>Generate a great deal of background information about: problem domain, user requirements and characteristics on the current situation.</td>
<td>Understanding current work in depth, provide a representation of how users perform their tasks, envisionment of how user’s work might be in the future, and establishing basis for satisfying jobs.</td>
</tr>
<tr>
<td><strong>Similar concepts in different models</strong></td>
<td>Waterfall model</td>
<td>Iterative design</td>
</tr>
<tr>
<td><strong>Expertise or skills required</strong></td>
<td>Purpose of analysis, Interviewing, Planning and Subject handling, user – analyst communication techniques, Group chairing, Survey design and analysis skills and expertise.</td>
<td>A depth knowledge of TA technique(s), Interviewing, Planning and Subject handling, System knowledge, Purpose of analysis, User – analyst communication techniques, Group chairing, Experience and skills in conducting the analysis.</td>
</tr>
<tr>
<td><strong>Differ on “who” does</strong></td>
<td>Done by systems analyst</td>
<td>Mostly done by User Interface designers, and Human Factors specialist.</td>
</tr>
</tbody>
</table>

5. The principle behind the framework

The bottleneck in producing such IMM systems is no longer in the technical stages of building it, but in the preliminary analysis phase of specifying the essence of design (producing the logical structure of the system) and capturing the specific features and characteristics. The advent of larger and more complex IMM systems has resulted in the need to reconsider the ways in which requirements are captured, analysed, formalised, modelled, represented and communicated pertaining to those systems. This reflects the author’s view that conventional systems analysis, design and development methods do not cater for IMM systems, and most published work on IMM focuses either on programming or hardware issues (and the real technical challenges involved). The specification of information requirements is a particularly important part of the Requirement Analysis (RA) phase, since poor specification leads to poorly-designed systems which in turn leads to reduced usability of the systems.

The problems of current software design methods highlights the importance of the Requirements Analysis phase in system development, and draws out the importance of integrating and combining with Task Analysis (TA) techniques in order to design usable IMM systems, see Figure 1.
There is very little published on how to capture, analyse, model, represent and communicate requirements for and design IMM systems [13]. IMM system design requires techniques to support the early phase of the development process that have sufficient expressive power to capture the nature of the context of use that supports the multimedia development life cycle. The development of multimedia application places many demands on the multimedia author, including the following:

- a knowledge of the information content required in the application.
- a knowledge of the application user and the requirements of the application user.
- a knowledge of the target user’s tasks.
- a knowledge of the working environment within which the system will be used.

6. An evaluation framework for assessing the capability of TA

Although some researchers, for example [5] and [14] have made claims about what TA, HCI principles and methods might contribute to system design, they have aimed at finding desirable criteria and identifying some distinguishing features for assessing the suitability and applicability of TA Methods, for example [4], [8] and [24] order to support comparisons between them. Finding the right criteria to determine what makes a good TA is difficult to find in the literature, despite the many suggestions that have been made about how TA should be done. It is an open question, as to which of the TA methods will prove most successful to design more usable systems. The views expressed in the literature have identified desirable criteria that should exist within the process/products of current TA models. These criteria were represented in a framework, called “An Evaluation Framework (EF) for Assessing the Capability of TA Methods”, which consisted of four main factors. These desirable criteria of each factor aimed to improve the capability of current TA methods in order to support and contribute directly into the Requirements Analysis (RA) phase, which could result in producing better requirements.

The Scope of Analysis Factor:
- Requirements Classification
- Identify Task Characteristics and Procedures
- Environmental Characteristics and constraints
- Select and Match Media to Content Analysis
- System Navigational Structure and Access Techniques
- Identify Special Interactions and Features of IMM Systems
- Requirements Implementation Plan

Representation Form and Support Factor:
- Variety of Representation Form Provided by TA Method
- The Completeness of Notational Support
- Automated Support to Represent the Features of IMM Systems

Requirements Mapping Factor:
- Feasibility Study/ Project Planning/ Problem Definition
- Requirements Analysis & Specification (RA&S)
- Information Design-Content Selection and Organising
- Choosing the Correct Navigational Structure and Access Techniques
- Choosing: Design Approach and User Interface Approach
- Iterative & Prototype Process
- Implementation
- Web/System Testing & Delivery

Core Criteria Factor:
- Understandability of Requirements Output
- Correctness of Requirements Output
- Usability
- Validity

In order to explore the reviewed TA methods’ support, contributions and capabilities, as well as to assess how their capability could be improved, the Evaluation Framework relates the scope of TA methods, in particular to the RA phase (i.e., to obtain better requirements), and in general to the IMM systems development process.

