

School of Information Systems

**Empowering Human Cognitive Activity through
Hypertext Technology**

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**Empowering Cognitive Activity
through Hypertext Technology**

Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand.

And as the instruments for the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions.

(Francis Bacon, *Novum Organum* (1620) Bk.1.Sect.2)

Abstract

This research explores how computers may be used by individual researchers engaged in cognitive activity and creating original outputs, specifically, how one of the emerging information technologies, hypertext, is able to provide 'suggestions for the understanding' to support and empower human cognitive activity.

The study investigates the possibility of a new model within which to approach that part of research that seeks to make connections to what has been done previously, and to stimulate new thoughts.

Imagine 'swimming' in a vast sea of potentially useful information. How can one possibly begin to make sense of it? Engage in a phenomenological experience in which the data is permitted to 'speak' to you. Immerse yourself, navigate around with the ability to backtrack, search, explore trails of associative thought, all with a prepared mind. The mind is prepared, or sensitised, due to the previous research and learning – the culture to which one belongs. The process will gradually cause an uncluttering of the sea of information resulting eventually in what in this thesis is termed *Generative Conceptualisation*. The tools and techniques used to do this (for it is impossible to work unaided with large amounts of data) will have provided the empowerment to generate and create. The tyranny of linear order has been replaced by the dynamically varying structure of selected, sometimes hierarchical and othertimes herterarchic or network views of the data, forming or exposing (primarily through juxtaposition) insights, new ideas, and new knowledge. These are some characteristics of working in a hypertext paradigm.

Generative Conceptualisation is introduced to describe the intermingling of human mind and computer hypertext, which, it is argued, results in a greater degree of original output by researchers. A hypertext paradigm, the definition of which emerges in the thesis, is suggested as being an environment for *Generative Conceptualisation*. A theory (substantive) of knowledge creation is

offered in the concluding chapter, in the light of which existing formal theories of knowledge creation may be reviewed or elaborated.

AIMS

Can hypertext technology, used in a definable way, empower humans in doing original and creative work? Speculation that hypertext supports, augments, expands and extends, the mind's capability to form, follow, manage and maintain associative links and 'societies' of knowledge or information results in an inquiry grounded in this author's experience of creating hypertexts from existing knowledge repositories. The research seeks to develop an understanding of some aspects of the cognitive activity of established researchers as respondents as they generate new knowledge. It aims to discover regularities and identify and categorise the phenomenological elements and their connections as exhibited by a small sample of knowledge-workers¹. The research is done in the Qualitative tradition.

SCOPE

This research collects qualitative data from a small group of active researchers through semi-structured interviewing and participant observation in two field studies. The first study yields data (F1_data) which, together with this author's tentatively formulated ideas, informs the design of an empowering software device called Hypertext Information Management System (HIMS). The second study (participant observation) provides the evidence (F2_data) of the effect of HIMS on the research activity of another group of active researchers.

¹ Consistent with its use in the Information Systems discipline, the term "knowledge-worker" refers to individual humans whose main work involves brain function (e.g. managers, professionals) rather than the production of tangible goods.

CONCLUSION

The design of an empowering hypertext device – HIMS – emerges from the first study. Nine factors influencing the knowledge generating behaviour of the researchers were revealed:

1. *Communication and terminology*
2. *Crossing the boundaries between disciplines*
3. *Interconnectedness of the knowledge domains*
4. *Specific techniques used*
5. *Doability of tasks*
6. *Creating a richly connected repository of ideas for future research*
7. *The 'loftiness' of science and the role of techniques*
8. *Ways of reading, ways of accessing knowledge repositories*
9. *Changing viewpoints (over time) created from the same data sources
(multiply useful data)*

An evaluation of HIMS, as it was applied in the field, reveals how the researchers overcame limitations and were empowered through its use and benefited from working in a hypertext paradigm. The study of the application of HIMS generates four major components impacting the work of the researchers; as the work proceeded HIMS provided augmentation and support for the researchers' cognitive activities. Each of the four components is further elaborated by a set of constituent issues.

1. *Knowledge-work inhibitors*

Limited aspirations due to respondents' perceived lack of intellectual power or capacity

Diversions prevented the work being done

Fear of missing something (completeness)

Tendency to delete (remove items from focus or view)

Paradigm entrapment – doing things the same way

2. *Strategies for knowledge creation*

Creating analogies (analogical thinking): Interstellar space and stardust;
Adding brush strokes to a work of art; Thickness of the dust; The sea of
knowledge; Panning for gold; and The skeleton lying there

Juxtaposition

Ways of reading

3. *Maximising knowledge-work potential*

Unexpected encounters and preserving a link for future follow-up

Stumbling across data and serendipitous discoveries

4. *Doability and empowerment*

Rich and voluminous data sources

Unboundedness of knowledge

The need for empowerment

Empowerment

The dissertation concludes with a characterisation of a hypertext paradigm as a possible environment for *Generative Conceptualisation*, and proposes a substantive theory² of knowledge creation, the hypotheses of which set an agenda for further research.

² The term "substantive" as used here does have the common meaning "of considerable amount or quantity" but rather "belonging to the real nature, essential part, or essence of a thing". The usage is consistent with that of Grounded Theory discoverers Glaser & Strauss (1967) and other Qualitative Research literature.

Chapter 1 - Hypertext and the generation of knowledge

Some three and a half centuries ago Francis Bacon was keenly aware of the need for 'instruments' or 'helps' to support 'understanding'. In this age of the personal computer, which provides a device so amenable to doing that which it is programmed to do, the information technology community is just beginning to enlist it as an 'instrument of the mind'.

This research explores how computers may be used by individual researchers engaged in cognitive activity and creating original outputs. Specifically, it explores how one of the emerging information technologies, hypertext, can provide 'suggestions for the understanding' and how it can support and empower human cognitive activity.

In this chapter a concept termed *Generative Conceptualisation* is introduced to describe the intermingling of human mind and computer hypertext, which, it is argued, results in a greater degree of original output by researchers. This intermingling is characterised by the ability to conceptualise, abstract, explore, add to, and re-conceptualise, so that the generative impulse enabled by computer technology can create and re-create. But first the reader is made familiar with the concept of hypertext.

Hypertext

The term hypertext was coined by Ted Nelson³ (1965) in the early 1960's (Cross 1995 p34) to refer to "an interactive computer environment ... [the design of which] should be based on the intended effect *in the mind and heart of the viewer*. ("Heart" here is added because we are too seldom mindful of the emotional component of a user's reaction.)" (Nelson 1980 p1014). Nelson is advocating that

³ Nelson is himself imprecise about this - Cross (1995).

systems which rely on computers to augment the intellect (and it can be argued that all systems do that to some degree) must recognise the "mental space of the user's experience" (p1014). In this case, Nelson is adding the emotional/imagined to the logical/rational experience at that time associated with computers. Computing systems of the 1960's were extraordinarily user-unfriendly and limited to answering only those questions formulated into formal and very precise queries of the data base⁴. There was little consideration of supporting the 'information exploration' desires of the inquirer. The ideas of Nelson, among others, would change that. Nelson's interest was in interacting with large repositories of text, as opposed to data bases with their highly regular structure. Enticed by Vannevar Bush's Memex concept (1945 p106), he designed and began to build a complete computer-based literary system (which he called Xanadu) – in effect a global hypertext. The era of computer hypertext was now visibly on the research and development agenda.

Douglas Engelbart, a researcher at Stanford Research Institute, was another key figure in the development of hypertext technology and first started to design hypertext systems in the early 1960's. He produced the first demonstrable hypertext system in 1968, called NLS (oN Line System) (Engelbart 1963, Conklin 1987). Later this was followed by another system, AUGMENT, a name which reveals a major purpose behind Engelbart's efforts – that of supporting the human knowledge-worker's cognitive activity rather than simply the computational activity.

The potential of hypertext was clear to Conklin (1987 p17-18):

... this new technology opens some very exciting possibilities, particularly for new uses of the computer as a communication and thinking tool. ...
The concept of hypertext is quite simple: Windows on the screen are associated with objects in a database, and links are provided between

⁴ *In this thesis the term "data base" means a repository or base of data stored in some generally suitable form for computer manipulation. The term "database" refers to a specially constructed computerised information system - in the jargon of the Information Systems discipline, a DBMS (Data Base Management System).*

these objects, both graphically (as labelled tokens) and in the database (as pointers) ... However, the reader who has not used hypertext should expect that at best he will gain a perception of hypertext as a collection of interesting features. ... one must work in current hypertext environments for a while for the collection of features to coalesce into a useful tool.

As Conklin (1987 p32) warns, a definition of this new technology, without the reader having the experience of using it, is unable to convey its power.

It is tempting to describe the essence of hypertext (through its functions). ... But this is a little like describing the essence of a great meal by listing its ingredients. Perhaps a better description would focus on hypertext as a computer based medium for thinking and communication.

The essential elements of hypertext are: nodes or chunks of knowledge which are the units of information in the hypertext; links between these units of information; a navigation or browsing facility which keeps a⁵ history of nodes visited, and may be used for subsequent backtracking; a dynamic indexing system to keep track of the body of knowledge which is currently in 'scope'; and a full text search function.

Thinkers and researchers have suffered for decades from the same problem for which Bacon prescribed his 'instruments' and in response to which Bush invented the Memex – the relative inadequacy of human cognitive capacity. Bush (1945 p107) describes his solution to the problem:

The owner of the memex, let us say, is interested in the origin and properties of the bow and arrow. Specifically he is studying why the short Turkish bow was apparently superior to the English long bow in the skirmishes of the Crusades. He has dozens of possibly pertinent books

⁵ The indefinite article used is consistently "a", even prior to words beginning with "h" (as in this case). Exceptions are: "hour"; "historian"; "HTML"; each of which sound 'better' prefixed with "an" rather than "a".

and articles in his memex. First he runs through an encyclopedia, finds an interesting but sketchy article, leaves it projected. Next, in a history, he finds another pertinent item, and ties the two together. Thus he goes, building a trail of many items. Occasionally he inserts a comment of his own, either linking it to the main trail or joining it by a side trail to a particular item. When it becomes evident that the elastic properties of available materials had a great deal to do with the bow, he branches off on a side trail which takes him through textbooks on elasticity and tables of physical constants. He inserts a page of longhand analysis of his own. Thus he builds a trail of interest through the maze of materials available to him.

And his trails do not fade. Several years later, his talk with a friend turns to the queer ways in which people resist innovations, even of vital interest. He has an example, in the fact that the outraged Europeans still failed to adopt the Turkish bow. In fact he has a trail on it. A touch brings up the code book. Tapping a few keys projects the head of the trail. A lever runs through it at will, stopping at interesting items, going off on side excursions. It is an interesting trail, pertinent to the discussion. So he sets a reproducer in action, photographs the whole trail out, and passes it to his friend for insertion into his own memex, there to be linked into the more general trail.

The 'trails' Bush envisaged were not those consisting of bulky books, notes on scrap paper which were prone to become lost, and forgotten snippets of information, but rather an organised store of links and information which preserved the richness of the researcher's journey. Modern hypertexts are used and interacted with in a strikingly similar way as to that envisaged by Bush more than half a century ago. Later it will be argued that this represents empowerment of the hypertext user to do cognitive work.

The trails of links to pertinent information feature prominently in Schneiderman & Kearsley's definition of hypertext in one of the first books to be simultaneously produced and published in hypertext form – *Hypertext Hands-On!* – (1989 p3):

The most common meaning of 'hypertext' is a database that has active cross-references and allows the reader to 'jump' to other parts of the database as desired. This makes the reading (and writing) process nonsequential. It is the requirement for active cross-references that makes a computer necessary to implement hypertext. The accompanying book can describe hypertext, but this hands-on software component allows you to actually try it out. A hypertext database can be conceptualized as a network of nodes and links where the various documents are the nodes and the cross-references are the links. Hypertext networks can take the form of hierarchies, but usually the associations among documents are more complex. The documents linked together are not restricted to text but could be graphics, photographs, sounds, narration (speech), or animated sequences (video). When the documents are multimedia in nature, the term hypermedia is often used. CD-ROM is a multimedia storage medium that is likely to become popular for hypermedia applications. Another important concept of hypertext is the idea that documents are shared across multiple locations/machines and allow collaboration in both reading and writing articles. By allowing such connections, it becomes possible for an individual to access a tremendous amount of information. In fact, some hypertext visionaries, such as Vannevar Bush and Ted Nelson, have envisioned "giant brains" and "universal databases" in which everything is connected to everything else.

It is in these 'jumps' that opportunities for *Generative Conceptualisation* occur as phenomena take on shapes, attributes and identities from which concepts emerge.

Computer hypertext has caught the eye of literary theorists in recent years. For example, both Jaques Derrida and Roland Barthes have argued for the abandoning of conceptual systems "based on ideas of center, margin, hierarchy, and linearity and replace them with ones of multilinearity, nodes, links, and networks" (Landow 1992 p2). In this mission they are of course not alone. Proponents of hypertext and committed serious users of the technology find that the deliverance from the constraints of linearity in computer documents and the

removal of the 'boxified'⁶ confines of databases permit new ways of working with computer data. This very study is itself dedicated to the task of exploring alternative ways of thinking with the support or 'help' of hypertext technology.

Changing the ease with which one can orient oneself within a hypertext context (in which individual references are easy to follow and the entire field of interconnections is obvious and easy to navigate) and pursue references radically changes both the experience of reading and ultimately the nature of that which is read. (Landow 1992 p5)

The common thread running through these characterisations of hypertext is the ability to support the thinking of the human knowledge-worker, largely through the ability to make links or, in some sense, to juxtapose knowledge. This juxtaposition, "(the) unique coming together of previously unconnected thoughts, processes, mechanisms, technologies, or philosophies" (Thorne 1992 p124) is required for innovation, a point also recognised by Rickards (1974 pp13-14): "Creativity is a mysterious process which can give rise to heated arguments among psychologists. It is sufficient here to regard the process as one which gives rise to novel combinations of concepts which have significance to the solver or his environment".

This process, which gives rise to novel combinations, need not be so mysterious. In a hypertext environment, in which everything can potentially be linked to everything else (but without the impossible cognitive load such a massive number of associations places on the brain) a central element of creativity – "the ability to view things in new ways" (Partridge & Rowe 1994 p3) can be readily supported or provided for. The hypertextual support system 'manages' the combinations by keeping track of the connections or links between them, leaving the user free to concentrate on other matters. All links in the hypertext are not necessarily active at once: invoking one or a combination of 'views' suitable to the current purpose reduces the cognitive load on the brain, thus acknowledging

⁶ 'Boxified' refers to the constraints which a previously thought up classification imposes on text, data, or knowledge stored in database form.

human brain function limitations. Hypertext permits combining or juxtaposing objects of varying type (text, still and motion picture, and sound for example) so as to admit a fresh perspective on them and this essential element forms the centre of this author's definition of hypertext:

A hypertext is a society of knowledge-containing objects of varying type (text, graphic, sound, motion picture, simulation, and composites). These objects are stored in a computer readable memory to which access is provided via a network of embedded associative links: hypertexts are non-linear and provide direct access to knowledge-containing objects and structures.

Hypertext permits doing 'other' things with what is read than has been possible (for most of us) hitherto. It admits an additional dimension of perception and conceptualisation for the knowledge-worker. Woodhead (1991 p71) refers to this as "A new information paradigm" which is "needed to manage the growth of information in general. Hypermedia can provide both the framework for production and the (online) means of distributing the finished products". Woodhead (1991 p93) sees hypertext/hypermedia⁷ as having "the potential to become the dominant software paradigm of the 1990's". The general approach to perceiving and conceptualising the vast quantities of information accessible in computer information systems worldwide, particularly unstructured textual data, is termed a hypertext paradigm⁸ in this work.

⁷ The problem of which term to use, hypertext or hypermedia, is one faced by all authors writing on this subject. Woodhead (1991 p2), amongst others, sees hypermedia as subsuming hypertext, and reserves the latter for text-based contexts. On the other hand, Nielsen (1990 p5) says he "would like to continue using the traditional term "hypertext" for all systems since there does not seem to be any reason to reserve a special term for text only systems". This author's preference coincides with that of Nielsen.

⁸ A definition of hypertext paradigm will gradually emerge throughout the thesis. Chapter 5 and 6 develop the concept and a formal characterisation is presented in Chapter 8.

Computer support for knowledge-work

Until relatively recently, information technology, particularly as embodied in the personal or desktop computing revolution that began in the late 1970's and early 1980's, has concentrated on providing solutions to structured problems, answers to questions, and retrieved data sets to database queries. Thus, modern information workers 'calculate' using spreadsheets, and 'analyse' situations by studying reports generated from database applications and other computer applications and 'write' their results into reports with the use of word processors.

These three modes of working with the computer – word processing, spreadsheet calculation, and database query – have accounted for the major use individuals make of desktop computers. But there is a clear indication that the users of personal computers expect more. The notions of connectivity and communications are major areas of advancement in the mid nineties, especially as embodied by the Internet and the World Wide Web. Workgroup computing, in which support is provided for groups of people working in a team and toward a common goal, is a second major theme of this decade. A salient point about these modes of work with computers is that the focus has been on quantitative data.

Whilst the three processing modes mentioned above have proved of significant benefit to individuals and groups, they address only a very small fraction of the entire domain in which computers can support human knowledge-workers. They recognise the importance of manipulating numbers and the quantities they represent. However, words and the qualitative states represented by language (through words) comprise the bigger part of the world's knowledge ([Feigenbaum & McCorduck 1983 p18](#)):

Most of the world's work is nonmathematical in nature. Only a small segment of activity has as its kernel the kinds of formulas that we see in engineering and physics applications. Even in such 'hard' sciences as chemistry, most thinking is done by inference, not calculation. The same

is true of biology, most of medicine, and all of law. Almost all the thinking of business management is done by symbolic inference, not calculation. In short, almost all the thinking that professionals do is done by reasoning, not calculating. As computing gets cheaper and the professions look to computer technologists to aid in relieving their ever-growing information processing burden, they will want to use methods that involve automated reasoning and use of symbolic knowledge.

Even where the work ultimately can be characterised as quantitative, thus calling for 'calculation', prior to putting pen to paper in writing mode to communicate the result and findings to the rest of the world the matter or idea which is to be written about (and involving calculation) must first be considered. The question needs to be asked: "why aren't computers being as helpful in the generation of new knowledge and in supporting original thinking as they are in calculating and writing?" Part of the answer may be due to the sheer volume of calculating, writing, and database retrieval that is going on, leaving little time to explore other possibilities. The mindset is guided by quantitative paradigmatic requirements. However, another major factor accounting for the non-use of computers to support 'thinking', has been the relative absence of sophisticated software to manipulate concepts (represented by elements of thought and language through which it is communicated – such as words, terms, and sentences) as opposed to numbers. This has been steadily changing since users have begun demanding text and qualitative data-manipulation software packages. Support tools and environments specifically created for qualitative data analysis, which permit concept manipulation, are now beginning to appear. Many of these are based on a hypertext paradigm, and support the associative link making and link following so characteristic of human thought.

A relatively recent and very well developed trend in computing is that known as Decision Support Systems (DSS). This movement has its origin in the early 1970's ([Scott Morton 1971](#)) and is concerned with the support of (human) decision making. The shift is very deliberately away from calculating and answer giving, to advice giving, option outlining, scenario building and so on. Rather than

being operational, its focus is tactical or strategic. Users of DSS are less concerned with how many widgets were sold or the quantity of overtime hours worked, and rather more interested in the impact of aspects such as working (or not) of overtime on the number of widgets which can be sold. Further, in situations where the focus is on strategy, the decisions cannot sensibly be made by individuals in the absence of their colleagues who can be, and usually are, impacted by the events under consideration. Information technology has now been developed to support the work of groups – hence the branch GDSS (Group Decision Support Systems), GSS (Group Support Systems) (Jessup & Valacich 1993), GCS (Group Communication Systems), CSCW (Computer Supported Co-operative Work), and Workgroup Computing (Johansen 1988). Such technologies include structured processes, the evaluative and outcomes-oriented parts enabled by mathematical devices, the generative parts enabled by process devices such as brainstorm/discuss/comment. But in all this support for knowledge-work the inbuilt purpose is on converging towards decisions or outcomes. Whilst some emphasis is on divergent thinking, and human processes, the overall aim is to support the attenuation⁹ of data and convergent processing, rather than divergent and idea liberating stimulation of the cognitive faculties. The problem or purpose for which these computing system types are used is ultimately for the human user to arrive at an answer or decision.

Some readers, particularly advocates of GDSS and its related areas, may feel that the inclusion of a brainstorming or other idea elicitation device in the GDSS toolkit qualifies GDSS for classification as a cognitive support system. However, such a support module simply records and arranges the ideas, possibly in a hierarchy. It does not support divergent thinking directly. To do this, one needs a network (perhaps in addition to a hierarchy), which permits the modelling of the associatively connected chunks of knowledge emanating from the mind. This may be largely a matter of opinion, although the latest trend seems to be to refer to GCS (Group Communication Systems) rather than GDSS, giving more

⁹ *Attenuation in this sense is used to invoke a meaning constructed from: making thin or fine, rarefy; to make less dense; to make rare; to reduce in magnitude; diminution (diminish) of density; to reduce the amount; to refine; to purify; make remarkably good or fine*

than a hint of the direction being taken – i.e. support communication for the purpose of arriving at a decision, rather than empowering cognitive activity to foster creativity the latter of which is the aim in this research.

This new domain in which to apply Information Technology emerges from the readily available and powerful computing systems now at our disposal – to support thinking creatively, and using the computer as an extension of one's own capability and capacity to think. In today's "computer culture" (Papert 1980), computers are enlisted in the service of empowerment, not merely the pursuit of operational tasks such as calculating, sorting, and comparing, but in building mental constructs. Take for example the constructs of *square*, *triangle*, and the ability to combine the shapes into another construct called *house*. These constructs are represented by the computer as a drawing on a screen or as a shape traced out by a robot on the floor. The *square* and *triangle* depict or represent mental constructs with those names. When the triangle is placed on top of the square the composite becomes known as *house*. The 'putting together' of (associating or juxtaposing) these constructs has been enabled by the computer - it has been used as a tool with which to think.

Thinking and learning are characteristically human cognitive activities. Augmenting the human intellect in generating original output can be seen as empowering the knowledge-worker with 'helps' for cognition, problem solving and creativity. For this special type of empowerment discovered in the second field study (Chapter 3) the term *Generative Conceptualisation* has been coined. It is a meta-concept defined in terms of cognition, problem solving, and creativity.

Generative Conceptualisation

Empowerment is generally associated with meanings such as "enabling", "permitting", and "giving power to" (Macquarie 1990). An alternate sense in which

the word is often used, that of "authorising". The former sense is the one of concern here.

In order to determine whether there has been any empowerment in a given situation, we need an operational version of the more general definition. To be able to say that empowerment has taken place we may look for evidence in relation to reliability, power, and speed - assuming that engagement, or sustained engagement, which are necessary pre-conditions have been met. These performance factors can be checked through self-judgement, peer judgement, and independent observation of the process and its outcomes. Goldman (1986 pp26-27) defines each of these standards of evaluation:

The first standard is *reliability*¹⁰. ... To be clear about reliability, it helps distinguish two different intellectual misadventures: error and ignorance. Error is false belief; ignorance is the absence of true belief. A reliable process, method, or procedure is an antidote to error. ... The antidote to ignorance is (intellectual) *power*. Power is the capacity of a process, method, system, or what have you, to produce a large number of true beliefs; or slightly differently, the capacity to produce true beliefs in answer to a high ratio of questions one wants to answer or problems one wants to solve. ... The third standard is *speed*, ... that is speed in getting true beliefs.

The idea that cognitive activity can be enabled, augmented or empowered through an information technology, hypertext, comes from this author's own experience. Other researchers have produced systems which go some way toward augmenting the intellect. Lawrence Young (1987) has enlisted database technology to do what he terms "idea processing", a scheme brought to market in the software package IdeaFisher (Fisher Idea Systems 1988-1992). An earlier example of the use of the term "idea processing" was by Halasz et. al. (1987) in which they (p42) "briefly describe NoteCards and the conceptualization of idea processing tasks that underlies its design". NoteCards is a hypertext system

¹⁰ According to Goldman (1986 p26): "'reliability', as used here, and in other epistemology literature corresponds to the behavioural scientists' term 'validity'".

designed to support the business sector. As is true of so much of the North American software, and despite the nature of idea processing being elaborated as the moving (p42) “from a chaotic collection of unrelated ideas to an integrated, orderly interpretation of the ideas and their interconnections” NoteCards appears to concentrate more on the mechanistic and less on the generative – the latter would enhance creativity. Douglas Engelbart (1963) produced an article in the early 1960’s entitled “A Conceptual Framework for the Augmentation of Man’s Intellect”. His ideas emerged in Tymshare’s AUGMENT system (Engelbart 1988) which provided support for knowledge-workers engaged in (p108) “planning, analyzing and designing complex problem domains”. In each of the above systems, synthesising knowledge is not of prime concern and is left to the human mind unaided by the technological support that the more rational and mechanistic of the thought processes are given.

Psychologist and cognitive scientist Donald Norman (1985 p334-335) sees the possibility of computers extending the human intellect although he has not produced a system to demonstrate the extension of the human intellect by computer:

The computer is, in some sense, an artificial extension of our intellect, invented by humans to extend thought processes. Just as we no longer need to master the art of memory because of the ease of writing, and just as we no longer need to master arithmetic because of the availability of the calculator, or calligraphy because of the typewriter, we may perhaps forego some forms of thought once small portable computers become commonplace. (Hopefully, thus freeing ourselves for higher levels of thought processes.) Here is not the place for social commentary on these changes, just notice of the heavy dependence our culture places on technological aids to thought processes.