To make a useful evaluation of TA methods, is to decide whether they are capable enough to support and contribute directly to analysis and web site design within the IMM context and environment. This requires a scheme that asks for...
what ought to be in a TA product, what can/cannot be offered, what the role and impact of these methods is in designing the usability of IMM systems, what the scope of the potential contributions is (i.e., what is the usefulness of the analysis), what resources (skills, time, modelling tools) would be required for application of the method (i.e., how usable is the method), and whether information obtained leads to positive design recommendations. The framework is a conceptual representation in tabular format and textual form, and is aimed to structure and understand a range of concepts of Task Analysis methods. Each factor represents some specific issues, desirable features and elements for the RA phase and other activities of the IMM approach, the TA method should cover and represent these features somehow in their process and outputs. Clearly these kinds of “criteria” are qualitative and not quantitative. The concern was with the use of TA methods to support the RA activities, see Figure 2 below.

Figure 2. An overview of the evaluation framework.

7. The case study

Arguably the most critical activity/phase in the development of a large, interactive and complex multimedia information systems is to capture, analyse, organise, represent and communicate the output of the early analysis process [16] and [25]. Furthermore, there is currently a growing interest in the explicit introduction of Task Analysis [3] and [15]. This has come about as a result of the realisation that the development of friendly IMM information systems is becoming increasingly difficult as contextual factors become broader and more sophisticated [10]. The researcher has to be domain-literate in order to understand the significance of events and activities in their domain context. It is argued that the nature of information collection processes under a naturalistic setting must be opportunistic rather than systematic.

Case study is a method for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence. A case study can describe a phenomenon, can build theory, or can test existing theoretical concepts and relationships [6]. To complement the theoretical assessment of Task Analysis (TA) methods and their evaluation against the framework (defined factors with their specific criteria), an empirical evaluation of TA methods for analysing user information requirements and tasks should be implemented. Although experimental laboratory studies could be used to study specific aspects of the task, it was felt that within the time span and scope of the research empirical study would allow consideration of a wider scope of TA issues and problems. The research is interested in human activity in a scientific approach (Positivist – Case study). At a more theoretical level, practical uses of TA help to further ergonomics knowledge and theory in this area. Through practical use, problems or deficiencies in methods will be highlighted; methods can then be improved to increase their capability. When a researcher selects case study as an appropriate method for a research study, the strengths of case study are considered of importance and the weaknesses are accepted as method-related limitations of the research [6].

7.1. Aim and purpose of the case study

Task Analysis covers a wide variety of roles, goals, methods and techniques, and because of this, it is useful to specify at the outset what is meant by a task. The task focused on here is that which must be performed from the point of view of Ph.D. research students, who usually carry it out, so that the potential user (Ph.D. student) of the system may be taken into account during the design process. The main goal of the analysis is to describe sets of tasks, in terms of tasks which must be executed, and that may be useful for the design of a WWW site/system. The aim therefore is to describe the execution of a set of tasks, as they are perceived by Ph.D. research students who perform them: in other words, how they would explain the performing of these tasks to a beginner. However, the basic idea behind the case study was based on using the selected TA methods in order to find out how Ph.D. research students conduct and plan their doctoral research programme from the start to the final step of writing up the
thesis. The results of using TA methods were collected and analysed, compared and evaluated as to whether their outputs were capable enough to support the Requirement Analysis phase. It was planned in the future to use the results of this research (i.e., the analysis output) to design and develop a WWW Web site in order to teach and introduce the basic steps, concepts, terms and aspects of all details of how Ph.D. research students can conduct their doctoral research, as well as to provide basic information that Ph.D. research students may find useful, to avoid the problems they are currently facing. It could save a great deal of time and frustration if research students get to know these basic procedures.

The research questions and objectives show that four-case designs (i.e., four examples of Task Analysis methods) are more desirable than a single-case study, because they allow us to examine the boundaries of TA methods in more detail, they also allow for cross-case analysis and for the extension of the boundaries of current Task Analysis approaches. More than one case may yield more general research results and enable the researcher to relate differences in context to constants in process and outcome. The Task Analysis methods that were selected, reviewed, explored, used, applied and evaluated during the case study were (four):

- The First Case: Analysis and Training in Information Technology Tasks: Hierarchical Task Analysis (HTA) method, [21].
- The Second Case: Task-Action Grammar (TAG) method: The Model and it’s Developments, [19].
- The Third Case: Supporting System Design by Analysing Current Task Knowledge; Task Knowledge Structures (TKS) method, [12].
- The Fourth Case: Task Analysis for Knowledge Descriptions (TAKD) method: The Method and an Example, [8].