Norman is alerting us to the possibility of relieving our brain from certain thought processes, and using the newly created spare capacity for higher levels of thinking and creating. Aids to thought processes are definitely warranted as our information systems now have the capacity to deliver vast amounts of

knowledge or information. The Internet, for example, permits researchers access to some ten million host computers (as at January 1996 rising to nearly 13 million six months later¹¹) across the world. It is reported to have generated traffic equivalent to 2,300 Encyclopedia Britannicas during May of 1994 alone and grew at the rate of 350,000 per cent during 1993 (Kleiner 1994 p36). It is very likely that somewhere amongst all that information circulating via the Internet and its sites there is something directly relevant to one's research interest or activity. Traditional search techniques no longer suffice in locating all or the bulk of relevant material for two reasons. First, the domain under which a specific piece of knowledge is stored or locatable is no longer clear cut. For example, should the reporting of a new computer supported data analysis technique specifically suited to molecular biology be categorised under "computer" or "biology"? Second, and for our purposes most germane, is the (unlikely) possibility of turning up something relevant through the usual 'page by page' consideration of that which has been found so far. This immersion in the knowledge would very likely be unproductive without powerful tools permitting browsing and navigating large repositories of knowledge that exist in the computers connected via the Internet. Traditional search tools do not encourage such navigation and browsing abilities. Whilst searching results in attenuation of data, permitting deduction from the collected facts, navigating and browsing, result in making connections between disparate pieces of information – exploring, discovering, and induction. The latter is much more akin to associative thinking, that very common form of human cognitive activity, and a form that is fundamental to *Generative Conceptualisation*.

As previously discussed, traditional approaches to selecting data pertinent to a research problem include sifting serially through data, searching data using techniques such as Boolean logic, and database selection or query (a form of searching). These approaches are highly directed, requiring the researcher to have a very clear vision of the actual search strategy. There is restricted room for adjustments and no room for spontaneous adjustments. And in these circumstances one will surely only find that for which one is looking, or nothing.

¹¹ As at August 1996 according to Network Wizards at <http://www.nw.com>

There is restricted opportunity to refine or redefine the searching yet to be done in the light of what has been uncovered so far.

This absence of an ability, or willingness, to adapt is seen by traditional scientists as 'good science'. Indeed, there are many researchers who claim that it is unacceptable to have no pre-conceived method (design) for tackling a problem. But if this inflexibility does not serve the purpose, why should we not experiment with alternatives; these alternatives should be just as admissible as 'real science'.

Paul Feyerabend has argued eloquently that "there can be many different kinds of science" (Feyerabend 1988 p3). His thesis (p1) that "the events, procedures, and results that constitute the sciences have no common structure; there are no elements that occur in every scientific investigation but are missing elsewhere" has created a striking controversy, despite his seeking only to make this thesis plausible rather than to establish it.

Whilst Feyerabend is a philosopher and artist-actor (1988 p272, p288) of the 20th century, similar ideas were part of Bacon's thinking some 350 years earlier (Bacon 1620 p129).

The human mind is often so awkward and ill-regulated in the career of invention that it is at first diffident, and then despises itself. For it appears at first incredible that any such discovery should be made, and when it has been made, it appears incredible that it should so long have escaped men's research.

Philosophers such as Bacon and Feyerabend, have obviously wrestled with the constraining influences of 'real science'. Method is useful so long as it does not hinder or thwart re-directing one's attention (altering or replacing the method) in the light of what the method has permitted to be discovered to date. In this sense, immersing oneself in the data, allowing it to 'speak' as it were, may

permit the creation of knowledge just as 'science' does. And in dealing with the vast amount of data available to the contemporary researcher, we must enlist the 'helps for the understanding' which technology can offer.

An alternate model for thinking permits concepts to be formed outside of existing knowledge structures, subjected to exploration, and ideas to be 'discovered' through intuitive perceptions.

Working in this way can be represented in the following model of thinking¹²:

1. Immerse oneself in the 'sea' of data (this happens naturally very often).
2. Labour, almost in a survival manner, struggling to 'swim' and keep one's head above water.
3. Discover that there is more than mere 'survival'; begin to develop one's interest in concept X.
4. Link the first thought/experience of concept X with another related one, say X1, then X2, etc..
5. Amend the emerging concept (developed from and about the concepts X1, X2, ...) forming XX.
6. With this new vision as a guide (the mind has been prepared – by thinking about XX) perceive the data one is immersed in, possibly in a slightly new or different way, and apply this view (as determined by XX) to others' data repositories (knowledge bases).
7. A fresh idea, Y, emerges and is generated from a reformulation of XX.

Figure 1: *Generative Conceptualisation* as a model of thinking

In doing the thinking as described in [Figure 1](#), support is needed if the data of interest are more than a matter of say ten or 20 (or perhaps 100 or 200 for some) printed pages. A hypertext environment provides such support, permitting the tackling of 'unrealistic' bodies of knowledge. In the field study described in [Chapter 6](#) – Empowerment through a hypertext environment, respondents worked with many megabytes of textual knowledge, of the order of the equivalent of 500 printed pages and more. Working with these volumes of data is clearly unrealistic without support.

¹² *To the extent that learning is a manifestation of thinking, this may also be seen*

Figure 2: Generative Conceptualisation, depicts the operations involved in working with vast quantities of sense-data derived from what can be termed a researcher's information space and with the goal of generating new concepts and knowledge. Such information spaces are filled with, for example, Internet Newsgroup postings, results of wide-ranging bibliographic searches, full-text versions of journal articles, special purpose collections of textual material on CD-ROMs (quality assurance documentation, legal statutes and cases, transcripts of proceedings, catalogues, procedures manuals, and so on), education material, and other eclectic data repositories.

One peculiar quality or characteristic of these data is that they are often created for purposes very different to those of the researcher seeking to discover new knowledge - said differently, an author's structuring of the knowledge is not necessarily suitable to our researcher, but yet buried somewhere amongst its vastness there may be relevant or vital pieces of information. From the researcher's standpoint the data is unruly, indiscriminate, or promiscuous, consisting of parts of different kinds brought together without order. The researcher's quest is to create some order, to discover, or perhaps uncover, that which is germane to the current purpose within a realistic time frame and resource usage. The goal is to move from the clutter toward a synthesis of new knowledge. By applying powerful 'information management' strategies to the data the researcher's attention is focussed on previously hidden or unperceived qualities, objects, or facts. This leads to the formation of a new Gestalt and through that a re-conceptualisation leading eventually (and hopefully) to new knowledge.

The notion of *Generative Conceptualisation* is revisited throughout this work and in particular in the concluding chapters. The next sections explore its relationship to Cognitive Learning Theory, Problem Solving and Creativity.

as a simple model of learning.

Generative Conceptualisation

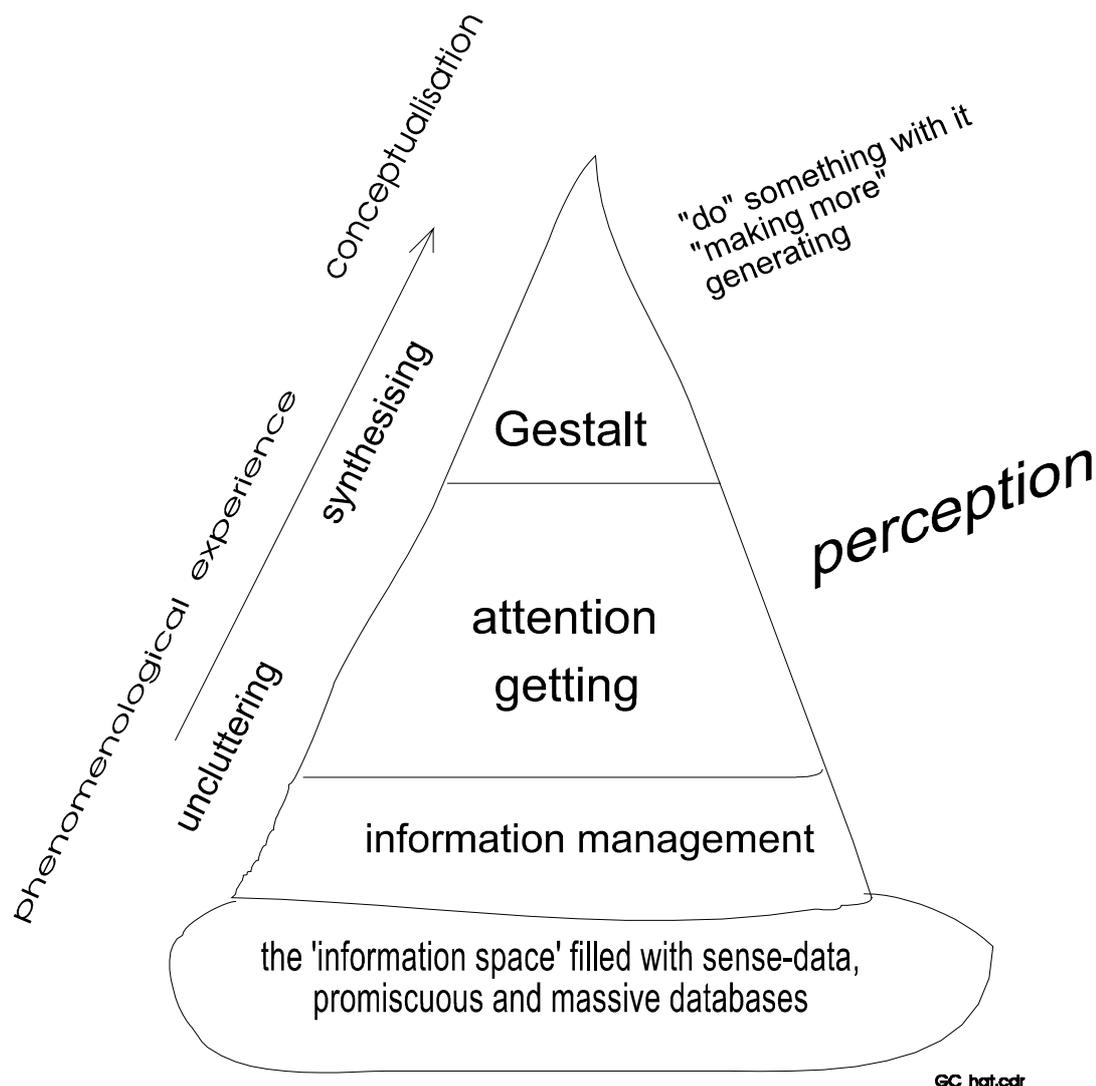


Figure 2: Generative Conceptualisation

Cognitive Learning Theory

Human development is distinguished from that of other members of the animal world largely on the basis of intellectual development. Bronowski (1973 p41) has made the point that:

Somewhere in that last million years or so, man made a change in the quality of his tools – which presumably points to some biological refinement in the hand during this period, and especially in the brain centres that control the hand. The more sophisticated creature (biologically and culturally) of the last half million years or so could do better than copy the ancient stone choppers that went back to Australopithecus. He made tools which require much finer manipulation in the making and, of course, in the use. The development of such refined skills as this and the use of fire is not an isolated phenomenon. On the contrary, we must always remember that the real content of evolution (biological as well as cultural) is the elaboration of new behaviour.

Thus we say that humans are intelligent where animals are not. Clearly, the truth of such an assertion can be challenged by witnessing that training a horse or dog to respond on command yields observable and otherwise unperformed actions on the part of the animal. But the learning manifested in the physical doing of things is only part of the concept of intelligence. Language, concepts, ideas, reason, thought, imagination, ... all are entwined in our notion of intelligence.

Psychologists, for example Coleman (1969 p90), see

Intellectual or cognitive development ...(such as)... growth and change in such processes as learning, language use, concept formation, reasoning, and imagining. ... (being) ... dependent on both inner maturational processes and on opportunities provided by our environment, especially opportunities for acquiring language, knowledge, and competencies.

Coleman (1969 pp92-93) describes and concurs with the views of Piaget: mental growth is

... an extension of biological growth, governed by the same general principles. Piaget recognizes, of course, that the *content* of thought is determined primarily by the environment – that the particular language, concepts, and values that the child acquires depend on his particular environmental input. But the sequence and general timing in the development of ability to form and use images, symbols, and concepts are guided genetically if the necessary environmental inputs are provided.

According to Piaget, the development of thinking is based on development of an innate tendency toward organization of and adaptation to incoming information. The newborn infant starts with no specific knowledge but with this tendency to organize and adapt to sensory information he receives. The tendency involves two basic mental operations: assimilation and accommodation. *Assimilation* is the process whereby incoming information is perceived and interpreted in relation to existing schema that he has already established through previous experience. *Accommodation* is the changing of his inner schema or frame of reference as a result of new information – the structuring or restructuring of his mental organization.

In the introduction to *The Origin of Intelligence in the Child*, Piaget (1936 p9) lays out his “picture” of the intellectual functions which develop in the human relative to the biological invariants with which the human is endowed.

‘Organization’ is the internal aspect of ‘adaptation’ in which the “interdependence of previously adapted elements” (Piaget 1936 p12) is under consideration in the mind. Piaget’s model suggests that the two mental operations of ‘assimilation’ and ‘accommodation’ (adaptation) are the

foundations of intellectual functioning. In the context of this research Piaget's "assimilation" may be thought of as making hypertextual associations - involving, intertwining, and interlacing concepts with others, and his "accommodation" as interpreting, making the meaning of the newly assimilated knowledge clear or plain among the existing cognitive structures.

Biological functions	Intellectual functions	
Organization	Regulating function	
Adaptation	Assimilation	Implicative function (synthesis of qualities; quantitative relations)
		classes (concepts or schemata); numbers
	Accommodation	Explicative function (deducing reality)
<i>Source:</i> Adapted from Piaget 1959 p9		

Figure 3: Piaget's "picture" of Intellectual Functions

The environment provides stimuli which are 'organized' by the human brain. This suggests an information management aspect to the workings of the mind. Selected material is 'assimilated' into mental structures - the 'synthesis of qualities' and formation of 'quantitative relations'. Cognitive structures -- a "reality" (p12) -- are created from the assimilated material through 'accommodation'. Accommodation confers "a certain permanence upon it ('reality') while supplying the reason for (the) transformations" (p12). But there is more to the generation of knowledge; there is an externalisation component which must be evident before we (generally) can know what the (particular)

mind knows. 'Accommodation', the "explicative function, (which) concerns the ensemble of operations which makes it possible to deduce a reality", according to Piaget (p12), is the intellectual function responsible for our ability to exhibit knowledge. For this externalisation to occur, there must be a means of communication, a language, which to Bruner is a prime example of "technological advances in the use of mind" (1964 p1):

... the development of human intellectual functioning from infancy to such perfection as it may reach is shaped by a series of technological advances in the use of mind. Growth depends upon the mastery of techniques and cannot be understood without reference to such mastery. These techniques are not, in the main, the invention of the individuals who are 'growing up'; they are, rather, skills transmitted with varying efficiency and success by the culture – language being a prime example. Cognitive growth, then, is in a major way from the outside in as well as from the inside out.

At issue in this thesis is the role a (hypertext) technology may have to play in the original thinking done by knowledge-workers. From Piaget's 'picture' of intellectual functions we see that to support the mind in its work we need to provide tools and techniques for 'assimilation' and 'accommodation' in addition to 'organization'.

The Hypertext Information Management System¹³ (HIMS) is conceived in terms of a software environment to support the intellectual functions described above (Figure 3). HIMS provides a modification to the environment of its users, and it will be argued, provides an opportunity for intellectual or cognitive development. It provides a means for its user to organise information (cf. Figure 3) into categories and relationships. The qualitative aspect of Piaget's 'assimilation' is supported by HIMS, especially the formation of concepts. Finding and forming links in the knowledge, deducing reality, as part of the explicative function Piaget calls 'accommodation' are central aspects to hypertext and thus also to HIMS.

¹³ HIMS is described in Chapter 5.

The HIMS design calls for the provision of technological devices, or as Bacon conceived of it so long ago 'instruments' for the mind. HIMS may be considered a language, but not in the ordinary sense of the term – it is rather a 'language' of association, juxtaposition, information management and uncluttering; it is a technology, specifically created to give 'mind support' to the individual researcher.

There is no doubt that insight can be sufficient to spawn the breakthrough – "Eureka!", cried Archimedes from the bath as he conceived the displacement principle. But for much of the time, insight is preceded by intense and prolonged thinking, cogitation, sifting through material, and creating, breaking, and recreating cognitive structures. HIMS is intended to help this process largely through an ability to juxtapose knowledge. Network structures are built by making associations among the many knowledge 'chunks'. These networks may be built upon existing ones or emerge as entirely new ones. The old and the new are not mutually exclusive as they tend to be in the (simpler) hierarchical structures invariably built by humans engaged in the more ordinary cognitive activities. A network provides for an indefinitely large and complex set of associations of the knowledge being considered. These associative links, and commentary about them, become the meta-knowledge superimposed on the knowledge, resulting in the construction of hypertext. Thus, the accommodated knowledge is manufactured into a hypertext with the use of HIMS, giving it form, function, and permanence for the ultimate enterprise of the researcher – the creation of something original. Human cognitive capability, capacity and power is augmented.

HIMS is intended to help overcome the inherent limitations of human memory capacity, and cognitive ability to assimilate and accommodate by providing technological support to acquire, select, store, manipulate, and generate. It contributes to the development of thinking, triggers and records the progressive

changes in thought patterns, and prepares the researcher for the ultimate act of cognition – original output.

Returning momentarily to that “more sophisticated creature” which Bronowski observed had acquired better tools than Australopithecus’ stone choppers; those tools designed to augment the intellect may produce as dramatic a change in our successors as it did in those of Australopithecus, albeit in a time frame of years rather than millions of them.

Problem Solving and Creativity

Problem Solving

Just how do people solve problems? Perhaps by insight or luck at times. Edward de Bono has published extensively his ideas on problem solving, providing some very practical advice on how it can be promoted. More recently, he acknowledges that Western Culture may have placed far too great an emphasis on analysis and argument (de Bono 1992 p63) thus hindering the unleashing of our creativity to full potential, and argues for more emphasis on ‘design’ and ‘what could be’ as opposed to ‘analysis’ and ‘what is’.

The cognitive activity we call problem solving furnishes an (new) approach to usually unique or remarkable circumstances. It calls for new understandings, insights, and perspectives. To this extent it is creative.

Wallas (1926) included preparation, incubation, illumination and verification as central aspects of a “Model of Creative Process” (Young 1989 p248). Simon (1965 pp53-56) developed a framework for decision making in the late 1950’s and early 1960’s in which the three phases of problem solving are: 1) intelligence activity - searching the environment for conditions calling for decision; 2) design activity - inventing, developing and analyzing possible courses of action; and 3) choice activity - selecting a course of action from those available. The emphasis on analysis is clearly evident. Whilst Wallas pre-dated the electronic age and

therefore concentrated on human problem solving systems in the absence of any significant supporting technologies (although one may argue about the relatively narrow but nevertheless generally accepted use of the term technology here), Simon foresaw the emergence and importance of electronic computers and listed electronic data processing as one of the “Modern Decision-Making Techniques” (Simon 1977 p48) together with computer simulation and mathematical analysis models from the operations research domain.

In the early 1970's, Gerrity (1971) developed a model which he used to analyse financial portfolio managers' decision processes, and subsequently identified a list of operators or functions which supported them during the five stages of decision making. The model was also used to identify various behavioural aspects in terms of supporting technologies. Gerrity's five stage decision process model, derived from Simon's earlier work, featured problem recognition, implementation, and control as important additional processes in financial portfolio managers' behaviour: 1) intelligence - problem recognition; 2) design - generation of alternative solutions; 3) choice - evaluation and selection of the “best” alternative; 4) implementation - putting the chosen solution into effect; and 5) control - monitoring the outcome and making the necessary adjustments.

Such algorithmic and highly systematic characterisations of problem solving and creativity are also hallmarks of the contemporary theories. Marvin Minsky's *k-line* theory (1988 pp81-92) appears very algorithmic and procedural. As the problem solver engages in successful activity, a representation of that activity is captured in a *k-line* (the *k* is short for *knowledge*). These *k-lines* can later be activated in an analogous situation. It is posited that various agents exist to carry out special functions, such as the *Find* (block), *Get* and *Put* agents of a *Tower Builder*. As these *k-lines* are called into play, or activated, the thinking work progresses, calling on more and more *k-lines* until a complex web or society of *k-lines* are activated and the job is complete.

Even more recently, and building on Minsky's work, Partridge and Rowe have proposed an adaptation to the *k-line* theory they have termed a *theory of emergent memory* (1994 p58). Their theory of learning and memory is "couched in the form of an algorithm, a structure that can be transformed, relatively easily, into a computer program, a computational model" (p73). This computer program is subsequently used to gather empirical data about the performance of their models' strategies when playing the game of Micro-Eleusis (Gardner 1977), a game that simulates the search for truth. In their book, Partridge and Rowe provide a rather useful set of characteristics which may form the basis for assessing creativity models (1994 pp21-23): 1) flexible knowledge representation scheme to maximise the number of possible associations; 2) representational imprecision to admit seemingly incorrect associations in order to build connections between concepts; 3) multiple representations of a concept – a concept should be applicable to many situations; 4) self assessment; and 5) elaboration of a new creation to discover consequences and applicability.

Maximising the number of associations, seeking to include representational imprecision in which imprecision is tolerated and diversity is explored, and accepting multiple representations of a concept may appear to conflict with the goal of creating a solution to a problem, but if the mind is able to make sense (for example with the aid of hypertext models) of this diversity a truly innovative solution may emerge.

Procedural renditions of cognition in relation to creativity and problem solving have been useful in clarifying how the human mind may achieve its original output, but as Boden (1988 pp175-6) notes:

One general process often attributed to the human mind is logical, deductive, reasoning. Many psychologists assume that we (often) make inferences by means of logical principles, not only in abstract problem solving but in many everyday problems too. ... If our problem solving does not involve the use of deductive logic, how is it done? An alternative hypothesis is that people reason by using mental models – where these comprise a sub-set of all mental representations: namely,

those having some significant structural similarity with what they represent."

Generative Conceptualisation as represented in [Figures 1 and 2](#) is manifested to a large extent by thinking which is unfettered by the shackles of procedural, logico-deductive thought. It is more akin to the use of the mental models Boden mentions. The point is that these models are not so constrained by linear or even hierarchical structure, but rather are informed by a network of associations, analogies, and trails of thought.

To the extent that the human mind is helped in its creative problem-solving endeavour one may say it has been empowered by the devices or 'instruments' employed. Hypertext, it is argued, is just such an empowering mental model, mode of thought, or paradigm in which cognitive activity occurs.

Creativity

There is probably very little doubt, assuming the necessary facts were available to make the judgement, about whether a given artefact or discovery is evidence of creativity. But when it comes to explaining just how it is that some people (or organisations) are highly creative whilst others are not, or how we might foster creativity and problem solving, we are immediately confronted with a complex subject.

Barry Staw ([1990 pp288-290](#)) advocates an evolutionary approach to creativity, one in which *variation* and *selective retention* operate to the advantage of creative output. An idea or solution evolves through the stages of presentation of a problem and idea generation, both of which result from a high degree of variation (of thought about the problem) and are refined through selective retention. The latter comprises stages of coalition building, project development, implementation and production. The refreshing aspect of this model is its focus on variation, which one may interpret to imply the deliberate inclusion of a

diverse set of inputs as opposed to the more usual focus on the inclusion only of inputs which the problem solver's expert knowledge of the relevant domain admits. The question of course then quickly presents itself: just how diverse a set of inputs to admit? It is reasonable to conclude that the unaided mind (problem solver) has less capacity in such endeavour than one empowered by some appropriate device. Selective retention too, could be augmented by some means or another. Exploring one specific device, 'instrument' or means is the main concern of this research.

Boden (1977 p247) introduces the subject of creativity through a concept of learning:

Aunts and uncles of Victorian damsels sometimes tried to improve their niece's mind by writing suitably moral values in her autograph book. No doubt they occasionally succeeded, for there are many different ways of achieving valued and lasting psychological changes, of generating new thoughts from old ones.

In both common sense and theoretical psychology, these are usually thought of as falling into three distinct classes: learning, creativity, and problem solving. Broadly, learning is then seen as the improvement of general cognitive capacities under outside influence; creativity, as the spontaneous generation of new representations of the world; and problem solving, as the achieving of new knowledge by way of thinking things out in a specific situation.

But it should be evident that these phenomena are very closely related.

Learning, creativity, and problem solving are exhibited by individuals and groups to varying degrees. Some of the variation may be attributed to volition, some to innate capacity, but surely one would not wish to exclude the possibility that augmenting the intellect may bear fruit. In fact, most if not all of the work of thinkers and writers on this subject is ultimately aimed at the possibility of improving these three fundamental outputs of cognition.

The (Boden 1977 p248) "intelligent development of representations already in the mind" is central to the enterprise of generating new thoughts from old. How then do we support this enterprise?

The question of how to *empower* creative thinking is central to this study. One rather obvious way is to provide extra knowledge. As Boden (1977 p221) puts it:

... provided that one can use it in a disciplined fashion, extra knowledge may speed thought up rather than slowing it down.

In addition to doing more thinking in a given time-frame, empowerment can also be fostered by providing suitable conceptual frameworks within which thinking may proceed. These organisations or cognitive structures can usefully be characterised into three modes of thinking: serial thinking, in which one idea after the other is processed; hierarchical thinking, in which taxonomies or classifications are built and re-built; and "heterarchical thinking" (Boden 1977 p126-7), in which the classifications of hierarchical thinking are represented by networks in which, potentially, everything may be connected to everything else – although not at the same time.

Linear or serial thinking is fruitful, but slow and limited. Since humans are underdeveloped in their ability to handle complexity, such as one finds in a hierarchical model and to an even greater degree in a network or heterarchy, the unaided intellect tends to be more often occupied with the linear. Any aid to the intellect, which may have the ability to support complex and associative thinking, thus becomes of primary interest to those seeking empowerment. Hypertext technology, perhaps one may even be permitted to say a hypertext mode of thinking – a paradigm, appears to show some promise on this front. Any rigid pre-defined knowledge structure entraps a reader's thinking in a way intended by the creator of that structure and tends to inhibit creative thought.

These two aspects of empowerment of human cognition: access to **extra knowledge**; and **diverse mental models**; will be the subject of the remainder of this study. Perhaps thirdly, a concern for the **speed** at which cognition proceeds, cannot be ignored.

In this introductory chapter we have explored a possible role for hypertext in the generation of new knowledge. Before proceeding with the details of such a role, we look at the historical context in [Chapter 2](#).

[Chapter 3](#) lays out the details of how the research was carried out whilst [Chapters 4](#) and [6](#) contain analyses of field data collected before and after respondents were empowered with a hypertextual intellect augmenting device, the design of which is explained in [Chapter 5](#) and was informed by the analyses reported in [Chapter 4](#).

The final three chapters conclude the thesis by offering an answer to the question "Does hypertext empower researchers in doing original and creative work?", describing a hypertext paradigm, and proposing a hypertext theory (substantive) of knowledge creation.

Chapter 2 – Historical and contemporary context

Augmenting the human mind with information technology is of central concern to this study. Technology of some form has always played a part in the thinking process. For example, without language (and in this sense it can be considered a technology) advancement of learning would have occurred but at the rate characteristic of the animal kingdom. In relatively recent times the invention of the printing press gave significant impetus to the dissemination of knowledge. But whilst language and the printing press facilitated the virtually universal dissemination of knowledge amongst people, the cognitive processes of thinking, learning, and creating new knowledge were still undertaken by the individual with whatever 'devices' could be mustered for the purpose.

Prior to the information revolution, the systems or 'devices' facilitating learning were not created for the individual, but rather for the benefit of society as a whole. They were able to cater for only the very general requirements of individual learners. Laurie Lee, in his book *Cider with Rosie* (Lee 1971p49) summarises his schooling in early 20th century rural England:

The village school at that time provided all the instruction we were likely to ask for. ... Every child in the valley came crowding there, remained till he was fourteen years old then was presented to the working field or factory with nothing in his head more burdensome than a few mnemonics, a jumbled list of wars and a dreamy image of the world's geography.

Learning the few mnemonics, the list of wars, and the image of the world's geography which Lee acquired during his time at the village school was a start at least. But his thoughts were on other matters (pp57-58):

For school in my day, that day, Crabby's day, seemed to be designed simply to keep us out of the air and from following the normal pursuits of the fields. Crabby's science of dates and sums and writing seemed a typical invention of her own, a sour form of fiddling or prison-labour like picking oakum or sewing sacks.

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So while the bright times passed, we sat locked in our stocks, our bent backs turned on the valley. The June air infected us with primitive hungers, grass-seed and thistle-down idled through the windows, we smelt the fields and were tormented by the cuckoos, while every out-of-door sound that came drifting in was a sharp nudge in the solar plexus. The creaking of wagons going past the school, harness-jingle and the cries of the carters, the calling of cows from the 17-Acre, Fletcher's chattering mower, gunshots from the warrens — all tugged and pulled at our active wishes till we could have done Miss B a murder.

How could we arrange for Laurie Lee's image of the world's geography to change from being dreamy to one which made obvious the earth's enormity at ground level compared to the relative smallness of the globe as viewed from space? Such a juxtaposition of knowledge, in the mind of Arthur C. Clarke, may well have sparked the invention of the concept of satellite communications for example. Systems which support the naked mind in forming juxtapositions, empower learners, and free them from the 'schooling' which even in today's hi-tech society is so prevalent.

Seymour Papert has long been concerned with learning and the role of the computer. In his 1980 article *Redefining Childhood: the computer presence as an experiment in developmental psychology* (Papert 1980 p998) he advocates the mounting of "experiments in which the encounter between children and the computer presence can be varied sufficiently to allow more informed thinking ...than has up to now been possible". The present study is such an experiment, albeit with adult learners as individual researchers, rather than children.

Just as our learning may have been empowered by language, so too, it is contended, can our cognitive activity bear greater fruit if it is supported with other 'devices'. The devices available in Laurie Lee's day were restricted to books, language, pencil and paper. Today we have all that too, and more. We have the computer, bringing with it vast amounts of reliable memory which is directly addressable and capable of sorting, sifting and delivering information at

astounding speeds. But it is the use of technology in the mode Papert (1980 p993) calls “*computer as pencil*, that is to say emulating the quality of the pencil as a familiar, freely available object that can be used for many purposes such as writing, drawing, scribbling, doodling, calculating, chewing and so on” which brings the possibility of momentous empowerment to thinker and learner.

The next section takes a historical view of the usage modes of information technology, concluding with its use as a ‘help’ for the intellect in generating new knowledge.

Computing system utilisation modes

When computers first became available for general purpose use in the mid 1960’s, Universities began to include their study as options in a wide variety of courses¹⁴. Typically, a “numerical methods and Fortran” study unit became the first exposure to computers for many students in the mid to late sixties. These students experienced the power available in solving mathematical problems virtually impossible to solve within a realistic time-frame in the absence of the computer’s ability to carry out a sequence of pre-programmed instructions at lightning speed – truly an amazing feat. Understandably, relatively few of the world’s people were interested in numerical problem solving.

The data processing era

In the business world, meanwhile, there was concern for efficiency. If it were possible to reduce the resource needed to process the company payroll, for example, this surely would translate into greater profitability. The pursuit of efficiency, and hence competitiveness, provided the impetus for many a sixties and seventies business to acquire computing systems together with the teams of specialist staff needed to make them work on what have been categorised as

¹⁴ *The author was one of these students; what follows is based on a personal retrospective observation.*

operational tasks, for example, personnel (human resource in more modern terminology) systems, accounting functions, sales and inventory systems, and many more specialist systems such as manufacturing, production, and numerical control.

As with the numerical methods problems, these business problems are characterised or made to be characterised by their quantitative and deterministic nature, but a major point of difference was the actual volume of paper needed to represent the information. Operatives within these companies 'read' reports – mountains of them, for example on the numbers, variety, raw material and manufacturing costs of widgets produced over a period of time. Perhaps it is more correct to say they were being 'fed' reports. Apparently very few questions were asked about **why** these vast mountains of paper were regularly churned out, and **whether** they actually served a purpose. This was the data processing era, with its batch processing systems and large centralised computer installations.

Tactical functions

By the late seventies computers were becoming the repository of the corporate information resource. This centralist view supported an integrated approach to organisation-wide information systems and was seen as a great step forward compared to the segregated systems and piecemeal approach of the data processing era. People were beginning to ask questions of the database systems. Instead of looking in voluminous reports for answers, it was possible to pose a query directly in real time and have the answer on the computer screen virtually immediately.

The voluminous reports were still being produced however, and one speculates whether very many discerning questions were actually being asked of the data contained in the database systems. In this respect at least three major obstacles had not been overcome: cryptic query languages; inability to ask the 'as yet unthought of' question; and non-adaptive systems. First, the query languages

were rather cryptic and required dedicated drill and practice to gain good facility in their use. More importantly, the person making the query needed to know about the database structure. This involved learning, or looking up, the names or 'handles' used to address the data within the database. For example, if a database programmer had decided to refer to a person's name by the 'handle' PRSNME, then formulating a query on the basis of the perfectly obvious 'handle' NAME would not reveal anything, or worse, the wrong thing (say department name).

By far the most severe restriction posed by the systems of the seventies (and indeed in many instances right up to the present day) and one which could not be overcome, was the inability to ask questions, that is, to pose queries, which were unsupported by virtue of the fact that they had not been pre-conceived and therefore the ability to answer them was not designed into the system. This fundamental lack of response to change in the 'computerised world' (i.e. the computer system as a model of the real world upon which it is based) to reflect changes in the real world (except via a re-design) is hardly empowering. Thus, the systems of the seventies and early eighties were non-adaptive, and geared to answering the 'pre-thought-of' question. The answers were provided purely on the basis of the 'computer model' extant at the time of asking the questions, and no possibility existed to explore issues further in the light of an updated or extended model. The emphasis was still very much on the processing of quantitative data with fixed structure.

Despite the restrictions of these database systems, they did contribute to the adroit management of business ventures and have thus come to be known as the **tactical** systems, sometimes also referred to as Management Information Systems. This era is characterised by DBMS (data base management systems), MIS (management information systems), with the concomitant centralised or monolithic databases.

Liberation via desktop computing

The hallmark of the eighties was the exceedingly rapid advance in computing technology. Without doubt, the most significant advance was the invention of the personal computer. Suddenly, all the computing power available on mainframes of the sixties and seventies appeared on the desktop. But who wanted the constraints which came with systems of that era? The almost complete absence of connectivity to the corporate database all but ensured personal computers were utilised for the individual worker's benefit rather than for the benefit of an entire group or section of the organisation.

Arguably the most significant and portentous software development was the invention of the spreadsheet¹⁵, matched on the hardware side by pointing devices such as the mouse. This permitted users, individuals not anointed as programmers, to develop their own systems, models, and 'databases'. Typical user-built applications included scenario building, decision support, trend graphing, and simple database systems. These were for home-use or private purposes as much as for the 'office', often one activity informing the other and yielding further superiority of support or empowerment.

Whilst the operational and tactical systems of bygone decades were being transported to smaller and vastly cheaper computers (a practice which became a fashion called downsizing), the systems of the eighties were beginning to deliver **strategic** benefit to their users. They were cheap to build, adaptable in a short time-frame, and above all accessible and **usable**. And as a result of the advances in connectivity, it was possible to distribute the corporate resources and systems over vast geographic areas, indeed globally. Inevitably, the

¹⁵ *Writers, as opposed to people doing calculations, may argue that the invention of word processing was more significant. However, spreadsheets suddenly became available to ordinary computer users whereas word processing evolved from typewriter origins largely for the exclusive use of 'word processing operators'. It was not for some time that ordinary computer users could avail themselves of the technology. One must remember too, that spreadsheets were invented after the Personal Computer. The first word processors were dedicated hardware/software packages not affordable by people in general.*

centralism of the sixties and seventies was seriously and successfully challenged as an appropriate corporate information technology strategy.

This third major evolution of computing system types was characterised by distributed systems, knowledge bases, decision support systems, interactive and real time applications, and systems enhancing and supporting individuals' capability and capacity to write (word processing), to calculate (spreadsheets), to draw (graphics packages), and to do their work (management information systems, and general information systems such as databases, query languages, information retrieval systems, and so on) for the organisation.

Consequent to the introduction of distributed systems came the realisation that knowledge-workers need not work in isolation on their respective tasks, but rather could share a work environment and contribute to a group effort. This phenomenon has become known as *workgroup computing* (Johansen 1988) and has spawned a whole new set of software products called *groupware* (Johansen 1988, Cavanagh 1991) such as Lotus Notes (DeJean 1990).

Utilisation modes 1 and 2 symbolise traditional computing systems thinking. Modes 3 and 4 begin to focus more on supporting the work of individuals, albeit in endeavours which have largely predictable outcomes. An entirely different mindset or paradigm in which to work is heralded in mode 5, although modes 1 to 4 are brought into use as needed. Computing becomes an intrinsic part of a person's thinking process, rather than being disconnected from it. Support is provided by a computing system in the characteristically human realms of political (small p politics) and social endeavour. Humans helped by computers, now explore issues and develop ideas. There is no specific direction (initially) in which the work proceeds. The help that the computer provides can be thought of in terms of extending the human memory capacity, but also enhancing certain of its functions such as juxtaposing, both of which are recognised as being important elements of creative thinking.

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Computing System Utilisation Modes	Characteristics
1. Operational	numeric, quantitative, automation, formulae, deterministic
2. Tactical	data bases, convergence, 'the answer', expert systems, simulation
3. Strategic	knowledge bases, Decision Support System, supporting, scenario building, interacting, enhancing, facilitating
4. Empowering; decision making	Group Support System, divergent, creative, idea processing, qualitative, mind lever, flexible, adaptive, augment, enhance, extend, – the computer as an extension of one's own capability and capacity to think
5. Tools for the mind abstractional & associative <i>Generative Conceptualisation</i>	Hypertextual systems (e.g. HIMS) with the capability of modes 1 to 4 above but designed for the purpose of associating, deassociating, reassociating, and construct/concept formulation

Figure 4: Evolving Computing System Utilisation Modes

Empowerment with instruments for the mind

The final decade of this century, and this millennium, brings the promise of computer support for cognitive activity. In addition to using computing systems for operational, tactical, and strategic pursuits, we are now poised to explore providing Bacon's '*instruments for the mind*'.

Whilst there has been little widespread computer support for computer-aided thinking, cogitation, and idea generation of individuals as yet, there are some interesting examples nibbling at the edges of this very tricky domain. Laurence Young (1989 pp1-27 1987) describes a system based on database technology which supports individuals in generating ideas. It operates on the basis of juxtaposing idea elements stored in a database and permitting the user to associate these elements to form new concepts. Young has termed this *idea processing*, and whilst it is certainly different from previous modes of computer system utilisation it suffers from the restriction of a fixed database of initial ideas and cannot easily be connected to the 'outside' world in which knowledge is constantly being created. *IdeaFisher* (Fisher Idea Systems, Inc. 1988-1992) implements the type of database method for creativity support which Young envisaged in the mid-eighties.

Juxtaposition is also a key element underlying the design of Gary Shank's most interesting software device he calls the Abductive Reasoning Tool (ART). Shank (1991) explains abduction:

In simple terms, abductive logic is the art of reasoning from the puzzling and the unique, to the ordinary and commonplace. It was first proposed in modern form by C. S. Peirce, in the late 19th Century.

Abduction, as a mode of logic, is best understood in relation to the two other modes of logic that we use; namely, deduction and induction. Deduction allows you to make claims with certainty, once you are sure that your premises are true. Induction allows you to go to the world of experience and observation, to see whether or not these observations are true. Abduction, finally, allows you to link an isolated case to an

existing rule or plan, in order to 'pull in' the observation as a case of the rule or plan.

ART is a database of what Shank calls "reflections" which are juxtaposed with the user's input concerning the problem or topic to be explored. When the juxtaposed topic-reflection pair suggests a new idea, provision is made to record this in the "Insight box". ART is clearly derived from a database model, but what makes it very different, and so interesting from the viewpoint of creativity, is its basis in abductive logic, which Shank believes "is the 'default' process of human thought".

Possibly aside from a small number of systems such as ART, IdeaFisher, and Young's system, most modes of use of the computer continue to be directed to functional performance. These are centred on tasks and problems where an outcome is achievable through an essentially quantitative or procedural approach.

Modern work organisation culture recognizes what Limerick (1992 p38) refers to as 'collaborative individualism', and nurtures the diverse contributions which individuals can make to the group or collaborative effort in society. In this climate it is seen as legitimate, indeed necessary and even fruitful, to provide for the peculiar political and social needs of individual humans. The recognition that humans work in groups and could be supported by information technology in this endeavour has sparked an intense research effort spread across some 40 centres worldwide (Wagner et.al. 1993 pp34-55) with a large proportion of the research effort coming on stream very recently.

Wagner et.al. (p33) note:

A quick survey ... reveals that approximately half of these facilities have come on-line during the last two years. This is clearly a telling sign of increasing research activity in the field of group support systems.

Some Group Decision Support Systems provide support for idea generation, idea organisation, and idea evaluation. Floyd Lewis' *MeetingWare* (Lewis 1987) is representative of such systems. Generally, these are modelled on Wallas' work of the 1920's (Wallas 1926). The GDSS design by Dreher and Siu (1990) embeds cognitive activity support, specifically for what they term the *cogitation stage* consisting of the five processes: idea elicitation; idea processing; problem formulation; alternative generation; and evaluation, in a generalised framework for supporting the work of groups. All these systems are based on procedural thinking – step by step linear progression of thoughts.

The Group Decision Support Systems (GDSS) research has not however ventured into the realm of generating new knowledge, rather stopping short at merely providing support for idea generation, although the overall effect is for supporting the messy, untidy, illogical world of humans as opposed to the 'procedural cleanliness' of the earlier computing system utilisation modes.

We have seen there is considerable research work in progress exploring ways of supporting people working in a team or group. But the work done by individuals prior to meeting as a group also calls for support with technology, particularly in situations where the data is so voluminous that the individual human mind is 'swamped' with stimuli (in the data) and cannot function adequately unaided. The early computing systems utilisation modes catered particularly well for individuals posing questions of the masses of quantitative data (mostly referred to as databases). And these individuals were satisfied with the rapidly delivered and highly accurate answers, or suggestions and scenarios. Where the problem situation is 'neat and tidy', well formed and definable, the myriad of techniques developed under the general heading of *Information Processing* are very suitable. But where the problem is 'messy' and difficult to quantify, a totally new approach is needed to help the individual cope. We have now arrived at the doorstep of an era where at last the computer can be harnessed in helping humans work on such 'messy' and at the same time 'natural' problems. Feigenbaum & McCorduck (1983 p18) see it thus:

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The Fifth Generation will stand apart not only because of its technology, but also because it is conceptually and functionally different from the first four generations the world is familiar with. These new machines will be known as knowledge information processing systems, or KIPS.

That term is extremely important. It signals the shift from mere data processing, which is the way present-day computers function, to an *intelligent* processing of knowledge. These new machines are to be specifically designed for artificial intelligence functions. We shall explain that in more detail, but for now, let us summarize by saying that KIPS are specifically designed to do symbolic manipulation and symbolic inference.

Most of the world's work is nonmathematical in nature. Only a small segment of activity has as its kernel the kinds of formulas that we see in engineering and physics applications. Even in such 'hard' sciences as chemistry, most thinking is done by inference, not calculation. The same is true of biology, most of medicine, and all of law. Almost all the thinking of business management is done by symbolic inference, not calculation. In short, almost all the thinking that professionals do is done by reasoning, not calculating. As computing gets cheaper and the professions look to computer technologists to aid in relieving their ever-growing information processing burden, they will want to use methods that involve automated reasoning and use of symbolic knowledge.

Such methods are already in use. Modern pilot projects, with the name of *expert systems*, have demonstrated that a computer is capable of the same kinds of intelligent behavior as a physician making a diagnosis, or a geologist deciding where to seek minerals. And these expert systems do this in much the same way human experts do- by combining textbook knowledge with the rules of thumb that experience teaches, and then making informed guesses about the situation at hand. We call such expertise in humans intelligence, intuition, inspiration, and professionalism. When a machine demonstrates the same kind of behavior, there is no compelling reason not to call it intelligence then, too.

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Our present computers can be programmed to do those tasks, and do them at a high level of expertise, often outperforming human experts (even the ones who've taught them). Moreover, computers can be made to exhibit expertise over a very wide range of fields, and new expert systems are being commissioned and designed all the time. But for the purposes of expert systems, our present computers are at a fairly primitive stage of design in terms of speed and power. The knowledge manipulation on a grand scale of humanlike intelligence planned for the Fifth Generation will require scaling up of several orders of magnitude in hardware and software.

Such advances and thinking meant that individual knowledge-worker empowerment was at last becoming a reality. Computers were affordable by individuals across the world. Hordes of personal computer owners turned into programmers and applications system builders and in their spare time created the most wonderful array of software packages imaginable. At last the user-interface was made friendly, colour was used naturally as in the real world, and new types of packages emerged. These new software types available on personal computers put the power in the hands of individual people, where previously the power had been vested almost exclusively in computer professionals.

The transition of work from computer programmer 'priesthood' to the individual user is still markedly influenced by the 'baggage' of the past however. A discontinuity between computing system utilisation modes 3 and 4 ([Figure 4](#)) is apparent. For mode 4 activities are divergent, rather than the convergent approach and functional focus of the earlier stages. These observations are cogent when linked with organisational life within which much computer usage and thinking takes place. This discontinuity mirrors the themes Limerick ([1992 p39](#)) identifies as shaping a new form of organisation taking business and management into the next century. The 'old mindset' ([Pascale 1990 p88](#)) is, among other things, one concerning itself with efficient and effective use of tools. The new mindset emphasises change, deviance, exploration, and ingenuity in problem solving. The old mindset is rooted in an organisation's response to

pressures to decentralise vs centralise, and in concerns for the flexibility – inflexibility issue, or efficiency vs responsiveness.

Knowledge-workers of the new mindset perform in a culture of ‘collaborative individualism’ (Limerick 1992 p38), one which will see organisations accepting, indeed searching out and nurturing the ‘Yiffies’ – young, individualistic, freedom-minded and few.

Computing system utilisation in the context of organisational culture

Nowhere in Organisational Behaviour, is limited, linear, logical, rational thinking more evident than in the accepted forms of corporate culture at the formative stages of organisational theory.

The development of computing systems utilisation modes mapped out above is remarkably cognate with the transition of work organisation from the Taylorist model (Mathews 1989 pp88-91) with its emphasis on efficiency, to the post-Fordist (Mathews 1989 pp108-113) and Quality of Working Life orientations of today (Mathews 1989 pp96-98).

Operational systems can be thought of as functioning within Gilmour & Lansbury’s (1984 p96) “technical core” (Figure 5). This production orientated level of an organisation’s structure is focussed on performance of tasks – precisely those tasks which the operational computing system type is built to accomplish in the place of human workers. An example would be a payroll system, being fed with workers’ ‘clock on/off’ data and payrates as input and producing virtually automatically, and repetitively for all workers and over time, a paycheque. The emphasis is on correctness and timeliness of output.

At Gilmour & Lansbury's "organisational level" the operational tasks are integrated and coordinated. This function is associated with management – devising and implementing ways to monitor and control the function of the "technical core". Performance evaluation is implied, and managers concern themselves with efficiency and effectiveness issues. Tactical computing system types are used by managers to inform their decisions about intra-organisational operational performance, such as reporting on the labour or raw material inputs to a production process, for example, and with what effect or output.

The strategic computing system types, perhaps best exemplified by the Decision Support Systems of the 1980's and including especially (SpreadSheet) models, scenarios, and simulations, are used at the institutional level of the organisation to support strategic decisions: "where is the best place to build our next factory?"; or "should we produce in the West, or ship from the East and warehouse in the West?". Such concerns clearly involve the external environment and are dealt with at Gilmour & Lansbury's "institutional sub-system" level.

There is no counterpart, however, to the "Tools for the mind" computing system utilisation mode featuring *Generative Conceptualisation*. The (Western) world's corporate cultures may well be on the edge of a major shift in thinking resulting in the rise of the 'empowered' organisation through the work of 'empowered' individuals and groups.

For three decades of computing systems development we in the Information Technology community have been making refinements to the basic model of assistance via computers. We are now emerging from the era where computers answer questions in 'black and white' cases and are making a change to use computers in a support role – that is, they support the work of humans. Beyond this we are beginning to experience a discontinuity from 'procedural' use of computers where programs must be written with precise specifications ahead of their execution and presumable delivery of some beneficial result such as a paycheque, to user empowerment. Suddenly users are released from the 'linear

tyranny' of step-by-step progression in working toward a solution to a problem and can be free to explore issues in ways akin to how they would in free association of ideas, but this time their own cognitive capabilities and capacities are augmented by the computer.

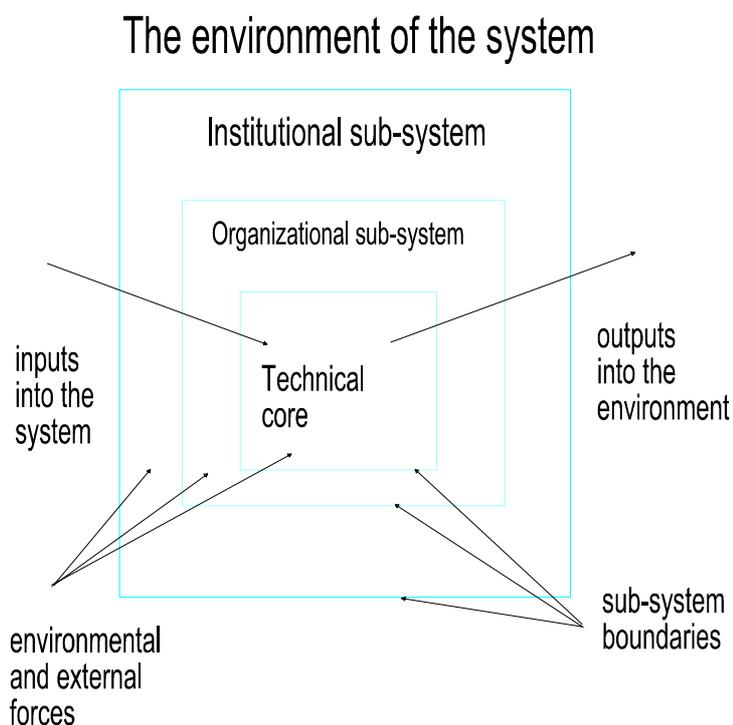


Figure 5: The organisation as an open system

Source: Adapted from Gilmour & Lansbury 1984 p96

In her essay *Culture Is the Medium of Life* Barbara Czarniawska-Joerges (1991 p289-290) pleads that visualising computers as social actors helps organisations better understand their impacts and thus benefit from their deployment. The machines of the industrial age, for example the conveyor belt, and mass

production factory processing trains, have dictated the terms for workers assigned to their support, sustenance, and maintenance. Even the modern automobile, which elsewhere is conceived of and portrayed as a liberating device, can be the master instead of servant. Compare the complexities of the internal combustion engine vehicle of [Figure 6: Usability Engineering](#) with its egotistical and captive, and bereft (of time and money; for the automobile consumes it all) owner, to the truly liberating 'movement machine' whose transportee just cannot understand the fuss involved in getting from point A to point B with a minimum of pollution, breakdown probability, and simplicity – just the flick of a switch is needed.

Now, in the nineties, the role of the work group is being emphasised, calling for new and empowering forms of computing systems support. Such structures of computing systems have not yet become prevalent, and where they have been created are 'struggling' to gain acceptance in a world manifesting a remarkably high degree of hesitancy in the acceptance of new information technologies such as hypertext. Workers supported with hypertext-like systems will be well placed to exist and perform in Limerick's new organisational culture of "collaborative individualism" ([Limerick & Cunningham 1993 p37 pp114-115](#)).

Having located the proposed work among the historical and contemporary developments we now turn to the details of how to proceed to investigate whether human knowledge creation can be empowered through hypertext technology.



Figure 6: Usability Engineering

Source: used with permission from William J. Hagen, Manager Copyrights and Trademarks at IEEE, Los Alamitos, California, 27-Sep-94, and originally published as the front cover to IEEE Computer Vol 25, No. 3, March 1992, and with the permission of the picture's creator Jay Simpson, Design & Direction, Manhattan Beach, California, 10-Dec-94.

Chapter 3 - Research design to study empowerment of original and creative work

Research aim

This research explores how computers may be able to be used by individual researchers who are engaged in cognitive activity and interested in creating original outputs. Specifically, it explores to what extent one of the emerging information technologies, hypertext, can provide 'suggestions for the understanding' and support and empower human cognitive activity.

Research question

Can hypertext technology, used in a definable way, empower humans in doing original and creative work?

The research question expresses itself well through the speculation that hypertext supports, augments, expands and extends, the mind's capability to form, follow, manage and maintain associative links and 'societies' of knowledge or information.