For each TA method, only one reference was used to obtain the details of the product (the references are those cited above). This is intended to avoid the problem of alternative versions of a TA being obtained from different references.

The purpose of the case study was to provide a complementary input into the study, and to offer an appropriate context for the study of the methods to complement the theoretical considerations of analysis. The aim of the case study, however, was to demonstrate how Task Analysis methods can be applied within an IMM environment and to evaluate and explore the limitations and boundaries of the process of the selected Task Analysis methods. The aim is also to find out the critical failure factors that limited the scope of analysis, representation form, usability, mapping and contribution of specifications to other development activities.

7.2. The problem situation

Doing doctoral research involves steps, skills, knowledge, planning, scheduling, etc, required by Ph.D. research students. Why should students know how to do research? One reason is that they are studying for a degree, which requires a thesis. By knowing how to begin and how to conduct the research successfully, they would save time, money and maintain more control over the research by discovering what kinds of things they need to know and what kind of help they need. Another reason for knowing how to do research is that they will be better able to weigh the value of other people’s research. The purposes of describing the procedures for the progression of doctoral research towards their final degree are: to encourage the most qualified and able students to continue in the doctoral programme and to assure their steady progress toward completion of the Ph.D. degree without imposing onerous burdens; to protect those students who are unlikely to succeed in the programme from pointless investment of time and effort and to help maintain and promote the high quality of the Ph.D. doctoral research programme.

A problem situation was selected in order to provide contexts and applications of TA method where adequate access (i.e., easy access to the expected users-Ph.D. research students) could be granted and where the availability of the application domain to analyse existed. Task Analysis methods considered typical decisions that had to be made and examined what information needed to be considered by the Ph.D. doctoral research students to conduct their research stages and also what kind of problems needed to be avoided.

7.3. Sources of information

A clear description of data sources and the way they contribute to the findings of the research is an important aspect of the reliability and vitality of the findings. The case study’s unique strength is its ability to deal with a full variety of evidence-documents, artifacts, interviews, and observations. The goal of using different data collection is to obtain a rich set of data surrounding TA processes, usability and capability, boundaries, limitations and the possible causes of failure, as well as capturing the contextual complexity. The data to be collected will depend on the research questions and the unit of analysis.

The more precise the goals of the investigation, the more specialised the data collection can be. Therefore techniques applied will depend not only on the methods of TA that are to be used, but also on the goal, the purpose of the study and the time and resources available. This is based on the view that different data collection techniques can offer a different perspective on the task. For example, document studies and interviews with real users determine.
what should be done and what they think they have to do. For an analysis of all but a simple task it is likely that several methods will be employed to collect the task data, either independently or in conjunction with one another. [2] report that in order to ensure that TA is reliable, it is useful to use different sources of information while developing and rechecking the TA. The resulting TA can only be as good as the original data [10].

Whilst the TA methods provide a framework for organising the task descriptions and information, the quality of the analysis depends on the information input into the analysis. Therefore, it is important to select a data collection method that provides information in a format that can be used by the analysts. Though observation and interviews are most frequently used in case study method, methods of collecting information were selected which were appropriate for the task, that is, in respect to the research method (i.e., Positivist - Case study), questions and hypothesis. However, in order to find out precisely what the task entailed and where the problem areas lay, the requirements information used in the case study was obtained and collected from a variety of diverse sources, and was governed entirely by the availability of documents and access to Ph.D. research students. Relevant task domain information had to be collected focusing on different phenomena, and using different methods of data collection. Based on an analysis of the character of the knowledge sources in the reviewed TA frameworks, different methods were identified to collect all information needed to construct the required task models. The techniques addressed the students’ research procedures and identified the main tasks, stages, goals and reasons for particular task structuring. The data collection techniques which were used are as follows:

- structured and un-structured interviews (subject-based);
- questionnaires (subject-based);
- documentation;
- walk through,
- focus group discussion.