Research objectives

1) To discover the domain specific 'disciplinary matrix' (Kuhn 1970 p182) within which respondents operate. Kuhn's disciplinary matrix refers to the common possession, by the practitioners of a particular discipline, of ordered elements of various sorts each requiring further specification.¹⁶

¹⁶ See *Operational definitions* at page 82, and *Figure 33: Populating the disciplinary matrices*.

- 2) To populate the disciplinary matrix with respondents':
 - (i) symbolic generalisations;
 - (ii) shared commitment to beliefs in models;
 - (iii) values;
 - (iv) exemplars;
 - (v) tacit knowledge and intuition. (Kuhn 1970 pp182-198)

- 3) To empower human respondents with a domain specific hypertextual KBS (knowledge based system).

- 4) To study and evaluate the respondents' degree of empowerment.

- 5) To infer the degree of efficacy of hypertext technology as an empowering instrument to augment and enhance the mental capabilities and capacities of the respondent.

- 6) To propose one piece of a 'substantive theory' of knowledge creation supported by appropriate technology (Glaser & Strauss 1967 pp32-34).

- 7) To set an agenda for future research in paradigm formation (Kuhn p10) and empowerment of cognitive activity.

Note: These were the original research objectives; as the research progressed some objectives overshadowed others. For example, objectives 1 and 2 appeared well-grounded at the original planning stage prior to any field work but their complete achievement requires a different direction than that needed to achieve objectives 3 to 6, and must be left to a future work. The emergence of 'knowledge-maps' (K_maps) during the first field study was completely unexpected (see Ch 4 and Appendix 2 – Derivation of a K_map)

Research design

The previous sections in this chapter set the direction for this investigation and give the expected research outcomes. Now we face the questions of how to proceed and what paradigm will guide the inquiry.

Positivism

Positivism may be defined as "a family of philosophies characterised by an extremely positive evaluation of science and scientific method" (Reese 1980 p240). Five central aspects guide its adherents: objectivity; hypothetico-deductive theory; external lawlike relations; exact and formal language; and, separation of facts from meaning (Lincoln & Guba 1985).

Research questions and answers that do not fit with these assumptions are unlikely to be illuminated through a positivist approach. It is difficult to imagine how a research problem in which there was only a vague and possibly ambiguous way of describing the phenomena to be investigated could be advanced by deliberately casting it in exact and formal terms, by deliberately treating observations as objective (or choosing to overlook them), and by ignoring those facts which are coupled to meaning.

As an example consider the contemporary and significant problem of road trauma. One aspect which has received much attention is the role of alcohol. The exact and formal research question could be: what is the relationship between blood alcohol concentration (BAC) and driver reaction time? We assume that the greater the BAC reading, the longer the reaction time, and that these values can be objectively observed; the readings (data) can be precisely noted. From an experiment which varies the BAC level in a sample of drivers, we may conclude that a high BAC adversely affects driver reaction time and thus contributes to road trauma. Such a problem fits very well with the positivist stance.

Constructivism/Interpretivism

But now consider how we might discover other factors in road trauma. Earlier, we assumed that BAC and driver reaction time were causally linked to road trauma and set out to prove the link and characterise it, i.e. how much alcohol in the blood is possible without its effect causing road trauma? Now our question is much broader – what does contribute to road trauma? The problem cannot be precisely stated, that is, there is no formal articulation of the problem. For some drivers speed contributes to road trauma, for others it is alcohol, or driver drowsiness, or driver attitude, or recent experience, or – there are so many plausible explanations for road trauma. Data collected on driver attitude immediately reveals the lack of agreement upon a suitable standard or base-line, thus driver attitude is a much more complex aspect which, *prima facie*, contributes to road trauma as compared with BAC. There is no one meaning which can be attributed to a 'good' or a 'bad' attitude. This research problem is far more challenging and demands we seek out alternatives to the positivist paradigm.

The notion that realities are constructed by individuals as subjects of an inquiry and interpreted by researchers is central to the constructivist paradigm.

As Schwandt (1994 pp125-126) so persuasively puts it:

In a fairly unremarkable sense, we are all constructivists if we believe that the mind is active in the construction of knowledge. Most of us would agree that knowing is not passive — a simple imprinting of sense data on the mind — but active; mind does something with these impressions, at the very least forms abstractions or concepts. In this sense, Constructivism means that human beings do not find or discover knowledge so much as construct or make it. We invent concepts, models, and schemes to make sense of experience and further, we continually test and modify these constructions in the light of new experience.

Where we are dealing with social as opposed to natural phenomena – the thoughts of individual researchers as they create new knowledge, which is central to the present study – our investigation may not be well served if we treat social phenomena as if they were natural phenomena. Alfred Schutz, in his analysis of German intellectual history, drew our attention to the importance of this distinction in his 1932 publication *Der sinnhafte Aufbau der sozialen Welt* when he wrote (Schutz 1967 p3):

... the whole subject matter of the social sciences as something unique in its own right and having prior existence in prescientific experience has itself been put in question. In one camp, for instance, we find social phenomena treated exactly as if they were natural phenomena, that is, as causally determined physical events. In another camp, however, we find the sharpest contrast drawn between two classes of phenomena. Social phenomena are here treated as belonging to a world of objective mind ('objectiver Geist'), a world which is, to be sure, intelligible, but not under the form of scientific laws.

In the last 20 years the recognition of more interpretive stances of research have been enhanced by writers such as Glaser & Strauss (1967), Denzin (1970), Eisner (1981), Lincoln & Guba (1985), Tesch (1990), Schwandt (1994). Most writers have something seminal to say, and for the purposes of this research Egon Guba (1990 pp17-27) provides an instructive comparison of the positivist and constructivist paradigms on ontological, epistemological and methodological dimensions, and is summarised in [Figure 7: Alternative Inquiry Paradigms](#) below. These three dimensions are also used in [Chapter 8 – A hypertext paradigm – the environment for Generative Conceptualisation](#), [Figure 35: Paradigm Characteristics](#).

Level	Positivism	Constructivism
Ontology (being)	<i>Realist</i> – reality exists and is driven by immutable natural laws and mechanisms. Knowledge of these entities, laws, and mechanisms is conventionally summarised in the form of time- and context- free generalisations. Some of these latter generalisations take the form of cause and effect laws	<i>Relativist</i> – realities exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them
Epistemology (knowing)	<i>Dualist/objectivist</i> – it is both possible and essential for the inquirer to adopt a distant, non-interactive posture. Values and other biasing and confusing factors are thereby automatically excluded from influencing the outcomes.	<i>Subjectivist</i> – inquirer and inquired-into are fused into a single (monistic) entity. Findings are literally the creation of the process of interaction between the two.
Methodology (doing)	<i>Experimental/ manipulative</i> – questions and/or hypotheses are stated in advance in propositional form and subjected to experimental tests (falsification) under carefully controlled conditions.	<i>Hermeneutic, dialectic</i> – individual constructions are elicited and refined hermeneutically, and compared and contrasted dialectically, with the aim of generating one (or a few) constructions on which there is substantial consensus.
<p>urce: Developed from Guba 1990 pp17-27</p>		

Figure 7: Alternative Inquiry Paradigms

The inquiry paradigm

In this study of empowering human cognitive activity a constructivist approach is indicated. It recognises that there is no socially stable and accepted version of another person's reality, cognitive process, problem solving ability, or *Generative Conceptualisation*. The material is interpretive. The outcomes are generative and constructed by researcher and respondents.

Having established the inquiry paradigm we now lay out the remainder of the plan for achieving the aim – in so far as it is known (indeed knowable) prior to embarking on the research itself. As Lincoln & Guba (1985 p226) point out for naturalistic¹⁷ inquiries:

It does not follow, however, that because not *all* of the elements of the design can be prespecified in a naturalistic inquiry, *none* of them can. And it is also the case that the nature of naturalistic inquiry calls forth certain elements not included in conventional design that must nevertheless be considered. Design in the naturalistic sense, means planning for certain broad contingencies without, however, indicating exactly what will be done in relation to each.

Data analysis

Data in this study comprises transcripts of interviews, respondents' audiotaped self reported thoughts and activities, and [this author's](#) field notes. They are words forming sentences, concepts, and categories – this is qualitative data. The data expected to emerge from the first field study will contain both *second-order knowledge* (knowledge about knowledge structures, processes or methods for creating knowledge), and *first-order knowledge* ([Goldman 1986 pp51-57](#)) with which the subjects work.

¹⁷ *Naturalistic investigation has two prime tenets: no manipulation on the part of the inquirer is implied; the inquirer imposes no a priori units on the outcome.*

Analysis of this data resulted in a general characterisation of how successful researchers create original knowledge. Such a characterisation informs the design of an empowering hypertextual environment. We are looking for the tools, techniques, strategies, heuristics, and examples of knowledge generation. Analysis was guided by the conventions of the method of *comparative analysis* (Glaser & Strauss 1967 pp21-44), more specifically, the *constant comparative method*.

Bogdan & Biklen (1982 p70) operationally define the *constant comparative method* of developing theory as:

1. Begin collecting data.
2. Look for key issues, recurrent events, or activities in the data that become categories of focus.
3. Collect data that provide many incidents of the categories of focus with an eye to seeing the diversity of the dimensions under the categories.
4. Write about the categories you are exploring, attempting to describe and account for all the incidents you have in your data while continually searching for new incidents.
5. Work with the data and emerging model to discover basic social processes and relationships.
6. Engage in sampling, coding, and writing as the analysis focuses on the core categories.

Although one can represent the constant comparative method as a series of steps, what has just been described goes on all at once, and the analysis keeps doubling back to more data collection and coding.

Data for analysis by the constant comparative method is selected by a process of *internal sampling* (Bogdan & Biklen 1982 p63):

By *internal sampling* we mean the decisions you make once you have a general idea of what you are studying, with whom to talk, what time of day to observe, and how many documents and what kinds to review. Narrowing the focus of your study will, in many cases, make it possible to examine the entire population of interest; that is, you will talk to everyone in the group, all the people in the setting, or review all the documents present. ... There are dangers in relying exclusively on a small number of subjects, but you should not approach internal sampling with the idea that you have to spend the same amount of time with everyone. Similarly, with documents and other material, some pieces of data are simply richer and deserve more attention.

The cyclic nature of the research process given in the six steps above concludes when the *theoretical saturation* (Glaser & Strauss 1967 p61) criterion has been satisfied. Theoretical saturation, also referred to as a category's theoretical saturation, is achieved when further data yields no new properties of the categories revealed in the substantive area. This of course implies the sampling-analysis cycle we saw above. Bogdan & Biklen (1982 p64) put it slightly differently: "qualitative researchers gauge when they are finished by what they term data saturation, the point of data collection where the information you get becomes redundant".

Generally, so far as 'experimental' or 'field research' design is concerned, the case may be understated in respect of the amount of work generated by the fieldwork, thus six respondents may provide a voluminous and rich source of data. On the other hand, more respondents, or further in-depth probing with the respondents may be needed to generate the richness which will ultimately yield the issues for subsequent consideration.

The decision was made to concentrate on six cases, and support it with further probing or cases if theoretical saturation is not achieved within this framework.

Upon the basis of the analysis as just described, and in the context of the limits, sources, and nature of knowledge (Arner 1972 pp1-18, Goldman 1986 pp42-57), an empowering technology (HIMS) was defined and constructed.

Analysis of the data from the second field study will use the constant comparative method, as for the first field study.

Instrumentation

In this study the primary instrument is this author who acts as researcher and interviewer in the field studies. On this point Lincoln & Guba (1985 p187) have this to say:

Naturalistic inquiry is always carried out, logically enough, in a natural setting, since context is so heavily implicated in meaning. Such a contextual inquiry *demands* a human instrument, one fully adaptive to the indeterminate situation that will be encountered. The human instrument builds upon his or her *tacit* knowledge as much as if not more than upon propositional knowledge, and uses methods that are appropriate to humanly implemented inquiry: interviews, observations, document analysis, unobtrusive clues, and the like.

This author's expertise as interviewer was gained through both theory and practice. He formally studied naturalistic research methods, which included considerations relating to taped interview data collection and semi-structured interview construction and use, and put them into practice *inter alia* in his Master of Education research (Dreher 1989).

Two secondary instruments were needed. The semi-structured interview schedule used in the first field study is reported in [Construction of the interview schedule](#) below. The second instrument is HIMS, the design of which emerged from this author's own ideas and experience and further developed and refined through the results of the first field study. Since this author has extensive

experience in design, construction and evaluation of information systems in general and hypertext applications in particular, it is argued that HIMS is satisfactory in so far as a prototype software device is concerned. HIMS was intended to provide an empowering environment for the respondents of the second field study. Its characteristics and functions are reported in [Chapter 5 – Associative thinking and the hypertext paradigm](#). The section headed [HIMS evaluation](#) in [Chapter 6 – Empowerment through a hypertext environment](#) gives some idea of the performance of the software device in the field.

Trustworthiness

In order to gain the trust of their audience, conventional inquirers seek to demonstrate validity (internal and external), reliability, and objectivity. Lincoln and Guba (1985 pp218-219) suggest that for naturalistic inquiries these terms be replaced with credibility, transferability, dependability, and confirmability (refer [Figure 8](#)).

Naturalistic inquiries	Conventional inquiries
Credibility	Internal validity – the results correspond with the reality they purport to describe
Transferability	External validity – the study is carried out under conditions of probability sampling
Dependability	Reliability – the study results are stable and replicable
Confirmability	Objectivity – the instrumentation is 'apart' from the inquirer

Source: Developed from [Lincoln and Guba 1985 pp218-219](#)

Figure 8: Demonstrating trustworthiness of inquiries

Credibility

The data in this study are argued to be credible due to three factors. First, the respondents are unimpeachable. What they do in their research and their knowledge generation activities simply cannot be questioned. They are experienced researchers actively working their fields. Second, there has been a prolonged engagement with the respondents. This promoted an opportunity to build trust between this author and respondents and ensured that distortions in the data were conspicuous. Also, it permitted this author to 'learn' the culture of respondents, as they were persistently observed. The notion of triangulation (Morse 1994 p214, p224) involves using different sources and different methods. The third mainstay of credibility in this study is that the sources of data in the two field studies are varied. Both semi-structured interview and participant observation techniques were used.

Transferability

To assist the reader judge the transferability of the findings, the transcripts of the interview sessions and meetings from both of the field studies can be made available. The transcript material occupies 280 kilobytes and 220 kilobytes of ASCII text for the first and second field studies respectively, amounting to more than half a megabyte of transcript occupying some 300 pages of single spaced text in 12point Times font with similar margins to this document. Space in this volume permits the inclusion of only a sample of this data – an entire interview transcript from the F1_data, and a set of meeting transcripts and recorded notes of one respondent from the F2_data: these are reproduced as [Appendix 4 – a sample from the F1_data](#) and [Appendix 5 – a sample from the F2_data](#) respectively.

Dependability

If it is true, as claimed above, that the respondents are unimpeachable in terms of the data they provided in this study, subsequent research would be expected to generate similar data even with varied methods. A belief or fact is true

irrespective of how it is elicited. Of course, respondents may alter their minds about these matters, but no claim is being made about a universal or enduring reality.

Confirmability

During the research, examples were given to independent individuals for scrutiny for plausibility and accuracy of data treatment.

The above arguments are intended to inform the reader that this naturalistic inquiry has been as trustworthy as the methodology allows.

The field data

Data sources

There were three sources of data: a small scale field study to construct, trial and refine the semi-structured interview schedule (known as the I_data); a qualitative investigation of six respondents using the instrument developed from the I_data (yields the F1_data); and a qualitative investigation of three respondents as they used the empowering device (HIMS) constructed from ideas which emerged from the F1_data and this author's own experience (yields the F2_data).

The field studies took place on university campuses at the work places of the selected respondents. Purposeful sampling, where one chooses "particular subjects to include because they are believed to facilitate the expansion of the developing theory" (Bogdan & Biklen 1982 pp67-68), was used to select a variety of respondents to facilitate the development of a substantive theory of knowledge creation. The sampling criteria and method are given at sub-heading [F1_data – pre-empowerment knowledge creation characteristics](#) below.

I_data – semi-structured interview schedule

An expert in the field of knowledge based systems was consulted to help develop a semi-structured interview schedule used in the first field studies. The instrument was trialed with a knowledge-worker representative of the respondents selected for the studies and evaluated on four criteria: 1) appropriateness of language; 2) time to complete; 3) divergent idea elicitation, permitting an exploration of matters as yet unthought of; and 4) description of respondents' current research content, methods, goals, and ideas about what they were doing and why.

F1_data – pre-empowerment knowledge creation characteristics

Respondents for the field studies were selected from the body of researchers actively working their knowledge domains. As the interest was in studying cognitive activity resulting in original outputs, the following criteria were used to identify potential respondents: PhD qualification, and actively pursuing research; non-computer expert, non-familiarity with hypertext technology; social sciences/qualitative/applied disciplines; and working with *a posteriori* knowledge to a large degree.

The PhD qualification helps identify active researchers. Many PhD holders are in administrative positions or concentrate solely on teaching. This study required active, experienced and successful researchers who have already contributed to their respective knowledge domains, and who view their future in terms of continued research.

Only researchers who have not experienced empowerment with computers as 'instruments for the mind' are suitable to this study. It was established, prior to engagement with respondents, that they were all working in the un-empowered state in this respect.

The form in which the respondents' data, information, and knowledge is normally represented dictated to a significant degree the type of hypertext system which was used. For example, the requirements for placing graphics and video in hypertext differ greatly from those for text knowledge. This study was restricted to purely textual forms of knowledge which in turn restricted the sample to those disciplines in which the medium for the knowledge is largely text. Art, Music, and Theoretical Physics, for example, would not lend themselves well to this study because they use knowledge types other than text to a considerable extent.

Finally, to witness empowerment of cognitive activity there must be some external representation of thoughts – the currency of the researcher's thinking needs to be text¹⁸ for it to be given form as a hypertext. *A priori* knowledge domains deal with matters prior to experience, innate in the mind, and with truths of reason. Logic and Mathematics are examples of such domains in which the currency of thought is abstract and conceptual and given form in the external world as strings of symbols forming equations and relations obeying inviolable axioms. The 'matters of fact' expressed in the empirical data of *a posteriori* knowledge domains lend themselves to representation by text (strings of characters or bytes of data). Goldman (1986 pp299-304), discussing the dichotomy in the history of epistemology of 'truths of reason' and 'matters of fact' assists in developing a clear notion of the differences. [Figure 9: 'Truths of Reason' versus 'Matters of Fact'](#) is a summary developed from his work.

Restricting the sample from which respondents were selected to those who worked in an *a posteriori* as opposed to an *a priori* knowledge domain facilitated the research.

¹⁸ *There is no theoretical restriction here - it is more a matter of do-ability. Dealing with textual knowledge representations is at this time far more efficient than dealing with pictures, both still and moving, and sound. With the computers of the future these latter forms of knowledge representation will be as amenable to manipulation as text is now.*

<i>dimension</i>	<i>truths of reason</i>	<i>matters of fact</i>
	<i>a priori</i>	<i>a posteriori</i>
	non-empirical	empirical
metaphysical	necessary	contingent
semantic	analytic	synthetic
certainty	knowable with certainty	not knowable with certainty
<i>Source: Developed from Goldman 1986 pp299-304</i>		

Figure 9: 'Truths of Reason' versus 'Matters of Fact'

F2_data – post empowerment knowledge creation characteristics

It was intended that the respondents who participated in the first field study proceed with the second field study, although it was recognised that due to the prolonged nature of this research that some respondents may not be available for the latter. In the event of unavailability, substitutes consistent with the criteria given in section [F1_data – pre-empowerment knowledge creation characteristics](#) above, were sought.

Whilst the F1_data derives solely from an audio-taped semi-structured interview conducted with each respondent one at a time, the F2_data comprises audio-tapes of successive sessions during which each respondent worked with HIMS and recorded his or her 'thoughts' as they worked. Further, there were audiotapes of as many regular review meetings with this author as were needed by respondents to put HIMS into practice.

Recording of data

Respondents in this study provided data in respect of the incidents, events, happenings, and mental states or *beliefs* (Goldman 1986 pp13-27) embodied in the person.

As the study deals with a small number of individual respondents we have the opportunity to ensure a very high degree of fidelity in the data. All interviews and meetings were audiotaped with this author's field notes cross-referencing the audiotape and included any diagrams that emerged. This author transcribed the audiotapes with reference to the field notes. This process ensured maximum data fidelity, and did not pose any threats to the respondents.

The second field study (F2_data) called for respondents to make some recordings on their own, therefore each respondent was provided with a voice-activated micro-cassette tape recorder which may be retained for personal use at the completion of the study.

Successive phases of data collection

The data sought for this study are those representing the thoughts of respondents as they progressed their research work. Words they uttered provided a glimpse of their construction of reality; their interpretation of events and sense-data in their natural work settings. Given the constructivist paradigm (see [Figure 7: Alternative Inquiry Paradigms](#)) guiding this inquiry, the data collection methods employed must yield rich and extensive data to permit the elaboration of hermeneutically refined and dialectically contrasted constructions of researchers' realities. Therefore, all data representing respondents' 'streams of consciousness' or 'thinking', were elicited in the minimally obtrusive verbal form and stored on audio-tape for subsequent transcription. Where respondents elected to create a written record, it was added to the transcription in appropriate temporal position.

Whilst the general direction the investigation was to take was known at the outset, one wished to admit consideration of possibly fruitful avenues which may emerge during the study. For this reason the data collection method of the first field study was guided by a semi-structured interview schedule. A preliminary small scale investigation (at Time 0, see [Figure 10: Successive phases of data collection](#)) was necessary to generate data (the I_data) which informed the construction of a semi-structured interview schedule.

At Time 1 (prior to any possible empowerment intervention due to this study), each respondent (referring here to the incidents, events, happenings, and beliefs embodied in the person usually associated with a respondent and denoting the work of these humans) was investigated using a semi-structured interview instrument ([Bogdan & Biklen 1982 pp135-139](#), [Tuckman 1978 pp196-226](#)). This resulted in the F1_data.

After the empowering technology had been in place for an adequate time, or an empowerment-related goal had been self-reported as having been reached (Time 2), the respondents were again investigated using participant observation and audio-taped "conversations" ([Morse 1994 p224](#)) which provided, *inter alia*, any evidence of knowledge creation and empowerment – the F2_data.

<----- Time 0 --->	<----- Time 1 ----->	<----- Time 2 ----->
I_data	F1_data	F2_data
Create instrument for F1_data collection	Create characterisation of knowledge structures of respondents	Examine data for evidence of knowledge creation and empowerment
<i>2 months</i>	<i>2 - 6 months</i>	<i>6 - 12 months</i>

Figure 10: Successive phases of data collection

Construction of the interview schedule

Since this research deals with a previously unexplored area, there were no existing data collection instruments available. A generative approach was required to develop a suitable instrument. This author checked his initial ideas on a data collection instrument with an experienced researcher who had worked with similar problems. An unstructured interview was conducted with L. Floyd Lewis, a visiting Information Systems researcher from Western Washington University who had created a software device to support face-to-face meetings called *MeetingWare* (Lewis 1987) and who was experienced in knowledge elicitation techniques.

The interview began with the statement :

HD - what I want to study is what knowledge, and what knowledge structures apply, pertain, in these (selected) areas (knowledge domains) and then see how hypertext can help.

The interview was audio-taped. The transcript and supporting notes (which became known as the I_data) provided the data which led to the construction of a semi-structured questionnaire (Figure 11) for use in the first field studies. The various versions showing the emergence of the final questionnaire are reproduced in [Appendix 3 – Preliminary Interview with FL](#).

The instrument (Figure 11) was trialed with an Information Systems researcher previously unaware of the research. During this interview both this author and the research supervisor took notes as the questions were being addressed. The independently created interview records were compared and found to be similar in content and justified a conclusion that the questionnaire was serving its purpose, that is:

1. it was understandable by the interviewee (appropriate language);
2. it took about an hour to complete (not too long);

3. it generated data about matters not specifically mentioned in the list of questions thus permitting an exploration of matters as yet unthought of;
4. it elicited the information which revealed individuals' research content, methods, goals, and ideas about what they were doing and why.

1. What is the nearest discipline to yours?
2. Tell me what knowledge domains comprise your discipline.
List the elements or components of knowledge that are part of your profession or discipline.
3. Can you list the related disciplines?
Show the overlap in the knowledge domains, and their relationship/interconnectedness/organisation.
4. What characterises your discipline in terms of related k domains?
5. What specific techniques would you use in your discipline?
6. What sort of applications would your discipline have?
How do you apply your knowledge in the field?
7. What sort of things do people research in your area?
What research field are you currently actively working
8. What literature (k groupings) do you follow?
What do you read, what catches your eye?
What research papers do you produce?
9. Describe what you do?
What domains of knowledge impact on your doing this;
i.e. what areas do you draw on to do your work?
What is your specific area of research and how does it fit into the totality of knowledge?
10. How would you compose the elements which made up the "...1 of ...4"
concept¹⁹?
11. What, in your opinion, is most often misunderstood about your discipline?
12. Describe your discipline as you would to someone from another planet.

Figure 11: Semi-structured interview questions used in F1_data collection

The above 12 item semi-structured questionnaire acted as a guide to the interviews with respondents in the first field studies.

¹⁹ Perhaps an explanation of the shorthand used will make its repetitive meaning clear. The "...1 of ...4" in this question refers to questions 1 to 4, which collectively pertain to a characterisation of the discipline. Question 10 was intended to provide an opportunity to relate the answers given in questions 1 to 4 to the actual doing of the research work rather than the talking about it. Since all this work is cognitive, there is very little difference between the 'doing' and the 'talking'. It was found to be redundant.

Question 10 was found to be corroborative; it produced similar information to that associated with questions 3 and 4 and was therefore not used in the field studies.

Logistics

The numerous practical aspects relating to this study can be laid out as a set of steps more or less in temporal order (the dates given are actual – the plan called for completion in approximately half that time – by mid 1993, but this was simply unrealistic in retrospect – (Figure 12: The research timeline):

Develop a bibliography of literature broadly relevant to hypertext and cognitive activity	1989-90
Literature search for evidence of uniqueness of the idea of empowering cognitive activity and generally related areas	1990-91
Develop initial version of HIMS to check out the practicality and feasibility of a hypertextual empowering device	1991
Collect I_data and develop F1_data collection instrument	1991
Select respondents for first field study thereby also determining the substantive areas, knowledge domains, or disciplines	1992
Conduct first field studies (F1_data)	1992
Evaluate commercially available qualitative data analysis software and if necessary develop hypertextual qualitative data analysis methods and tools based on the SmarText hypertext package by Lotus	1992-93
Analyse the F1_data and use the outcome to refine and improve the HIMS design as necessary	1992-93
Collect vast amounts of sample data for use by respondents (50MB over 6 months from a selection of Internet NewsGroups relevant to the respondents' knowledge domains)	1993
Test HIMS for operation with vast amounts of data, and apply any preliminary processing or formatting of the 50MB of NewsGroup data	1994
Conduct second field studies; check literature for development of competition to HIMS	1994
Analyse the F2_data for evidence of empowerment and working in a hypertext paradigm	1995
Report: Findings and Conclusions	1995-96

Figure 12: The research timeline

Operational definitions

Empowerment

Respondents will have been 'empowered' if they can, by their own judgement, in addition to that of their peers, and that of an independent judge, do 'original' or 'creative' (Goldman 1986 pp247-249) knowledge-work (including problem solving):

- more 'reliably' (Goldman 1986 p26) (the knowledge has not been created in error or ignorance);
or
- with greater 'power' (Goldman 1986 p27) (producing more knowledge);
or
- with greater 'speed' (Goldman 1986 p27) (producing knowledge more quickly);

when compared with the pre-empowerment period.

Paradigm

The term paradigm is used in a wide variety of senses. Thomas Kuhn, who popularised the term in *The Structure of Scientific Revolutions*, was criticised for having used it in "at least twenty-two different ways" (Kuhn 1970 p181), and although claiming that most of these differences were due to "stylistic inconsistencies", he felt it necessary to devote a large part of the *Postscript—1969* published some seven years after the first edition, to elaborate the meaning of paradigm. Originally, Kuhn (1970 p10) demanded a paradigm must have at least two characteristics. It will be sufficiently "unprecedented to attract an enduring group of adherents away from competing modes of scientific activity", and it will simultaneously be "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve" It is in this very general sense that the present research aims to make a contribution toward theory; theory in the 'grand theory' sense of the word theory – another construct which is subjected to diverse usage.

A much more specific meaning and according to Kuhn the one in more global use, is for any given community of specialists the set of symbolic generalisations, shared commitment to beliefs in models, values, exemplars, tacit knowledge and intuition (Kuhn 1970 pp182-198), which characterise a paradigm. To avoid confusion of this important sense with the more general meaning for paradigm, Kuhn suggested the term “disciplinary matrix” (p182), a lead which will be followed in the present work also. This liberates the term paradigm for use in the general sense corresponding to “model”, “pattern” or “ideal type” (Levin 1988 pp21-30).

Disciplinary matrix

For a community of specialists in a particular discipline there exists a set of ordered elements of knowledge which may be composed into a disciplinary matrix. There are five major elements (Kuhn 1970 pp182-198). **Symbolic generalisations** are expressions which may be represented in mathematical form such as $f=ma$ or $I=V/R$, or unambiguously in textual form such as *action equals reaction*. A second element is the **shared commitment to beliefs in models**. For example, *heat is the kinetic energy of the constituent parts of bodies*, or *the electric circuit may be regarded as a steady-state hydraulic system*. These models function, *inter alia*, as sources of preferred or permissible analogies and metaphors for the group of domain specialists. **Values** are a third element, providing the group with guidance about how to proceed in the face of crisis, and include the knowledge (also moral knowledge) needed to make judgments about accuracy, simplicity, consistency, and plausibility. An example might be some statement about educational opportunity such as *all school age children should have equal access to education despite individual differences*, or *each individual child’s potential should be fully realised irrespective of relative cost* (probably not a popular value to hold in current times!). Fourthly, the concrete problem-solutions prevalent in the text books which introduce a discipline to its students are termed **exemplars**. In physics the inclined plane problem, in early childhood education the pendulum problem and the other Piagetian experiments (Ginsburg & Opper 1969 pp182-188), and in electromagnetics the magnet and iron filings problem – all would serve as exemplars for the

community of students of the respective disciplines. Finally, **tacit knowledge and intuition** is a source of reference for a group of specialists. Whilst the preceding four elements of the disciplinary matrix can be more easily described, this element is somewhat intangible and resists concise direct enunciation. Kuhn refers to the knowledge stored in “deliberative processes” and in “appropriately programmed perceptual mechanisms” (1970 p195), and to the “knowledge embedded in the stimulus-to-sensation route” (1970 p196) of perception. The immanent act, the suspicion, that an inquirer trained in a specific discipline has but cannot explain adequately and fully to a colleague let alone to a layman, is not always discarded in the best interests of progressing an inquiry simply because it appears *prima facie* illogical.

To summarise, a disciplinary matrix consists of:

1. Symbolic generalisations;
2. Shared commitment to beliefs in models;
3. Values;
4. Exemplars;
5. Tacit knowledge and intuition.

The hypothesis debate

It is expected in subsequent studies that some of the aspects of the present work will become socially stable, at which point the associated phenomena may be considered for hypothetical treatment. This would move them from being expectations, or questions for exploration, to hypotheses. A potential list of these is given in [Appendix 1 – Potential hypotheses list to investigate the specific phenomena of this study](#).

Diagrammatic overview of the research

Research design to investigate the empowerment of original and creative knowledge-work		
<i>stage</i>	<i>constituent aim</i>	<i>incremental outcome</i>
Preliminary	Explore the fields of hypertext and cognitive support systems; Experiment and develop initial ideas about empowerment through hypertext technology	Author's self analysis for hypertext potential; Background for HIMS (Hypertext Information Management System)
Time 0	Prepare formal research plan	Consolidate plan
	Develop interview instrument	I_data
Time 1	Select and interview six PhD qualified and active researchers	F1_data characterises K_domains and informs the HIMS design
	Establish issues for consideration in the HIMS design	Categories
	Create HIMS	Provide hypertextual aid
Time 2	Implement HIMS in the field; Interaction with respondents as they use HIMS	F2_data Evidence of empowerment
	Research outcomes	Substantive theory of knowledge creation; <i>Generative Conceptualisation</i> in a hypertext paradigm

Figure 13: Research strategy overview

Chapter 4 – How do researchers create knowledge?

This chapter reports on the results of the first field study, during which a selection of researchers was studied in an attempt to discover how they generated new knowledge. We wanted to discover how the researchers went about their knowledge creating work, permitting a comparison with this author's hypertext techniques which he had found empowering. If the data revealed the researchers could also benefit from the hypertext techniques, we wanted to learn what features would be helpful so they could be formally implemented in HIMS. The F1_data was also expected to inform the context of a subsequent study (F2_data or the *HIMS implementation stage* of the overall research project) to check on the level of empowerment.

Analysis of the F1_data yielded two major components: issues which were important to the individual researchers in terms of their knowledge creating work; and a characterisation of each of their specific knowledge domains which have been rendered as knowledge maps (K_maps) to depict the domains within which these researchers work.

Rendering knowledge in the form of graphs or maps emerged naturally during the interviews, initially as a time saving technique whilst taking notes and then during the first of the F1_data interviews it was used by both respondent and author for reference purposes - making links with previously developed and discussed issues and also acting as a basis for placing the evolving issues into context. During the transcription of the audio-taped F1_data, reference to these maps, hastily scrawled on paper during the interviews, facilitated the multi-stage analysis to such an extent that they became a significant feature in their own right. [Appendix 2 – Derivation of a K_map](#) describes how one of the K_maps was created and the notational system used.

[Appendix 4 – a sample from the F1_data](#) permits the reader to see the full context of the qualitative data derived from one respondent.

Individual researchers' K_maps

One of the most striking aspects of the F1_data was the emergence of K_maps, as we have termed them. These maps depict the respondents' primary knowledge domain and its relationship with ancillary domains. They were compiled by this author during the interview and refined by reference to the interview audio record. A characterisation of the domain, in text and as seen by each individual researcher was also created (using their own words).

Political Science K_Map

R1²⁰: -

Political Science is the examination of structures, mechanisms, processes which distribute human and material resources by threats of enforcement and habits of compliance.

I research, teach, ... the old cliché about pushing back the boundaries of knowledge. I would like to see myself doing whatever seems relevant or what pops out of all this reading that I do. The topics, or questions, could come from anywhere really so it's a very eclectic source from which they're emerging.

I even have books on the role of chance and serendipity in science, you know I think it's a great subject because the way that scientists do discover things is really not this rational straight line process of reasoning at all, not in the main. Nobel Prize winner Professor of Astronomy Fred Hoyle once said: "The best ideas come when I'm fishing". In my case I hope reading widely, and much of it, while it looks like chance, is in fact the prepared mind seeing something that the unprepared mind can't. It looks like chance and if it happened to ordinary people it would be chance. The scientist's mind is prepared by years of cogitating about a given area.

The most often misunderstood aspect of Political Science is the widespread belief that public bureaucracies are inefficient – held in low esteem. I believe they are far less inefficient, and obviously there's room for improvement, but they are maligned.

Language is not impartial in Political Science – it's a question of expressing yourself impartially and at the same time knowing what images are being produced by the words you're using.

²⁰ Note: in the word sequences below the Rn capitalised initials refer as follows: R1 political scientist; R2 structural engineer (civil engineer); R3 economist (labour); R4 historian (political, social, agrarian); R5 historian (intellectual, science); R6 chemical engineer .

Chapter 4 - How do researchers create knowledge?

There was a time when I thought the study of my area was the study of how to do it – now I believe it is a study of how not to do it.

Kmap_R1c1r

K_map for R1's domain

R1 deliberately studies subjects which bear no relationships

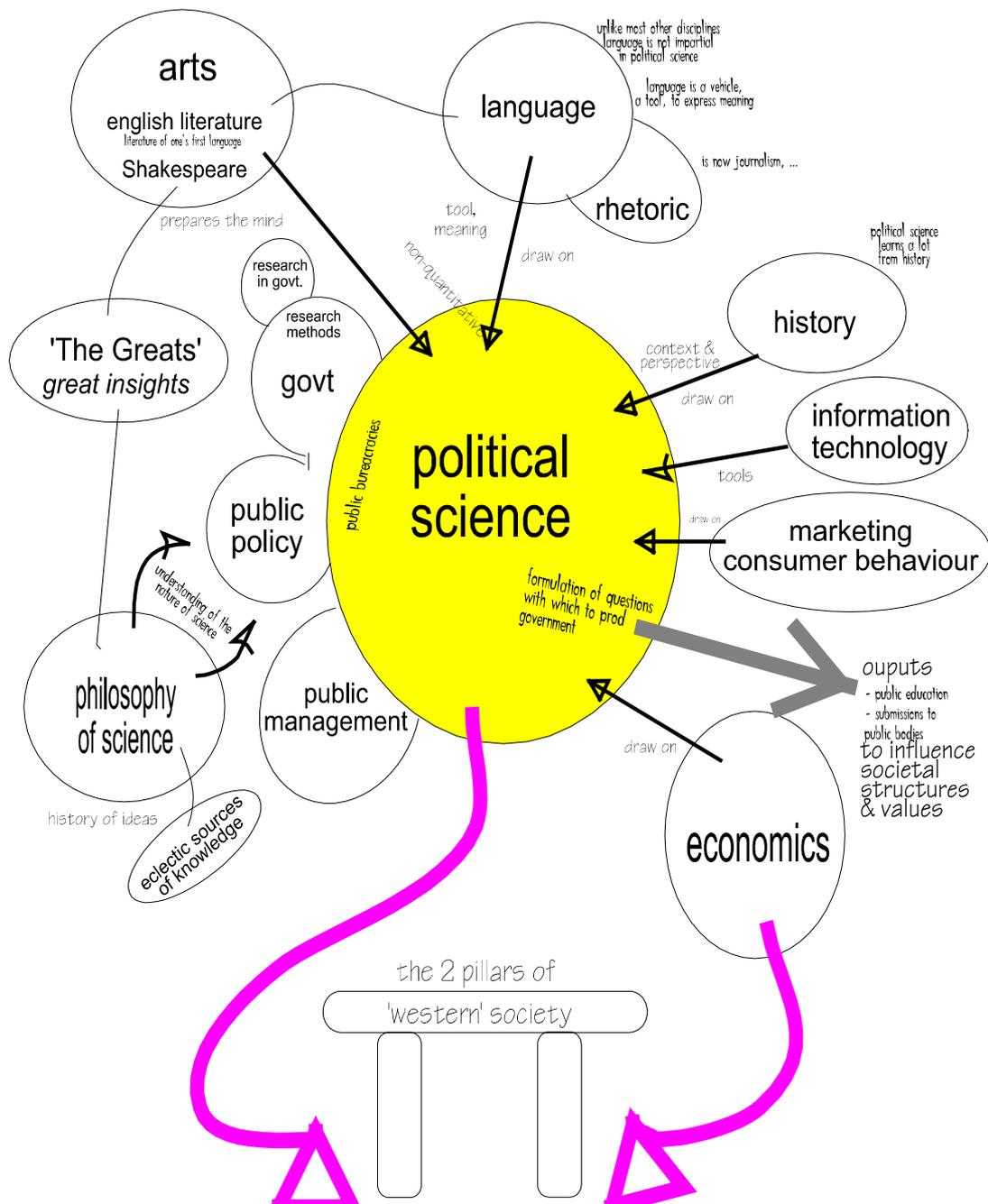


Figure 14: K_map: Political Science

Structural Engineering K_Map

R2: -

If it doesn't move,

if it has to be built,

if it solves a problem that makes life easier for mankind,

then a civil engineer has designed it and supervised its construction.

Structural Engineering (a specialisation of Civil Engineering) is to do with buildings: the way they behave and the way they are designed and built. The basic idea is that buildings sometimes fall down and we need to work out how to avoid this during the useful portion of its life. But I have a real job convincing parents of prospective students of the value, to society, of civil engineering. Civil engineering has a really bad press. The only time that you ever read anything about civil engineering is when a civil engineer said a heritage building has to go, or a bridge has fallen down. Success stories in civil engineering don't sell newspapers or television news programs so they never get told. We have a big image problem from that point of view.

Kmap_R2cor

K_map for R2's domain

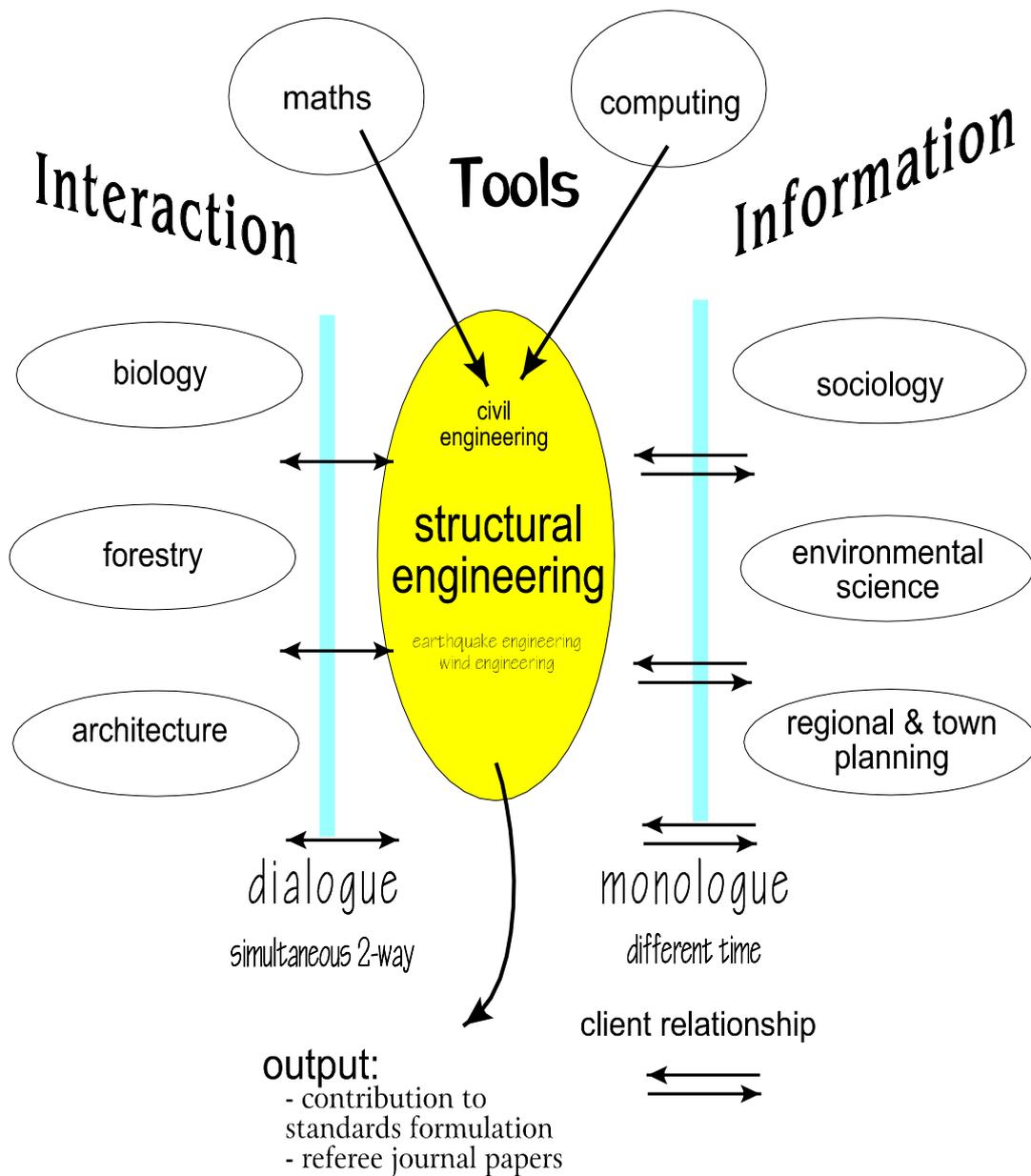


Figure 15: K_map: Structural Engineering

Labour Economics K_Map

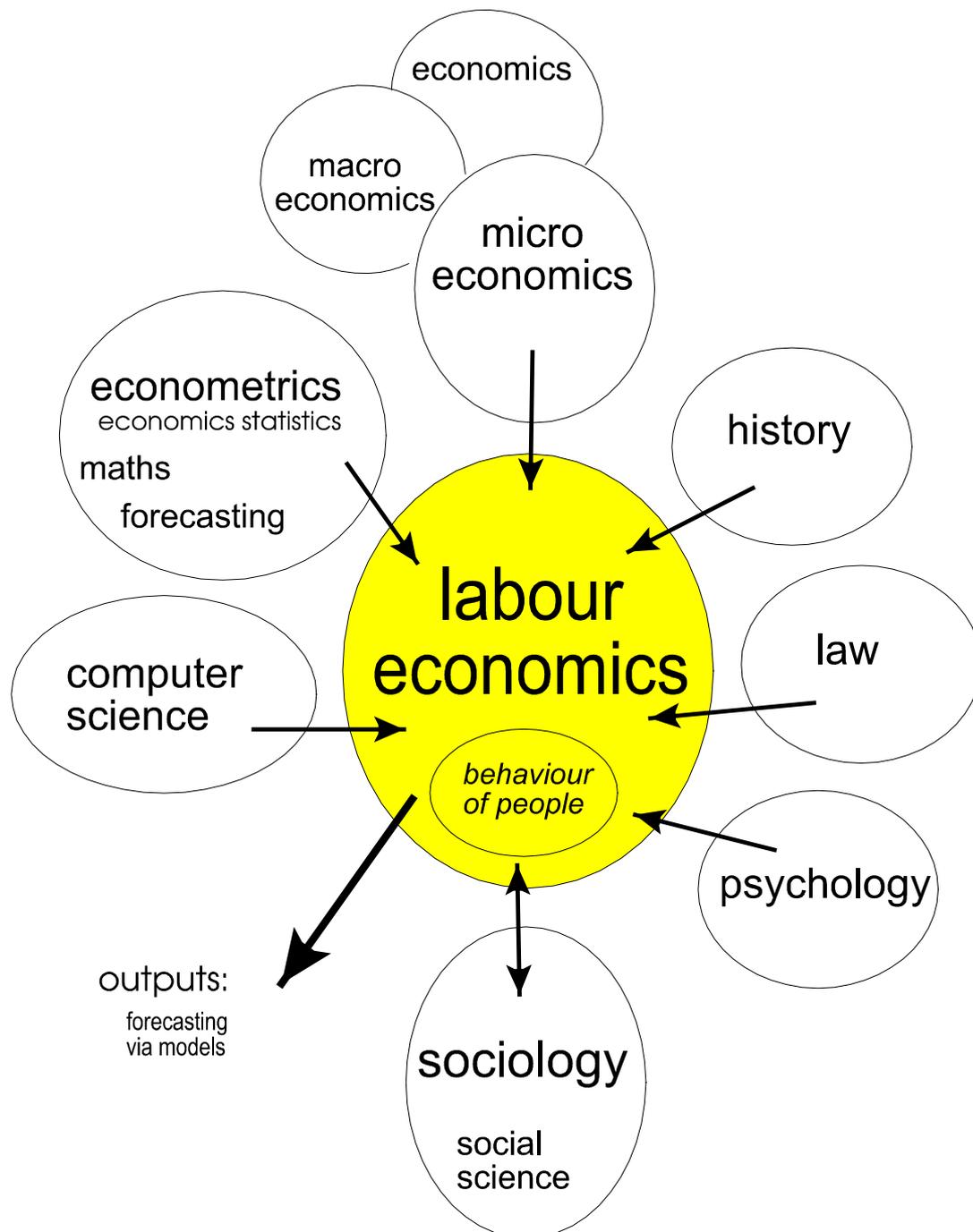
R3: -

Economics is an attempt to distribute scarce resources in as efficient a manner as possible.

Labour economics is the application of the theoretical concepts derived in the micro economics area. What I do is run various data files through the econometrics package and get the best fitting models. And obviously before all that one has a range of theoretical hypotheses. One tests them out on the data and modifies the model and then writes it up – typical sort of journal article type exercise.

The most misunderstood thing about this domain is the inherent complexity of economic systems with the multitude of interrelationships.

K_map for R3's domain



kmap_R3b.cdr

K_map for R3's domain

R&D specialisations

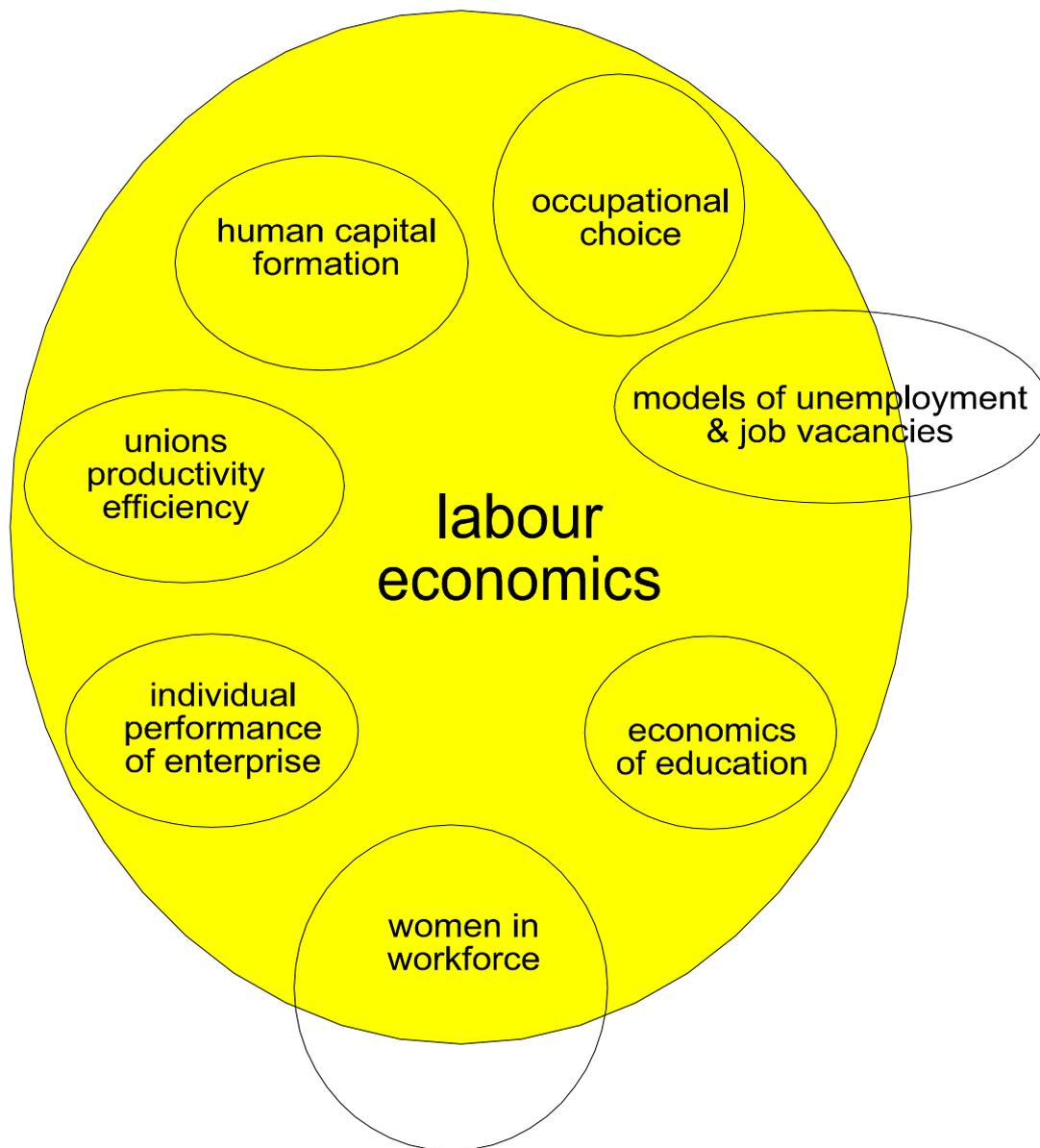


Figure 16: K_map: Labour Economics

History K_Map

R4: -

History is the informed explanation of past human behaviour in particular communities, particular societies, with the aim of understanding and affecting the present and the future. Many people think history is merely the making of a chronicle whereas much of it is interpreting, refining and explaining material. They don't see history as helping people build desirable futures. History is a technique for looking at the materials from the past and bringing those together and thinking about how to investigate and conceptualise about a period.