8. Research reflections

A major problem with the introduction of information systems is the fact that a very large proportion of them fail to meet their initial aspirations [22]. This is due to the lack of obtaining better requirements during the Requirements Analysis (RA) phase as a result of inadequate support and contribution by Task Analysis (TA) methods and techniques. The followings are what the author has learned from the research process:

- advances in information technology and the expansion of the numbers and types of systems and applications that use the new technology in innovative ways are quickly leading to a world in which pervasive computing is the norm. The result impacts upon people in both individual and organisational contexts and in society at large. This is particularly so with recent developments of the internet and web-based applications and with the rapidly-expanding range of technological devices that are being embedded in many products and systems. It is essential that the research, tools, methods and techniques developed in the field of HCI are considered and integrated into the development of software and systems using these new technological advances, if the anticipated benefits are to be fully realised.

- there are many tools, methods and techniques that can be used to gather task-related information and place it into a meaningful context. Each of these has its particular strengths and weaknesses. Therefore, the success or otherwise of any TA exercise will to a large extent depend upon how the mix of TA techniques and data sources is selected and applied. Ideally, for any TA project there should be an overall plan and subsequent close monitoring to ensure that objectives are met.

- mechanisms for collecting the raw data could similarly be structured. The analysis of existing tasks tends to rely largely upon observation, interviews and documentation. While techniques for analysing these data independently are available, these have yet to be integrated and combined with the task analytic method. Conceptually, at least, this is not a difficult undertaking, but one that has yet to be proven in the field.

- at present, little is known of the reliability and validity of current TA methods. There is certainly plenty of scope for more research of this kind to be conducted, and the development of methods would clearly be beneficial. In addition, standardised training and documentation of methods should be developed, as acquisition appears to rely largely upon self-development at present.

- the way in which all user views, tasks, needs, requirements, preferences, characteristics, and environment (i.e., physical, aspirational and functional) are re-ascertained will be a major factor in supporting the Requirements Analysis (RA) phase which leads to obtaining better requirements, as well as in determining the quality (effectiveness, efficiency and satisfaction) within the end product.

- since Task Analysis is a time-consuming activity, a guidance to the application of the method, in particular during the generification, can limit the employment of resources necessary to carry out the complete TA process. Essentially, it is apparent from the case study that there is a need for the development of guidelines
to address the various stages of undertaking a TA, including planning the methodology, data collection, data analysis, presentation of TA information and mapping the output information into each activity of the development life cycle. However, such guidelines should provide systematic advice, rather than inflexible, prescriptive rules.

9. Conclusion

Attempts to tie the various theoretical and methodological strands together will only come about by framing the problem in terms of human activity in context. This ecological perspective seems to be fundamental to task analysis [3]. In this research the application of TA methods has been used to assess the adequacy of a proposed design for a World Wide Web (WWW) site within an IMM environment which will help research students conduct and deliver their doctoral programme as carried out at the University of Salford, UK. The results of the application of TA methods and their input into the design activities were analysed and compared both to each other and to a defined framework (a set of four main factors with desirable criteria that should exist in the output of the TA process) in order to evaluate their capabilities. These criteria were developed as a result of an extensive literature review, where methods which could potentially be used for this purpose were identified. The findings however, have shown that TA methods have a number of weaknesses in the support and contribution they made.

The philosophy of IMM is quite unlike that of the more traditional mediated systems which are designed for a specific task or range of tasks. IMM systems have special and different characteristics, which make their design and development process more difficult and thus should be approached differently from the early phase. Some of these characteristics are: the complexity of the system’s navigational structure, media-selection, integration and synchronisation, the type and variety of contents, the style and the level of the interactivity and interactions and the UI design, etc. The research argues that the design process can be more efficient or optimised by the continuous use and application of the relevant TA methods throughout the development cycle in order to aid IMM system design activities.

Surprisingly little Task Analysis (TA) has appeared for one of the most discussed and fastest-growing interactive computer application the ‘WWW’. The reviewed TA methods did not however include any concepts explicitly intended for interactive systems involving multiple media types. This was an intentionally important aspect of our chosen application (i.e., WWW). This failure of the reviewed TA methods can be seen as a further example of how the technological developments of IMM pose novel design issues for HCI, in this case raising the need to broaden the scope of TA. The scope of the selected TA methods needs to be extended to cover and focus on the complete system’s design and development activities, including for example the application domain of the intended system (i.e., the major constraints on design decisions) and to bridge the gap that exists between the analysis process and the subsequent development activities. Proper operation of any TA method should form part of a general planned approach to a problem.

10. References