The kind of history I do is about development and about social, economic and political change. I think good history, I mean history that's more than just a chronicle just passing on that information, actually is interpretive. It is interpreting the period, the subject, the problem, however you want to visualize it and hence it has the capacity to teach. It explains why present situations are as they are and so offers at least the possibility to learn from what happened in the past.

The literature I use can be divided into four main categories: congruent regional or chronological material (at the most pragmatic level); explanations of similar patterns either anthropological or political in focus; conceptualisation of what is meant by political change or social change (theoretical-conceptual level); historiographical literature – methodological stuff about history.

From such literature I derive the primary and secondary data for my research.

Primary data: acts of parliament (British, Indian, local legislature); bureaucratic documents (proceedings of government files, minutes, record of meetings, operational memos); private documents (letters, correspondence, diaries, journals, papers – e.g. Governor Haley's papers); oral material (actors' and witnesses' interviews); newspaper articles; media, video, etc..

Secondary data: books (historical, contemporary, novels, poetry, religion, values, attitudes).

Kmap_R4cdt

K_map for R4's domain

the nation that forgets its past has no future

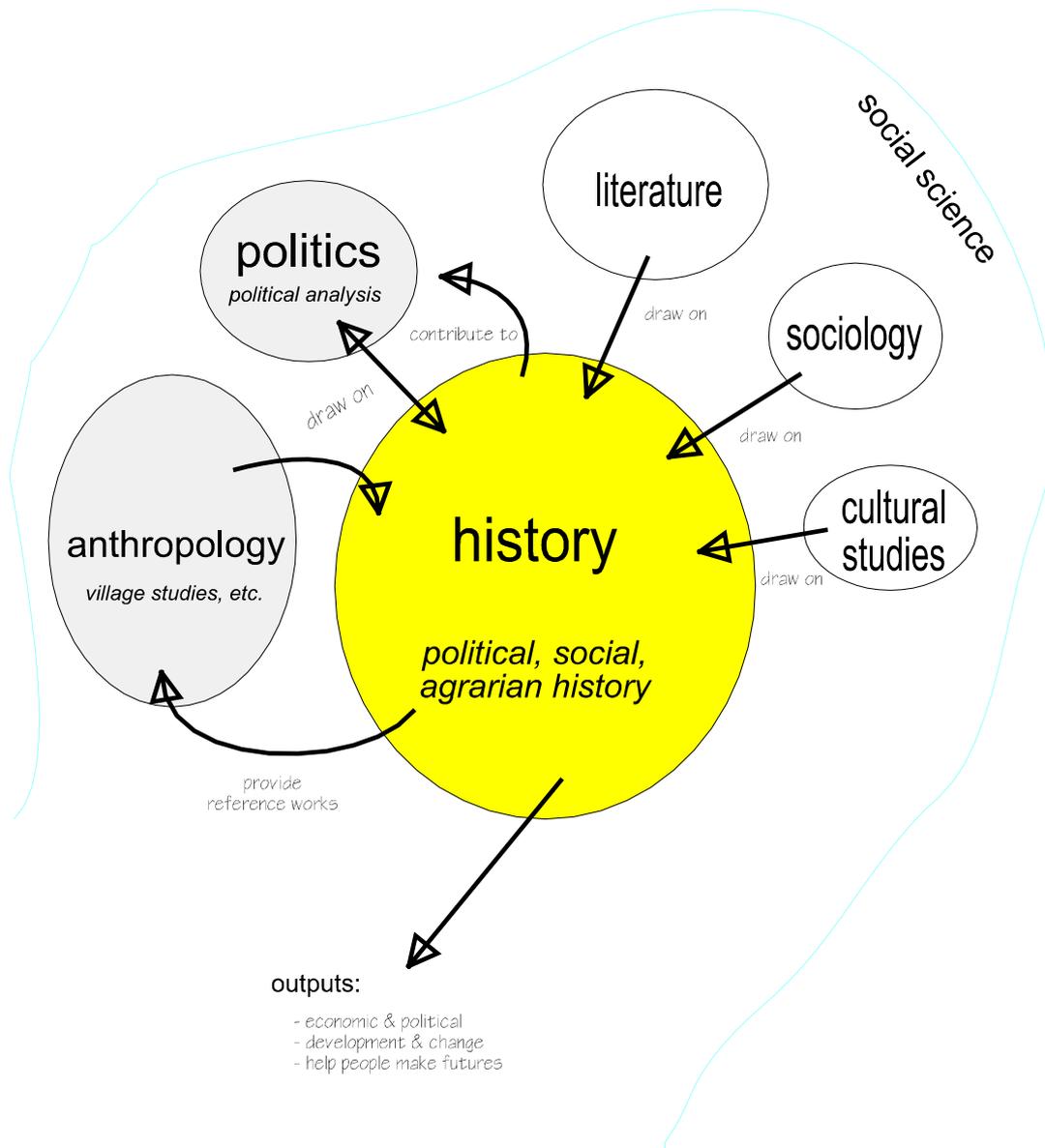


Figure 17: K_map: History

Chapter 4 - How do researchers create knowledge?

The research I do comprises a number of stages which are in symbiotic relationship with one another – one keeps going backwards and forwards. Broadly they comprise:

1. From reading or from experience or some observation (immersion in the data or experience) begin to conceptualise a problem, an area, a set of interesting concerns; and ...
2. Begin to shape a field of study within which to move ... setting up a kind of field, almost like a hypothesis;
3. Go back further into the literature and see what there is, refining that problem, setting up some operational questions that you're going to have to answer, and that leads you to where you should look for materials;
4. Collection of materials, simultaneously interrogating, assessing, and evaluating. Immerse oneself in the material; 'listen' to the document, pick up issues/questions not uncovered before – possibly leading to other sources (back to stage 3);
5. Begin to write two sorts of things: both re-writing the specifications of the field itself and the problem; and writing about particular things that you're in possession of;
6. Write and publish the thesis, book, monograph, conference paper, article, lecture or discuss findings with others.

I see it as a totally interactive process all the time – between ideas from your own reading, your own experience, your own observation, to collection of material and the interrogation of that material to redefinition of that and the product of, or the outcomes of, your work.

An important part of human culture is understanding the nature of the group to which you belong: (a) where the group came from and how it has constituted itself over time; and, (b) the kinds of behaviour and decisions and other sets of value judgements that have gone into that make-up.

History of Science K_Map

(see Figure 18)

HD: - Describe your discipline as you would to someone from another planet.

R5: - Perhaps I'd just try explaining it to a computer person – my discipline is concerned with giving an account of the ways in which our social world has changed over time; to describe and understand and perhaps explain what the processes of change have been. And many historians would have much more open political purposes – they'd see it in some way that the understanding would have implications for political action. I suppose my work has implications for religious belief and science policy. It would have implications for other disciplines, like philosophy and sociology which remain totally theoretical implications.

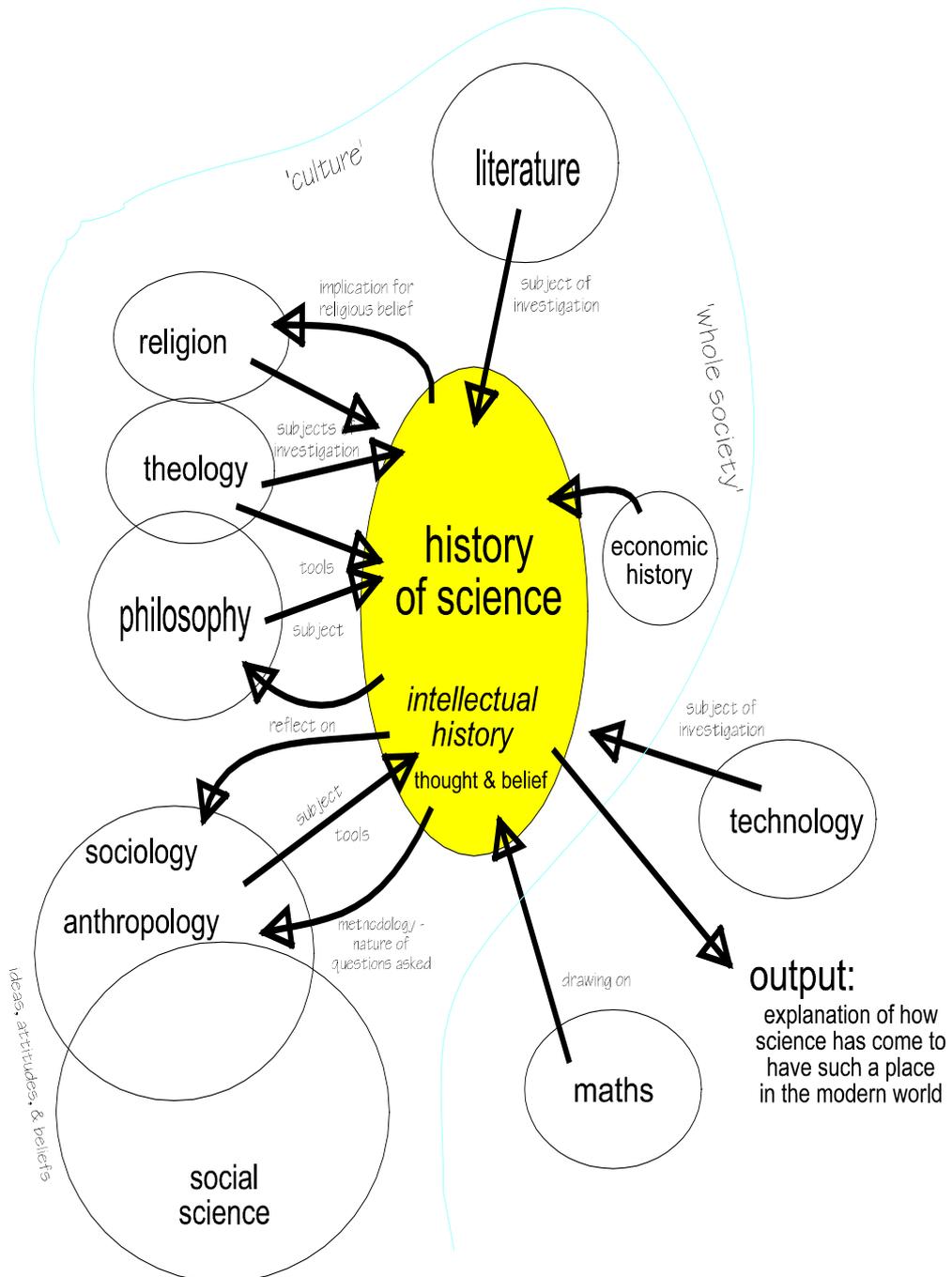
Chemical Engineering K_Map

(see Figure 19)

R6: - To describe my discipline to someone who has no concept of what a Chemical Engineer does I say "You go down to Kwinana (Perth's chemical manufacturing precinct situated on the coast 30 kilometres to the south) and you look at that dreadful mess there. That was all designed and built and run by Chemical Engineers" and that is what a Chemical Engineer does. And I'm not proud of that part of it. We get thought of as Chemists, or as being just exactly the same as Chemists. Most people don't know what Chemical Engineers do.

Kmap_05a.cdr

K_map for R5's domain



K_map for R5's domain special project

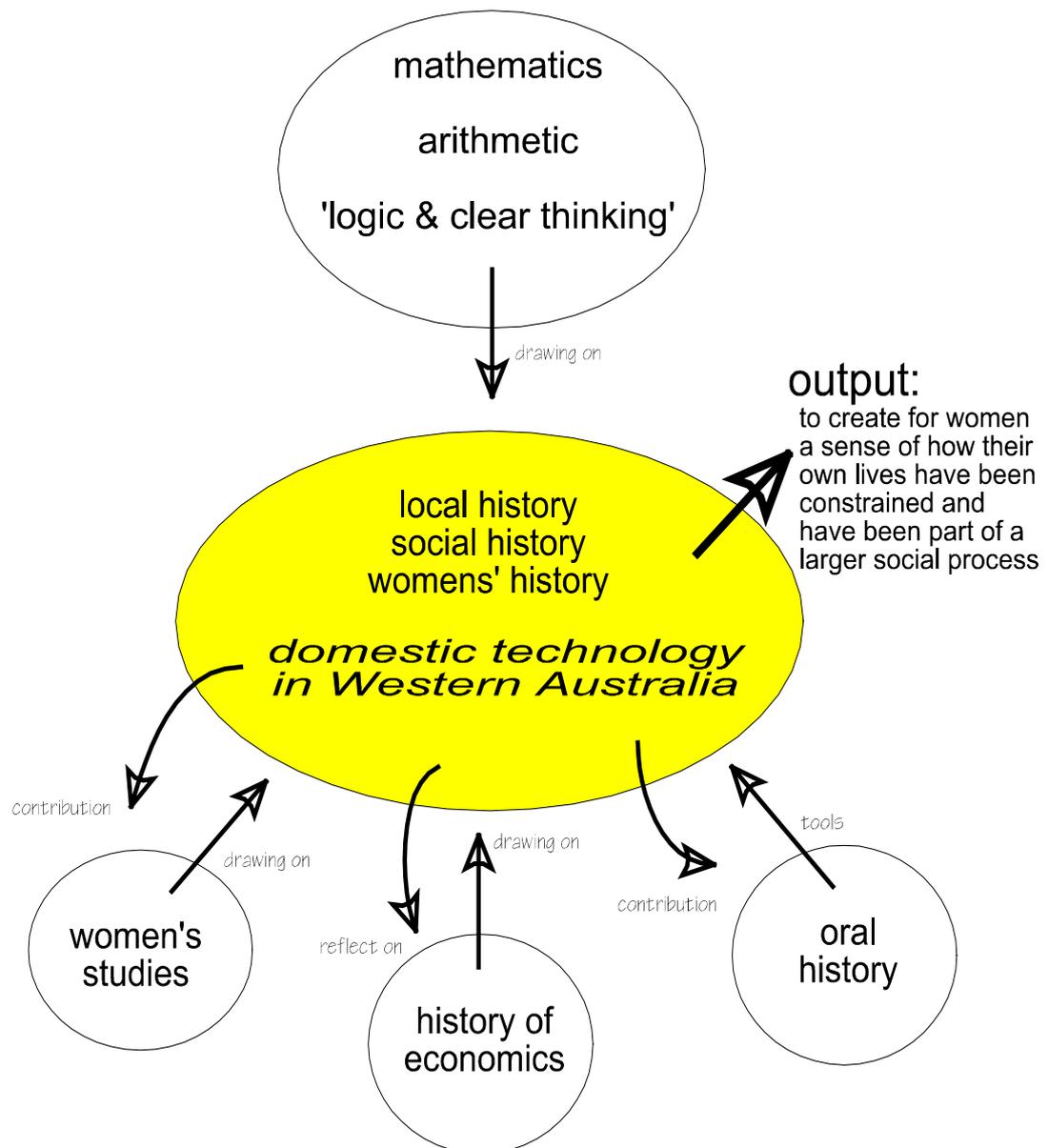


Figure 18: K_map: History of Science

Kmap_R6.cdr

K_map for R6's domain

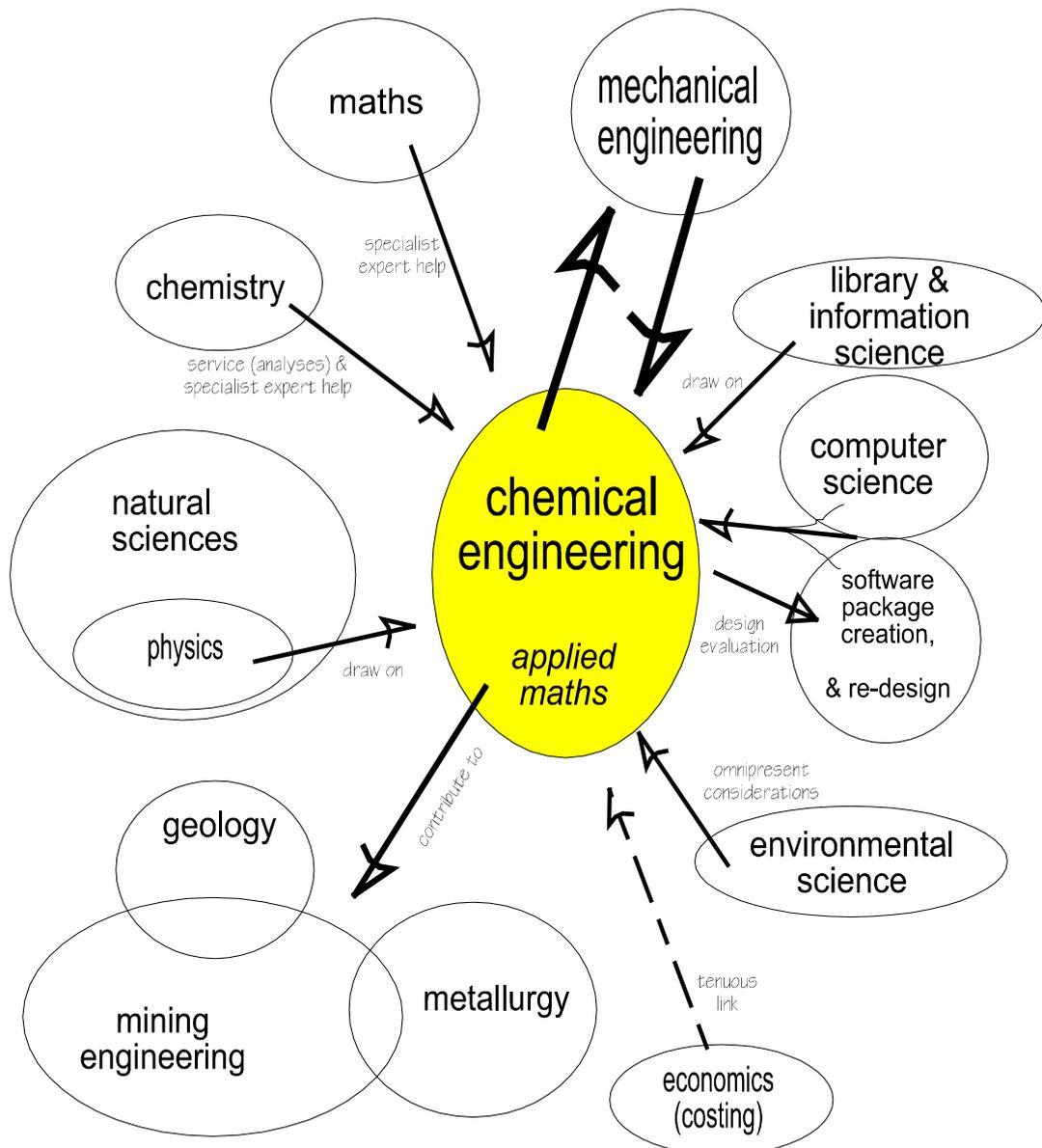


Figure 19: K_map: Chemical Engineering

Connection categories of core and supporting knowledge domains

Three notable facts emerge from a study of these K_maps. First is the degree to which research in a definable field or a knowledge domain depends on manifold other domains. This suggests the traditional compartmentalisation of knowledge is blurred when actual research is undertaken, in contradistinction to reporting of research results or to educating students in the disciplines. When contemplating the provision of cognitive support for researchers, this inter-relatedness of domains implies the need to cater for expansive access to a very broad range of data (knowledge).

Second, categories of connections (arrow labels in the K_maps) between the core and subsidiary knowledge domains inform us of the scope, type, and direction of connections. [Figure 20](#) is derived from inspection of the K_maps. If nothing else, it reveals the reliance on other disciplines for specific things such as data and tools, but also for very broad support – one respondent termed this “omnipresent considerations” and another the provision of “mind preparing, meaning, context and perspective”. In an outward direction from the core disciplines, there is almost a matching set of connection categories. Respondent R2 classified the type of interconnection between domains as “dialogue” on the one hand (simultaneous two-way communication), and “monologue” (two-way communication but at different times) on the other. This implies that e-mail (being an example of a *store-and-forward* communication system) is likely to provide effective support for the *monologue* connection type whereas computer conferencing would be needed to effectively support the *dialogue* connection type, however, as this study concerns itself solely with support for individual researchers, as opposed to groups of researchers, this observation is of passing interest only.

towards core domain	away from core domain
drawing on	contribution to
tools; specialist expert help	methodology
subject of investigation	provide reference works for
prepares the mind; meaning; context; perspective	implications for
learn from	reflect on
	design evaluation

Figure 20: Knowledge domain connection categories

Researchers require access to data (sense-data for analysis and interpretation) generated within other domains but they also need other types of knowledge – tools, methods, and expert help. To find, select, and access vast knowledge repositories manually, unaided by a ‘device’ of some type, is a virtually impossible task. In fact, as we shall see in the next section, respondents commented specifically on the ‘un-doability’ of things in the absence of supporting devices.

When viewed from this perspective of interrelated knowledge domains, we are able to see clearly that the creation and dissemination of knowledge form a pair in the research enterprise. Without either one the other becomes futile. Given the high degree of interconnections between things, the publishing act may be better facilitated by the hypertext medium rather than the linear paper-based document medium. Some support for this statement is provided by the explosive publication, for example, of conference proceedings on the World Wide Web²¹, and by the rather clumsy footnote and endnote object-link pairs to which many authors resort in an attempt to cater for important but tangential material.

²¹ *The World Wide Web (WWW) is a hypertext based network interconnected knowledge containing objects of varying type on thousands of computers scattered around the planet Earth. As all hypertexts do, WWW provides an easy to use human-computer*

A third feature to emerge from the K_maps is that researchers create K_maps describing their Gestalt with respect to specific projects. Researcher R5 provides an example in [Figure 18: K_map: History of Science](#).

Issues in knowledge creation

This section reports nine issues affecting researchers as they go about their work. Each of these problems, desires, or requirements, are then incorporated into the design of HIMS.

Issue	
1	Communication and terminology
2	Crossing the boundaries between disciplines
3	Interconnectedness of the knowledge domains
4	Specific techniques used
5	<i>Doability</i> of tasks
6	Creating a richly connected repository of ideas for future research
7	The 'loftiness' of science and the role of techniques
8	Ways of reading, ways of 'accessing' knowledge repositories
9	Changing viewpoints (with time) created from the same data sources

Figure 21: Nine issues in knowledge creation

interface and permits its users to concentrate on their research rather than on mastery of strange computer languages. Unfortunately the same cannot be said (at this time) when creating Web documents and placing them on a Web Server - in this work the user must be an HTML coder, anointed with the 'special' gift of talking gobbledygook with computers.

Issue 1: Communication and terminology

One of the difficulties in conducting the Field_1 data collection concerned the general area of language. At one level there was the usual barrier to communication due to the use of discipline-specific terms, and sometimes even general terms but with specific meanings within the discipline. At a deeper and more theoretical level there is the matter of what may be referred to as 'un-shared' concepts – it concerns the difficulty in sharing or arriving at a common understanding. This phenomenon slows down progress in doing cognitive work and can of course lead to incomplete and possibly incorrect conceptions. Not only was this apparent in this author's interactions with respondents in the F1_data collection, but it was reported by the respondents as something which they had to deal with on a regular basis.

R1²²: - Now in putting that diagram together I was very conscious that you can't put things in little boxes even though people like you (*referring to HD as an Information Systems type*) do it all the time and it's the way you explain your sequences and so on. You probably realise, as I do, that knowledge can't be broken up like that. But essentially and again these would be your knowledge domains – or call them modules here.

In discussions between knowledge-workers one finds a recognition that the language, the 'devices' that have been constructed to enable communication (the concepts belonging to a knowledge domain), may cause misconception: R1 was not entirely comfortable with the term *knowledge domain* and signalled that this meant *module* to him. Even though he uses 'devices' himself (e.g. in putting "that diagram" together) he feels he must draw attention to it. More specifically R1 shows the difficulty posed by different usage of terms:

²² Note: in the word sequences below HD refers to the author, the other capitalised initials refer as follows: R1 political scientist; R2 structural engineer (civil engineer); R3 economist (labour); R4 historian (political, social, agrarian); R5 historian (intellectual, science); R6 chemical engineer .

Chapter 4 - How do researchers create knowledge?

R1: - "Political Science" is called "Government" at Sydney University, "Politics" at UWA (University of Western Australia), and there is a trend or fashion to refer to it as "Public Sector Management".

The sometimes overwhelming nature of this terminology problem was made plain by R6 when we were discussing the contribution the computing discipline made to chemical engineering:

R6: - I guess it's called Computer Science. I'm never quite sure what "Computer Science" precisely means. There's so many jargon terms around the computer field, that I can't keep up with them all.

R3 is also cautious about his use of the term computer science:

HD: - Would you call that computer science ... that you draw on?

R3: - Oh, well I hesitated, I did start calling it computer science but it's different things to different people, but yes I suppose so, computer science.

The structural engineer R2 has a well developed strategy to help avert misconceptions:

R2: - I have to be able to talk intelligently with the biologist. HD: - Do you ever struggle with the terminology that's being used? R2: - Frequently, I mean they speak 'Latin'. I don't ... Eucalyptus Citronella and Marginata and all of the rest, and I'm frantically thinking oh yeah that's Lemon Scented Gum, and Marginata now that must be Karri. HD: - would it be helpful or a hindrance to become literate? R2: - Yes, I've tried to become more literate, but at the same time I recognise that my expertise is in an area outside of that and that has marginal benefit for me. Consulting an expert in the other domain is more beneficial to me than actually becoming an expert in his area. HD: - sociologists use some pretty specialised terminology. R2: - Oh they do and debunking sociology type writing is an artform.

R3 has recognised that he cannot do everything and must rely on 'aids' or 'helps' (consulting an expert in the other domain) if he is to be productive in his

domain. At the simplest level a rapid encyclopaedic device would be helpful and R2 uses telephone communications to other domain experts to satisfy this need as opposed to investing his own resources to learn what is missing. But dictionary definitions do not always suffice, and the value of an on-line expert, as it were, is very much understood by him.

The HIMS design helps overcome communication and terminology problems with a hypertextual device known as the *Concept*.

Through *Concepts* the HIMS user will be able to associate numerous terms (e.g. Political Science, Government, and Politics) with explanations and notes about the reasons, subtleties, connotations, and so on. That is, whenever one views text containing occurrences of the specified terms, they are 'bound to', or 'linked with', the associated *Concept*. Without losing the train of thought, users may follow such a link to help make the meaning clear, and then return, without the cognitive burden of retracing steps or picking up the thread, to the place from which they came. As work proceeds, the *Concept* may be elaborated, altered and developed to reflect the knowledge creator's emerging thoughts.

We can see from [Figure 14: K_map: Political Science](#) how R1's 'athletic reading' of philosophy of science, 'The Greats', and eclectic sources of knowledge, provides a rich source of concepts (articulated *inter alia* through specialist terminology) which 'prepares the mind for his political science research. From these sources he formulates questions with which to prod Government. Creating, managing, linking and communicating these concepts, often comprising specialist terminology, places a heavy burden on the researcher.

Issue 2: Crossing the boundaries between disciplines

We see a stark example of how an interest in one very specific component (earthquake engineering and wind engineering) of a discipline (structural

engineering) can lead quite naturally to an interest in distinct, and at first seemingly unlikely fields. R2's research interest is the effect of wind and earthquake on buildings.

R2: - Through this earthquake engineering, wind engineering, ... I have been doing a lot of work in developing countries using alternative building materials or traditional (to their culture) building materials such as mud-brick or bamboo. Inevitably I become involved in communities and the social aspects, and the financial implications as well as disaster relief and how that can be better coordinated. Planning for disasters is another area. So that all of those things have sort of piggy-backed on to my structural engineering interest."

Through this work R2 makes links into social science, management and planning:

R2: - a disaster like tropical cyclone Tracy (the name of a major and devastating cyclone which hit Darwin, the capital of Australia's Northern Territory, on Christmas Day 1974) demolishes buildings. And my interest is in the buildings. But because the buildings are demolished so is the community. Sociologists have an interest in community also, and in this respect we have parallel concerns. This publication "*Procedures for post-earthquake safety evaluation of buildings*", is right up my street, but it's a sociology paper.

Delving more into R2's work other surprises emerge:

R2: - ... looking at these interactions with forestry (and biology, architecture etc.), I'm interested in the behaviour of timber, the strength of timber, and biologists and some foresters are interested in the timber's microstructure. This and the timber's performance or behaviour are inextricably linked. I have to be able to talk intelligently with the biologist, but it's not in a quantitative fashion.

Inspection of the K_maps for each of the six researchers studied, reveals the extent to which the sometimes very clear boundaries between disciplines are

crossed. Clearly HIMS will need to be general enough to accommodate access to any given knowledge domain.

A related issue, that of the already established interconnections between disciplines, becomes our next focus.

Issue 3: Interconnectedness of the knowledge domains

Consider the work of historian R5.

R5: - You could say that what I do is intellectual history. That's all areas of thought and belief. HD: - What are some things that you definitely would not have as subjects of investigation? R5: - Oh there's almost nothing that I'd leave out. Mm. (Laughter). I mean, the history of culture includes practically everything. I limit it by time period and by cultural area. And I never know what I'll end up with next with what I will consider relevant to what I'm investigating. ... See one of the things that I'm interested in is that these things can't be separated from one another. ... I don't care where the boundaries come.

For R5 the boundaries are not circumscribed by discipline or knowledge domain but rather by time period and cultural area, and then only as a means of defining something which is doable and as a mechanism to avoid the unmanageable and infeasible, from the standpoint of the volume of work. Her intellectual range is indeed expansive.

Two further examples from R5 concern ideology and the place of technology vis-a-vis science.

R5: - ... one of the important concepts in sociology would be the concept of ideology which raises questions about the relationship between people's ideas and their social location and political location
...

Chapter 4 - How do researchers create knowledge?

R5: - ... what is the relationship between science and technology? Is technology merely applied science, or is technology something that stands on its own? We can say over the last 100 years science has come to be perceived as some uniquely true way of knowing the world in contrast with other ways of understanding which are illogical or in some way inferior to science. I'm interested in those knowledge claims of science, and in the extent to which they are justified, and to the extent that they were made in the past, rather than just in the present. And it seems to me that in the past you couldn't distinguish, in that nice simple way, between theology and science, or what you call philosophy of science. If you go back as far as the 17th century most major scientists also wrote philosophy and theology at the same time. So I'm interested in how these boundaries have come to be so clearly marked.

R5 recognises that scientists tend to be somewhat narrow at times, in the belief that persisting with the 'scientific method' is the only way of attaining the true knowledge. She recognises the potential of being cut-off from sources of data and information outside one's respective disciplines ...

R5: - ... science has professionalised; it's set up boundaries around it and it has tried to make those boundaries impervious; but I think they still get broken down from time to time.

...and ponders

R5: - ... such questions as whether science itself almost becomes a religion in some cases.

Political Scientist R1 deliberately makes connections to other domains by reading widely to see if this will open up a new avenue of investigation.

R1: - Well in terms of my general reading I'm fairly athletic and I read *the New Scientist* on a weekly basis and that takes me -- I received a questionnaire from them some time ago asking "how long does it take you to read it" and I had to say -- three hours. A hell of a long time to spend with one journal. I do that religiously and I cut them up and have created very thick files which cover the whole area of science. The kind

Chapter 4 - How do researchers create knowledge?

of thing that catches my eye is all the book reviews that go on in there; and there's some of the best ones. *New Scientist* reports many things which involve government. It's a great vehicle for learning about government, and yet I don't think people in Political Science bother reading it.

And he does this with some authority and theoretical underpinning:

R1: Scottish philosophers said that you could create an inner seeing eye, that you have more understanding, more wisdom, by studying subjects which are deliberately selected so that they bear no relationship to each other – quite the opposite of what we do today.

The previous issue (Issue 2 – Crossing the boundaries) informs us that the HIMS design will need to accommodate access to specifically selected knowledge domains. Such connections are not ones which have been forged in prior research – they are unlikely and surprising. This implies HIMS must be dynamic in making links to other domains.

From Issue 3 we see that we must also provide the flexibility to move with considerable fluidity among the domains. Our researchers do not restrict themselves to any of the accepted compartments of knowledge, on the contrary they intrepidly roam the universe of knowledge, making their own interconnections to suit their purpose. These links may be based on matters other than disciplinary specific subject or content, for example on location, culture, time period or methodology. Contemplate just how productive and innovative they might be if the scope of their endeavours were not constrained by a lack of power to achieve that which is conceived compared to that which is practical. We consider notions of what is possible and realistic in Issue 5.

Interconnections among, and unconstrained movement between disciplines are important, but without Bacon's 'helps for the understanding' or Vannevar Bush's Memex features – in our terminology, empowering hypertext techniques – many investigations will remain un-doable. The next two issues deal with this matter.

First we look at the techniques our respondents use and then we'll consider what they have to say about the limitations they perceive being placed on their work by inadequate tools, techniques, devices, etc..

Issue 4: Specific techniques used

The two engineers use specialised techniques which they themselves prefer to cast into computer programs:

R6: - I try to avoid using software packages and prefer to write my own as they will better suit the specific problem at hand. I don't sort of feel that I'm using a specific technique. If there's a problem you solve it. HD: - but the technique which you create to solve a given problem – e.g. the "alumina drying and humidification problem", will find its way into the literature. R6: - Oh no, Alcoa is not going to tell anybody. That gives them an advantage. The hard cold world of making alumina is getting very competitive these days.

R2: - ... statistical maths, done with specialised models written in Quickbasic. It's programming that I do ... to crunch the data as I like.

It is important to realise that at times there will be the need to go back to first principles. In both cases above, the researchers felt the need to implement their particular simulations and mathematics in a specially written computer program rather than adapt to the algorithms provided in a software package.

On the other hand, economist R3 would not contemplate writing software, preferring to invest his time in selecting computer packages and in running data through them:

R3: - What I do is run various data files through the econometrics package and get the best fitting models. ... I try and keep up with the, you know, the computer software side of things.

Chapter 4 - How do researchers create knowledge?

All researchers have their well defined method of working, but these are quite specifically constructed to suit the individual and his purpose. Political Scientist R1 took some time in becoming comfortable with the word technique or finding an alternative ...

R1: - I see techniques, I define techniques as rule following behaviour and therefore I don't use them. And I argue against their use in this area ...

...R1 then selects the term paradigm to substitute for the term technique and better represent to him the idea behind the latter term:

R1: - one might call them paradigms. I see a paradigm as something which is sort of an ideal model, like a perpetual motion engine which has a check-list of certain characteristics.

The concept of paradigm with its associated check-list having emerged, R1 then offered his list of 'things' he uses in his work:

- To write persuasively ... is absolutely critical ... have to try and do the same thing with verbal expression;
- Networking, in the sense of keeping up good relationships with some part of the Public Sector;
- Creating and continually improving one's own professional, call it 'image', but it is a 'reality'; and
- Trying as hard as possible to measure up in the discipline through the publication of articles, writing of books, reviewing of books, writing lectures.

It was not only R1 who found the term "technique" troublesome, historian R5 elaborated on this also:

HD: - What specific techniques would you use in your discipline?

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R5: - Although I teach research methods, I think a lot of things I do can't be reduced to technique. No I'm not happy with calling it a technique, but it's the closest I can get to something else ... HD: - Ok, we'll put something else in place of "technique" – a set of questions to ask. R5: - At the most general level, yes. HD: - So, let me try then and rephrase it: what specific sets of questions or question do you ask in your discipline? R5: - Oh dear, you're asking the most difficult questions.

However, there are quite specific things all researchers do and R5 now explains one of the most elementary:

R5: - I spend a lot of time doing bibliography, sorting out cards into some sort of collection of categories so that, so that I can go and find all the material on one topic at once, and read it in a relatively orderly way. Um, yeah I guess a major effort has to be put into ordering my material so it can be read in ways that make sense.

Whilst the other historian R4 did not once express a problem with the term "technique", and offered some very detailed explanation of his technique, or even what he called the *technique of historical analysis*, one can see that it is a 'high level' technique. This implies that doing it cannot necessarily or easily be relegated to an automaton.

R4: - accessing the literature, the data sources, and interrogating these, break the material in them down, into usable material for the reconstruction of the events in some kind of ordered manner that provides explanation.

R4 uses six by four cards which contain:

- Date
- Links to the source (bibliographical details) – like a hypertext link
- Data type (e.g. newspaper article, archive file, letter, etc.)
- Text or paraphrase of content of article, an abstract
- Keywords, a categorisation – like a hypertext pop-up note

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- Biographical data about actors

R4 even has a very specific list of the types of data he seeks out:

R4: - The literature I use can be divided into four main categories:

- Congruent regional or chronological material (at the most pragmatic level);
- Explanations of similar patterns either anthropological or political in focus;
- Conceptualisation of what is meant by political change or social change (theoretical-conceptual level);
- Historiographical literature – methodological stuff about history.

From such literature I derive the primary and secondary data for my research.

Primary data:

- acts of parliament (British, Indian, local legislature);
- bureaucratic documents (proceedings of government files, minutes, record of meetings, operational memos);
- private documents (letters, correspondence, diaries, journals, papers – e.g. Governor Haley's papers);
- oral material (actors' and witnesses' interviews);
- newspaper articles;
- media, video, etc..

Secondary data:

- books (historical, contemporary, novels, poetry, religion, values, attitudes).

Obviously the above items make sense when presented as a list, but they do not convey exactly and completely what R4 does – this can only be given in general terms:

R4: - The research I do comprises a number of stages which are in symbiotic relationship with one another – one keeps going backwards and forwards. Broadly they comprise:

1. From reading or from experience or some observation (immersion in the data or experience) begin to conceptualise a problem, an area, a set of interesting concerns; and ...
2. Begin to shape a field of study within which to move ... setting up a kind of field, almost like a hypothesis;
3. Go back further into the literature and see what there is, refining that problem, setting up some operational questions that you're going to have to answer, and that leads you to where you should look for materials;
4. Collection of materials, simultaneously interrogating, assessing, and evaluating. Immerse oneself in the material; 'listen' to the document, pick up issues/questions not uncovered before – possibly leading to other sources (back to stage 3);
5. Begin to write two sorts of things: both re-writing the specifications of the field itself and the problem; and writing about particular things that you're in possession of;
6. Write and publish the thesis, book, monograph, conference paper, article, lecture or discuss findings with others.

I see it as a totally interactive process all the time – between ideas from your own reading, your own experience, your own observation, to collection of material and the interrogation of that material to redefinition of that and the product of, or the outcomes of, your work.

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One does get the impression that these researchers want to preserve their work methods as eclectic, and simultaneously, specialised – is that what makes them scientists or keeps them scientists? It appears that R4 has very carefully laid out a plan for doing research (historical analysis in particular). Perhaps the difficulty in adequately representing the complete method is that it does not lend itself to being expressed in a linear form. R4 used the term “symbiotic relationship” to express both the distinctness of stages and their tight non-linear coupling. R5 refers to “reading in ways that make sense” and the engineers ‘protect’ their most valuable ideas within self-written computer gobbledygook.

A hypertext paradigm might well suit a rendering of such ‘methods’, simultaneously making them both accessible and protecting them. This is what will be attempted in the development of HIMS.

A technique often mentioned in the creativity literature is that of juxtaposing, and has been deliberately used by the respondents.

R5: - Right, one that I found recently was “*Political Economy and Social Science*” it was called. I was very interested because I think that words have different meanings at different times. And to putting all those words together showed he was going to discuss what those different things meant to the people involved. HD: - Is that how it turned out? R5: - Yes, yes. It’s an article I wish I’d written myself. Half of what I wanted to do was already done. HD: - Really, so the thing that caught your eye there was not one or two terms it was ... R5: - It was the juxtaposition of the terms, that are not often put together.

Part of R4’s game plan when working with his 6 X 4 cards is to pluck out items of interest and bring them back together again, indexing them chronologically, so that they may be seen in the context of the problem or event which is to be explained. He then looks for any explanatory idea.

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R4: - the individual entities, the cards, won't tell you, but a group of them will. HD : - we might call this technique 'juxtaposing'. R4: - historians would call it historical analysis.

In his 'fishing' mode Political Scientist R1 deliberately studies subjects which have no relationship. This can be seen as a bringing together, a juxtaposing of disparate material in the expectation that so positioning it will bear fruit.

An event not to be overlooked, and one which probably occurs more often than we realise (as we slavishly pursue the exact linear plan in our attempts at avoiding the tempting asides which we see as hindering goal attainment) is what could be termed a fortuitous or serendipitous discovery.

HD: - How was this found? R5: - I probably found it in a footnote to something else.

R5: - Um, well I was in the process of looking for one thing and came across something on the validity of numerical data in history and I took a copy of it ... it seemed to be about a topic that I was interested in so I just noticed it as I was looking for something else.

R1: - Yes, I even have books on the role of chance and serendipity in science, you know I think it's a great subject because the way in fact that scientists do discover things is really not this rational straight line process of reasoning at all, not in the main.

Since making these 'fortuitous associations' is so important, we need a way of tracking the link-sources and link-targets. Once a fortuitous or serendipitous discovery has been made, HIMS must preserve the context for future revisit and continuation of the work. Actually this is almost standard hypertext functionality (- of good hypertexts that is).

Closely associated with technique and method is the concept of efficiency. If the technique is inefficient the work stalls or is done incompletely and incorrectly. Historian R4 is keenly aware of the efficiency issue: ...

R4: - I mean every time you go back to the document, or had to go back to it, you are using a lot of time, so in a sense the economy of the effort is to do it as well as you can the first time round, and have it there and know that you can in fact retrieve the information from it.

... and structural Engineer R2 has developed an innovative multi-purpose strategy to help increase his efficiency:

R2: -It's more the mechanics of doing all of these things, and the efficiency thing that are my limitations. And as I said I'm at the stage where I'm happy to evolve or develop systems like this that are moderately efficient that enable me to stay on top of my work. HD: - The manual process you've just described sounds to me efficient. R2: - Oh sure, see this works really well because I catch a bus. Now I catch a bus to work not because it's quicker, cheaper, or anything like that but because I want to get reading done. See, once I hit this desk I don't do much reading. If I'm on a bus I can't do anything except read and since I've been catching a bus, which is about a year, I've been able to get through all my reading, whereas before it used to pile up and then I'd say "Oh look I can't read all that stuff, junk it. If we took the bus away, I wouldn't be reading it. I'd have difficulty reading it.

It is evident that empowerment does not necessarily imply use of computer-based tools. A bus could be a good 'tool' too. In fact, one gets the definite idea that there is much more than tools and techniques involved; perhaps R1 was right in substituting paradigm for technique.

A 'device' augmenting the intellect of knowledge-workers cannot just be a tool, or implement specific techniques. It will have to be more akin to a guidance system which shows possible paths to follow, and assists in making, exploring, annotating, and managing new associations. The knowledge-work needs facilitation, support, and leveraging. And if the degree of leverage is large enough, the previously un-doable now falls within the realm of the possible.

Issue 5: *Doability of tasks*

Many researchers have more ideas to follow and things to do than time (with their current level of empowerment) permits.

R3: - There's a large range of sub-areas that people research in. HD: - Would economists, or labour economists, typically choose one of these and work it as part of their profession? R3: - Oh well, yes except like me, probably they'd try and spread across two or three, but you certainly couldn't try and cover them all because the literature would be voluminous.

R2: - I am at the stage where I am contracting my interests because I have got too many irons in the fire, it's a burnout avoidance program I'm undertaking.

However it is not simply an efficiency issue. Doing it 'more' in a given time is not necessarily doing it better. And then there is the issue of what one can now see as doable in the newly empowered state (for example working from the hypertext orientation) which was not seen at all previously (say, with a linear orientation). R5 gives an example in which her empowered (by a deep understanding of mathematics) state admits not only conceiving of a method but actually applying it to a problem, whereas an un-empowered researcher might not even think about the possibility of doing it – just how un-doable can a task be?

R5: - I'm recalculating census data, really it only uses arithmetic, but it does such large recalculations that I suspect that someone who hadn't

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done more mathematics wouldn't have thought of trying it. HD: - Oh I see, so you need to have had an in-depth view of mathematics to take this on, or to think about the possibility of doing it. R5: - Yes, to think about the possibility of doing it.

A deep and comprehensive understanding of a field is itself empowering. All respondents have talked about how important reading is to them; accessing knowledge repositories for a given purpose. But the reading is not just an 'eyeball passing over words activity', there are ways of reading:

HD: - You mentioned the ways of reading. Can you tell me about that.

R5: - In reading what other historians have written, it's a way of reading that can identify differences in viewpoint between one historian and another historian.

This can be seen as a juxtaposing of historians' alternate viewpoints, forming images in the mind in ways previously unsupported, or not possible due to limitations in human brain function.

HD: - So, has this 'ways of reading' and 'identifying viewpoints', more to do with learning to be totally open and unbiased ... to picking up threads through which you would then gain further interpretation? R5: - Yes, yes or at least identify other people's biases anyhow, even if you actually remained biased yourself. And in some sense that's not peculiar to history, that would come through certainly all the social sciences. I really do find these questions very difficult to answer satisfactorily, even for myself.

In the absence of an example of what is possible in a hypertext paradigm, the present author also finds difficulty in satisfactorily explaining these emerging themes, but when we come to the Field_2 data, where HIMS is actually implemented, a clearer understanding will result – the respondents will actually be working in a hypertext paradigm and will be able to relate their experiences and thoughts in an additional context and possibly without the burden of a logico-deductive paradigm.

So as not to lose sight of the significance of the doability issue let us just listen to R5 once more:

R5: - Half of the things in my bibliography I don't even get to look for in the Library. I just write so many more references than I've ever had a chance of following up. The problem then is keeping them somewhere where I'm going to find them again – not only the references, but the photocopies or the notes that I've taken. All those things have to be filed in ways that make them accessible and there's also the distinction between the primary and the secondary sources that I've got. Hundreds of pages of photocopying from old census volumes, and they have to be filed in some way related to the articles about ...

The obvious inadequacy of existing methods and devices to deal with the volume of references, notes and photocopies which R5 has made can be rectified by a support system of the type of HIMS. In a hypertext environment, R5's "references" become hypertext links which when followed, lead directly to the body of knowledge they represent. R5 is thus freed from the burden of actually following the trail to the Library implied in the "reference" and may concentrate on making sense of and seeking new understandings about the data pointed to by the reference.

Issue 6: Creating a richly connected repository of ideas for future research

There appears to be a concern by researchers that the work they are doing is not only useful for a present project but that it will have a bearing on some 'larger questions' in the future. They see their work as a building up of interconnected knowledge, and seek to preserve any connections which may be useful in the future.

R1: - I've got very thick files at home which cover the whole area of science and that kind of thing.

R5: - I spent a lot of time doing bibliography, sorting out cards into some sort of collection of categories so that, so that I can go and find all the

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material on one topic at once, and read it in a relatively orderly way. I guess a major effort has to be put into ordering material so it can be read in ways that make sense. ... I suppose in many ways the sorts of empirical studies I do in the history of science reflect on sociology, anthropology, philosophy and when I get old and reflective I might write about them. They're the larger questions to which this work is relevant.

This investment in the 'larger questions' or on possible future projects detracts from work-in-progress. The researcher is torn between progressing the current research and not losing track of a seemingly important connection for future research. Even when all that could reasonably be done has been done, there is a recognition that it may not be adequate for those future purposes:

R4: - There is one whole card file of material on that city. So for one reason or another I've been extracting a lot of material, but I haven't recorded that in exactly the way I would have done had I had the note-taking for the history of politics in Lucknow as a prime purpose of that. So I mean there are situations where you'll wish you had a bit more on that, but at the time it wasn't particularly important to go beyond where you went.

And a solution to this seems ...

R4: - ... very hard unless you simply took down every single thing verbatim out of every record.

Of course with paper-based materials it is impracticable to collect everything possibly needed into one physical place but if one considers the linking together of electronic computer files into an archive a solution is much more achievable. The World Wide Web on the Internet is an early example of just such a global repository of knowledge. But even when one has access to the data sources needed ...

R4: - ... then of course you'd still have the analysis of the documents to do. It's that breaking down into these units, that is in fact the first crucial step in the whole of what I dare call historical analysis.

This breaking down is itself such a large problem that R4 cannot contemplate any distraction from his current research, despite acknowledging now that there are future possibilities.

The emerging design for HIMS tackles these issues: Firstly it 'connects' to electronic knowledge repositories from around the globe, implying that the entire data, rather than notes taken from it, can be on hand. And most importantly, HIMS will permit the weaving of a web of trails among the source data and the researchers' own notes. This network of associations, consisting of hypertext links and this authors' emerging ideas based on the source data and their own thinking, comprises the *HIMSConcept*.

Issue 7: The 'loftiness' of science and the role of techniques

R1: - I define techniques as rule following behaviour and therefore I don't use them.

This is perhaps a rather peremptory statement, but it admits a notion shared by others:

R5: - Well we can say, over the last 100 years science has come to be perceived as some uniquely true way of knowing the world in contrast with other ways of understanding which are illogical or in some way inferior to science. ... Science has professionalised; it's set up boundaries around it and it has tried to make those boundaries impervious, but I think they still get broken down from time to time.

The aloofness of the theoreticians, from whom all (important) knowledge is supposed to flow, does an injustice to the vitality of the connection between theory and praxis. When R1 was implored to find an alternative to the term "techniques" he came up with "paradigm":

HD: - I've used the word technique when you sort of said you don't use it, or you don't use techniques. I'm trying to find a word that you are more

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comfortable with that does still get at that. R1: - I can see what you mean by that check-list thing because it reminds me of ... But yes, one might call them paradigms.

This 'loftiness of science' issue is very important here because HIMS will be a 'technique', a 'way of doing things', although we envisage it will be very flexible, adaptable and general and not (too) prescriptive. Prospective users who see it as a 'mere technique' may not bother to invest any time in exploring its empowering features and may prefer, as the engineers did, to write their own programs. The difference here of course is that, in the main, the techniques, and thinking underpinning them, are not common knowledge to the degree that say statistics or simulation are. The consequence of HIMS being dismissed for such reasons would be indeed unfortunate. The HIMS design must take account of the whims of users in addition to empowering its user and augmenting the intellect. See it this way: if we aren't prepared to countenance the whimsical and fanciful we have diminished our chances of accessing the engine of *Generative Conceptualisation*.

Issue 8: Ways of reading, ways of accessing knowledge repositories

R1 provides a good example of accessing a wide range of material:

R1: - There is a huge background of reading, whether it is Shakespearian plays, English literature... I buy a vast amount of books, and seldom read them from cover to cover. I read about what's going on in other states, other parts of the world, at other points in history. For example, let me show you what I picked out which is not from my area at all. Here (pointing to piles of print based material), that's Sociology, that's Political Science, that's Education. I pick things out of them for my purposes ... and the purpose is to create a list of questions with which I will 'prod' (the subjects of my investigations).

While Political Scientist R1 seems to be comfortable with his strategy and the results it brings, Chemical Engineer R6 offers an example of frustration and near failure. He was working on a problem concerning the drying and humidification of Alumina. It dealt with core sizes of two nanometres and particle sizes of about a hundred microns (this is very, very small):

I hunted through the literature and found nothing in our library and went out to UWA and found even less in their library and went out to Murdoch and found nothing in their library and contacted the State Reference Library and they told me they had nothing. At this stage I was going to ring up the problem owner and say "you've got a problem mate". Then I eventually managed to dig something up – one line in one of the books from our library that said that for sizes smaller than this you need to look at the kinetic theory of gases ... which is something that you learn way back in first year and very quickly forget because it's incredibly complicated and awfully theoretical and you generally have the impression that it doesn't work in real life. I then went back and started searching the libraries again for the kinetic theory of gases, and, eventually found a statistical equation that could be modified, with suitable messing around, to apply to that situation. I then began writing a simulation program in Basic. It grew bigger and bigger and bigger and nearly drove me around the bend trying to follow the logic of it all the time. But, I think it now is nearly finished and works. HD: - Was that enjoyable? R6: -. What was not enjoyable was that chasing through libraries, I can't stand that, that's frustrating, but writing the program was enjoyable.

R6 could have saved time, effort and the frustration if he'd had an electronic knowledge base to search. But the access we are dealing with here goes beyond mere physical access to the actual knowledge; we need to provide something akin to R5's 'ways of reading'. R6 needed support to make connections and suggestions for further exploration. As he did not give up, he eventually found (perhaps one should say re-found, for he says he had learned about it in first year) a fruitful link to the kinetic theory of gases. This link acts as meta-knowledge (knowledge about knowledge) up to the point where he discovers it. Subsequently he uses it as knowledge in solving the problem.

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The issue of R6's library search is interesting. It can be frustrating, especially when the end result is not achieved. But use of electronic knowledge systems can be equally frustrating. Problems which must be guarded against in HIMS include: long search wait times due to database size; limited databases not cross-referenced; items missed by the search; text orientation of search excluding audio-visual material. Of course, these difficulties can be negotiated even without hypertext, but it is claimed here that a hypertext environment provides a superior way to access knowledge repositories.

Hypertexts formalise the notion of meta-knowledge in that the links or trails, the associations between chunks of knowledge are explicitly represented. HIMS will bring its users this advantage and so support the sort of work R6 was doing in this example (always assuming that the knowledge is electronically available).

More and more knowledge is becoming accessible electronically, and as this trend continues we are experiencing a deluge of material which may contain just a modicum of possibly relevant information. Whether the medium is print or computer files the problem remains – how does the researcher select out the gem from the rubble? Existing techniques are sometimes quite innovative:

R2: - There are other journals that I scan primarily for information. I would read about one tenth of what I scan. And I can do this on the bus. Now, I catch a bus to work not because it's quicker, cheaper, or anything like that but because I want to get reading done. So that if I'm on a bus I can't do anything except read. Since I've been catching a bus, I've been able to get through all my reading, whereas before it used to pile up and then I'd say "Oh look I can't read all that stuff, junk it".

A variety of solutions are appropriate, depending on circumstance and resources available.

R2: - ...And it's a question of going up to the library and sitting down with "Wood Science Technology" and going through the index and then skimming that and then scanning the papers and then looking up

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another journal and I just don't get around to that, the library isn't on the bus.

Frequently, as in R2's last sentence above, one finds an admission of the impossibility of it all:

R6: - Well what I do read is very little, mainly because I just don't seem to have time to sit around reading this stuff. HD: - Do you seem to spend a lot of time wading through stuff that doesn't seem that relevant. I mean all of the material in these journals couldn't be relevant. R6: - Oh no, only at the most one article per journal would be relevant, most of the rest of the journal is boring.

HD: - Journal of Economic Literature, that sounds interesting. R3: - That's amazing. That comes out every quarter and that's got a summary of all the articles that've been published in economics journals in the previous quarter, so it's a sort of bible where you start. HD: - Well that'd be a candidate to create electronically. R3: - Well yeah, this is actually one of those that's on Dialog. But the amount of material is just voluminous.

R3 is finding that even the paper based indexes to the actual articles in the field of Economics is somewhat overwhelming, and R2 gives an impelling case for providing information in a medium which can be more readily brought up-to-date:

R2: - Civil engineers work to codes, which are a whole sequence of design rules, and they're 'live' documents. They have to be changing all of the time as new materials and new analysing techniques are invented and come on stream. HD: -Would there be a crosslink between these various books of codes? R2: - Yes. HD: - Is it so bad that you're constantly ducking from one to the other? R2: - Yes, in fact the SAA has produced compendia of these codes, where the concrete structures code, the steel structures code, the timber structures code, the loading code, the wind code, are all in the one document to save us going backwards and forwards, but that's a failure because you spend a

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fortune on this document and it's got a steel code that's right up to the minute say, but the concrete code has been superseded.

Any future techniques should not attempt to replace ones which work satisfactorily but rather complement them. In this sense HIMS must be an optional extra, as it were, and must possess a versatility permitting adaptation of pre-existing techniques.

A particularly illuminating approach used by R5 relates to the paradigm or mind-set within which she consciously works as she applies her techniques:

R5: - It's ways of reading, in the techniques I use bibliographic searches. Is it a mind-set? I think it's a set of questions. A set of questions and a set of possible relationships to look for.

Political scientist R1 also deliberately varies the reading space within which he works:

R1: - I usually get the feeling that very few read very much outside of their direct field. I mean it's like all of our specialisms really, there's a tremendous tendency to narrow the focus down and I see little signs that that's an incorrect view. So if researchers are reading widely it does not show up in their writing, they're not connecting their wide reading with their narrow publishing. Yes, I even have books on the role of chance and serendipity in science, you know I think it's a great subject because the way in fact that scientists do discover things is really not this rational straight line process of reasoning at all, not in the main. The one's who win the Nobel Prizes as the Professor of Astronomy Fred Hoyle once said "The best ideas come when I'm fishing". You know, and I have the same feeling about the Nobel Prize breakthroughs. In my case I hope reading widely, and much of it while it looks like chance it is in fact the prepared mind seeing something that the unprepared mind can't. And that's why I think scientists can argue that there is no such thing as chance. It looks like chance and if it happened to ordinary people it would be chance, but because their mind is prepared by years of cogitating about a given area and then they go off and do something else and hence we get

back to that triangulation of knowledge. They can do it because a) they've studied deeply in one area, b) they've gone 'fishing' because presumably they like it and they may even know something about 'fishing' and there's some third variable here.

How HIMS is to be used (for example to support pre-existing specialised techniques such as R5's 'ways of reading') and on what bodies of knowledge, are just as important to the empowerment issue as is its functionality. Probably the most important characteristic HIMS requires, is flexibility and adaptability to help its users to conduct what we may term a 'Fred Hoyle fishing trip'.

Issue 9: Changing viewpoints (over time) created from the same data sources (multiply-useful data)

R5: - I teach a course in the history of social sciences and there's been a lot of debate about the failure of sociology in England in the 19th century ... a recent article says all that has been asked has assumed that success was to have sophisticated theories and a university environment. But in fact in 19th century Britain they were trying to achieve some sort of political reform. They ran annual conferences with 2,000 people at them and made representations to government and had an impact. So, what's happened is we've used our current conceptions of success (namely being a university and having sophisticated theory) to measure what they were doing. The historian's assumptions about what it is to succeed as a sociologist has affected their analysis. There are all sorts of other ways in which viewpoints affect analysis, I think most history is anti Catholic. And the Catholics always get a bad time. They're regarded as the reactionary forces and the Protestants aren't quite as bad, but the closer you get to the present the more any sort of religion is regarded as unsatisfactory.

R4: - ... one of the reasons they weren't interested before the 1860's was that pearls produced a lot of revenue. They controlled the pearl fisheries ... therefore this was what they saw as fisheries. They read fisheries as pearls, or pearls as fisheries. This other fishing didn't seem to them to be important and so they ignored it until people pointed out to them there

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might even be some revenue in there. Then they became interested. So my discussion of the history of fisheries now goes back to the 1780's when they first became involved in the areas where pearls are, and so the whole story has to now take account of their policy towards pearls. So that it's a refinement in that way. That's why I say you'll go back to re-organise the field, redefine the field. You may have to drop things off because they're dead ends as well. But it's that interaction between the collection of the material and the setting up of the thesis if you like, the hypotheses that you're working on – that goes on all the time, but at some point there is then a process of retrieving from the assembled material, stuff that's valuable in answering particular sets of questions that one has, and maybe in that process, having to redefine those questions because you haven't got the right question. I see it as a totally interactive process all the time between ideas from your own reading, your own experience, your own observation, to collection of material and the interrogation of that material to redefinition of that and the outcomes of your work.

In both examples above one sees how the same data can provide varying outcomes. In R5's case she is looking at the effect which the varying sets of assumptions, the accepted knowledge of the time if you will, affects what the facts are indicating. R4 discovered that his starting date of 1860 was not early enough to admit a proper explanation of the pearl fisheries policies of Indian legislatures and extended his scope by almost a century back to the 1780's. These realisations were not apparent upon first analysis of the data. Presumably the author of the paper R5 refers to could still be unaware of the trap which circumstance set for him. R4, being a very experienced researcher, was alert to the possibility of varying explanations being apparently supported by the source data, and amended his research plan so as to offer a more complete account and explanation in his historical analysis.

A 'device' which permitted viewing source data once this way and then another way may assist researchers in emulating the techniques of R5 and R6. The particular views may be likened to the use of alternate spectacles; the 'rose-coloured' ones putting everything in the 'best light', whereas the 'green' would

highlight all things Catholic and the 'orange' would make prominent Protestant values and assumptions.

Perhaps another example will help make clearer what we are dealing with here.

R5: - An article I found recently was called "*Political Economy and Social Science*", and something about sociology in the 19th century. I was very interested because **I think that words have different meanings at different times**. And to put all those words together showed the author was going to discuss what those different things meant to the people involved. HD: - Is that how it turned out? R5: - Yes, yes. It's an article I wish I'd written myself. Half of what I wanted to do was already done.

Word meanings and viewpoints change over time. The hypertextual 'device' to be called HIMS, and being proposed as augmenting the intellect will help with the interpretation and meaning. Imagine an explanatory note being instantly available to alert the reader of an article to a particular shade of meaning, the one current for the period of interest. Later one could go back and make a subsequent pass of the data with another set of meanings switched in, those corresponding to another time period or set of assumptions. These are the 'views' or cross-sectional cuts which the variously coloured glasses would provide. Perhaps this technique will assist with the 'ways of reading' issue with which we ended the previous section.

Supporting Generative Conceptualisation

The type of thinking involved in creating new knowledge by our sample of researchers is perhaps representative of *Generative Conceptualisation*. The foregoing analysis of the Field_1 data has yielded nine issues, each of which inform the design of a hypertextual cognitive support system.

The next chapter reports on what hypertextual cognitive support system emerged from the above design issues and gives an example of how it can be

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used. To discover how HIMS was *actually* used and whether it really does support *Generative Conceptualisation* and the creation of new knowledge, the reader must wait for [Chapter 6 – Empowerment through a hypertext environment](#).

Chapter 5 - Associative thinking and the hypertext paradigm

To support free associative thinking as opposed to the hierarchical and logico-deductive (logical, procedural) thinking that is promoted by prior technologies (e.g. database) and the majority of the world's schooling systems, it is helpful, perhaps even necessary to work in a hypertext paradigm. For this purpose HIMS (the Hypertext Information Management System), and its precursors have been built.

HIMS developed out of this author's²³ desire to have an extended support system for original cognitive activity. He observed, that relative to what was possible with low priced personal computers and appropriate techniques, his brain could not compete in terms of memory capacity, memory searching and retrieval of (hierarchically) organised or web-structured knowledge (networks or webs of knowledge associatively connected with 'trails of thought'), speed and accuracy of doing repetitive work on these knowledge structures, making and remembering links between chunks of knowledge, or even consistency of doing a pre-defined act or process such as selecting out the chunks of knowledge dealing with a well-defined and specific matter. The usual form of technology one observes in the field and which supports much of this intellectual activity includes: Post-It Notes by 3M; traditional bookmarks; fluorescent highlighting of important text; marginal notes; dog-eared pages, photocopies; and laborious transcriptions.

When the cognitive activity is associative in nature, when the result being sought is less well defined, when exploration and discovery are the aim, then the

²³ Here the author quotes and reports on his own experience. Readability considerations dictate that references to him be in the impersonal or plural. It seems a little odd, as a researcher deeply involved in this enterprise, to be forced by convention not to refer to one's own experience using singular or personal constructs, but accepted practice requires otherwise despite the gradual but very definite emergence of other reporting forms, as found, for example, in naturalistic research studies. Actually, many elements of the present work are naturalistic in that the author is immersed in the research both as researcher and subject.

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personal computer is far less supportive. The human mind “operates by association” (Bush 1945 p106) and if support or help is to be provided then it must not force a change in the mode of thinking, but rather enable it. Hypertext technology permits and supports such associative thinking. Its user may make or follow links from any one chunk or node of knowledge to any other and is not constrained by “the artificiality of systems of indexing” (Bush 1945 p106):

“With one item in its grasp (the human mind), it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain. It has other characteristics, of course, trails that are not followed are prone to fade, items are not fully permanent, memory is transitory. Yet the speed of action, the intricacy of the trails, the detail of mental pictures, is awe-inspiring beyond all else in nature.” (Bush 1945 p106).

As this author was working with large bodies of (textual) knowledge during his research and development of hypertext applications, he became aware that “His excursions may be more enjoyable if he can reacquire the privilege of forgetting the manifold things he does not need to have immediately at hand, with some assurance that he can find them again if they prove important” (Bush 1945 p108). Through this experience in using and creating hypertexts the feasibility of creating a cognitive support system became clearer. “The creative aspect of thinking is concerned only with the selection of the data to be employed, and the manipulation thereafter is repetitive in nature and hence a fit matter to be relegated to the machines” (Bush 1945 p104). The ‘machine’ which this author created in response to this need, emerged in the early part of the current decade as various software systems. By 1994 the design elements based on the author’s own thinking and the research reported in [Chapter 4 – How do researchers create knowledge?](#) had been distilled into a software package built with hypertext technology. It is itself an environment in which all of the empowering features of a hypertext system – link making and following, dynamic search lists, information management support, remembering the “manifold things

he does not need to have immediately at hand" (Bush 1945 p108) are all instantly available at the touch of a key or a mouse-click or two.



HIMS had emerged in prototype form and was ready for testing against other researchers' work practices.

Emergence of Hypertext Information Management System (HIMS)

Whilst researching applications of hypertext technology during the late 1980's this author accessed the vast streams of text being delivered by on-line data bases, CD-ROMS, Internet NewsGroups, and all manner of similar knowledge repositories. Of course, having acquired a selection of such material the problem is one of what to do with these large quantities of data, and then of how to do it. As a glimpse of what is to come one may reveal at this point the answer to the 'what-and-how' question lies, at least in part, in shedding one's procedural, linear orientation, and permitting the mind to roam unfettered through the galaxies of 'interstellar dust' in the hope of discovering a 'star', rather than to create a 'chart' and then follow its prescribed route. 'Immersion' in the huge data repositories now within our grasp most definitely requires help from the technologies man has created – and one's yet to emerge. Perhaps a new paradigm for thinking is soon to emerge.

Internet NewsGroups

Restricting ourselves to the Internet NewsGroups for the purposes of providing an example of the methods this author used in making sense of vast streams of textual knowledge, we'll choose one of the groups, of which there are approximately two thousand, for detailed examination. These on-line discussion

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groups exist for most, if not all, knowledge domains. Some are very active, others exhibit but little activity, reflecting the degree of world-wide interest in the various topics and knowledge domains. Figure 22 shows a list of the NewsGroups this author monitored during 1993:

alt.hypertext	<i>hypertext</i>
comp.cog-eng	<i>computers, cognitive engineering</i>
comp.groupware	" , <i>groupware and CSCW</i>
comp.human-factors	" , <i>human computer interface</i>
comp.lang.smalltalk	" , <i>languages, Smalltalk</i>
comp.mail.multimedia	" , <i>multimedia</i>
comp.text.sgml	" , <i>text markup with SGML</i>
curtin library	<i>Curtin University library</i>
wa.multimedia	<i>multimedia in Western Australia</i>
sci.eng.chem	<i>science, chemical engineering</i>
sci.eng	" , <i>engineering</i>
sci.philosophy.tech	" , <i>philosophy, technology</i>
sci.econ	" , <i>economics</i>
sci.bio	" , <i>biology</i>
aus.politics	<i>Australian politics</i>
soc.culture.india	<i>society, culture, India</i>

Figure 22: Internet NewsGroups monitored during 1993

In these NewsGroups we find 'streams of consciousness', or ideas and viewpoints of authors, thinkers, researchers, and students, from across the globe. Each contribution, essentially an e-mail sent to the NewsGroup in the form of a public letter (and known as a "posting"), may be accessed by anyone connected to the Internet. Below is an example of a posting. It is reproduced in part (approximately the first 30% of it) so that that reader may judge the type of matter being dealt with. Observe also that the 'header' or 'envelope' is lengthy and complex, potentially detracting from the actual content of the posting.

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```

X-NEWS: vax7 comp.groupware: 1293

Path:cujo!uniwa!munnari.oz.au!mips!mips!sdd.hp.com!wupost!uunet!news.claremont.edu!uc
ivax!gateway

From: kling@ics.uci.edu (Rob Kling)
Subject: Article - Behind the Terminal
Message-ID: <9208131722.aa25629@q2.ics.uci.edu>
Newsgroups: comp.groupware
Lines: 81
Date: 14 Aug 92 00:22:06 GMT

This is the abstract of an article which you might find of interest. It examines the
social dimensions of implementing information systems and office systems with ideas
that are pertinent to groupware. But it does not specialize in groupware issues.
Consequently, I'm not posting the full article on comp.groupware. I have posted the
full article on comp.society and comp.infosystems. I will soon be giving some
seminars on the web models which are partially explained in this paper. Consequently,
I'd appreciate any feedback. If there is interest, I'll post an earlier, companion
paper, "Defining the Boundaries of Computing Across Complex Organizations" in
Critical Issues in Information Systems Research. Richard Boland and Rudolf
Hirschheim (eds.) John Wiley and Sons, 1987.

Best wishes, Rob Kling

=====

                Behind the Terminal:

                The Critical Role of Computing Infrastructure
                In Effective Information Systems' Development and Use

                Rob Kling

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                Public Policy Research Organization
                University of California
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                714-856-5955
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                Draft 4.02

                July 17, 1991 (Aug 4, 1991)

                To appear in: Challenges and Strategies for Research in Systems Development. William
                Cotterman and James Senn (Ed.). John Wiley, London.

                ABSTRACT

                Contemporary approaches to systems analysis ignore the importance of computing
                infrastructure -- the kinds of resources necessary for making computerized system
                workable and effective. Infrastructure includes "hard resources" such as electricity
                and physical space; it also includes human resources such as the skill levels of
                systems users and maintainer. Systems analyses which account for infrastructure can
                help lead to more effective recommendations. ...

```

Figure 23: Example Internet NewsGroup posting

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Often the material is repeated, in full or in part, to assist subsequent readers establish the context of the viewpoint being presented. The above example posting by Rob Kling entitled "*Article - Behind the Terminal*" generated a flurry of interest within the space of one day. There were four related postings (which were easily findable):

```
Article - Behind the Terminal [eggert@twinsun.com (Paul Eggert)]
Re:Article - Behind the Terminal [kling@ics.uci.edu (Rob Kling) back to Paul]
Re:Article - Behind the Terminal [kling@ics.uci.edu (Rob Kling) back to Paul]
Re:Article - Behind the Terminal [eggert@twinsun.com (Paul Eggert)]
Re:Article - Behind the Terminal [mcgregor@netcom.com (Scott L. McGregor)]
```

In related postings the reproduced part of the initiating article's text is usually marked with a leading ">" character. It is physically juxtaposed (as opposed to logically or virtually juxtaposed via a hypertext link) with the new material, and obviates the need to trace the content – to establish the context – elsewhere. This increases the volume of material overall and makes the data sifting, selecting, and attenuating task even more onerous.

```
kling@ics.uci.edu (Rob Kling) writes:
>Contemporary approaches to systems analysis ignore the importance
>of computing infrastructure -- the kinds of resources necessary
>for making computerized system workable and effective.
That's utter nonsense, of course. System analysts spend much of their
time worrying about computing resources and infrastructure. I spent
some time reading Kling's article, and I think I know where he went astray.
```

When setting out to discover new information of relevance to one's topic of interest, the repetition could of course be filtered out – but according to what criteria? If the richness (the complete data) can be maintained and yet only that which is relevant be brought into 'focus' then the insight or new idea being pursued may well have a better chance of emerging.

Sometimes repetition is in itself an important item of information. For example, the flurry of activity regarding the above posting surely tells us that there is some degree of interest in the matter.

Massaging vast amounts of textual knowledge

Over many months, as this author monitored a selection of NewsGroups, the data began mounting into virtually unmanageable quantities. After six months there was some 50 megabytes of data. One is able to very quickly conclude that some sort of structure needed to be placed upon these 'streams of text' and that normal methods of dealing with such data were inadequate. Support is needed for this information management aspect of the work, and is a fundamental component in the HIMS design.

Existing NewsGroup reading software available to this author was helpful only in that it permitted reading, replying to, and storing the items, whereas much more sophisticated processing was desired. Experience with outlining techniques as implemented in Microsoft's Word (and present since numerous versions and for many years) proved useful with large files of text (say 2, 3 or even 4 megabytes) on previous occasions and would be the starting point of an attempt at reducing the burden of making sense of such large masses of text.

The postings were structured into a hierarchy (outline) with the use of macros within the word processing environment so that more than one item was readily available for viewing, and possible printing in whole or in part. All the other useful editing and manipulation functions were available in a known environment with a familiar user-interface. As knowledge of the material grew, it was possible to decide which parts to retain and which to discard, except, having spent considerable effort to download these postings meant that one definitely wanted to preserve as much of it as possible for future research. Furthermore, considerable effort had gone into the decision to discard an item and it would be a pity not to be able to preserve the knowledge associated with forming the decision to discard (we may call it meta-knowledge, since it is knowledge about

the body of knowledge) too. Thus, whilst some items were not relevant to the current (or particular) field being researched, they may subsequently turn out to be useful. The reasons (meta-knowledge) for discarding items may, in another context be reasons for retaining items. The pressure was on to both reject as many items as possible so as to reduce the overall body of knowledge to something more workable with existing (and one must say, 'linear') information handling strategies, and yet to retain as much as possible for fear of discarding something potentially useful²⁴. This author found himself going repeatedly over the same articles trying to make a definite decision – reject or accept. The strategy adopted was essentially one of scrutinising each article or posting and rejecting it if it was judged not to hold promise. The effect of this arduous task was that one became more familiar with that which was to be rejected than that which was deemed to hold promise with respect to the research matter at hand. True, the goal of attenuation, after many iterations of the above strategy, was achieved in that the resulting body of knowledge was say but 10% of the original size. But the (author's) mind was now so full of the discarded knowledge, and rather weary after the process. This is surely not the best way to deal with the problem of selecting out the 'gems' from a vast 'mine' of (qualitative) data.

An 'experienced' researcher (of positivist persuasion) might at this point exclaim: "but why on earth does this person not do a search!" Yes, of course, but just what does one search for? If one uses the catalogued terms or keywords one will only find those things that have been previously thought out. For example, a repository of knowledge on say, psychology, is likely to yield hits only on established terms, constructs and concepts from that domain, and prove uninteresting from another point of view. An article published in the domain of civil engineering and catalogued as such, will likely not reflect the growing connection with ecology and biology. If one's task is to discover or generate

²⁴ *The point at issue here is that one doesn't necessarily know at any given juncture what will be relevant and what won't; one can form a judgement only about what is relevant (actually – what is currently thought to be relevant!) . Perhaps for those doing 'traditional science' this is symptomatic of an unruly research design, or even a non-design. But there is mounting evidence that not all (useful) research follows the positivist tradition (see the methodology chapter for a discussion of this very issue). In a related sense, the comment by André Delbecq "it is sometimes the unchartered waters one travels upon which yield a far richer experience than following the original plan" [personal communication with the author, December 1983].*

something entirely new, to create knowledge, then such a restrictive strategy cannot succeed.

There is another matter (as is evident from the "SPT Case Study" below); even using traditional techniques such as thoughtful selection of the data (choosing one or a few of the circa 2000 NewsGroups to monitor), and employing complex Boolean search strategies, the potentially useful data is still so immense as to defy proper consideration with traditional data manipulation methods.

The SPT Case Study

An extract from relevant statistics, [Figure 24](#), illustrates the immensity of the data. Assume that a researcher deems that the SPT NewsGroup dealing with "Science, Philosophy, and Technology" may yield useful data for his research on ethics and morality. The accumulated postings, downloaded in 19 weekly chunks from this NewsGroup over a six month period from April to September of 1993 comprised in excess of 4.5 million characters of text. [Figure 24: Weekly downloads of SPT postings](#) shows the actual file sizes. The largest weekly file is very nearly 0.7 million characters in size, this in itself forming a document bigger by far than most users of wordprocessing technology have ever manipulated, indeed dared to manipulate. This data represents some 1500 individual e-mail communications, posted to the SPT NewsGroup over the nearly six month period.

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filename	size	
93P04-08 SPT	153684	<i>These files contain all the new postings made to the SPT NewsGroup since the previous week's download, and in the case of the first week, all postings since the default purge time set by Curtin University Computing Centre.</i>
93P04-16 SPT	13016	
93P04-27 SPT	125118	<i>Filenames are created to provide certain information about the contents. The first two digits give the year (1993 in this case). The "P" indicates that the file has been 'prepared' for use by HIMS. The remaining 5 positions of the 8 position filename is for the month and day numbers in the form MM-DD. The file extension or file type is reserved for the source NewsGroup, in this case SPT meaning Science, Philosophy, Technology</i>
93P05-10 SPT	369262	
93P05-19 SPT	192816	
93P05-27 SPT	273503	
93P06-03 SPT	177926	
93P06-10 SPT	98670	
93P06-17 SPT	153726	
93P06-28 SPT	247961	
93P07-01 SPT	51777	
93P07-15 SPT	369629	
93P07-23 SPT	175136	
93P07-30 SPT	108492	
93P08-06 SPT	375263	
93P08-16 SPT	683786	
93P09-02 SPT	492809	
93P10-12 SPT	24477	
93P10-05 SPT	479927	
19 file(s)	4566978 bytes	

Figure 24: Weekly downloads of SPT postings

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Since "ethics and morality" is the topic of the case-study, the obvious (pre HIMS) strategy is to search for all instances of these key words and look at the results. A search throughout the 19 files (or a concatenation of them) yields 255 hits on "ethic*" and 374 hits on "moral*". The * indicates that any combination of characters may appear after the given characters, thus including in the hit-list, inter alia, instances of "ethical" and "morality". This of course does not inform us of how many articles there are dealing with a given term – it may be that all of the 255 hits on "ethic*" are in the one article. We do not know the number of cases where a combination of the terms exist, or how far the terms of interest are separated by other words, or about possibly related concepts such as chastity, virtue, rectitude, probity, prudence, or about cases where relevant concepts are developed but not using the established key words. We cannot get a 'feel' for the topics being dealt with by each posting, how the key terms are being used, or any relationships that may be evident therefrom. There is a vast amount we may want to know, which quantitative analyses can never yield.

Context analysis programs and frequency analysers do exist, but this software often presents yet another (unfriendly, or at best unfamiliar) user interface, distracting the researcher from the primary goal: that of building some sort of cognitive structure (later we'll see this is actually a web of associative trails in the mind, or a hypertext) out of the relevant material. One should point out that now, in the mid-nineties, software packages are beginning to emerge which deal with concepts rather than words or strings of text and their Boolean combinations. Notable among these is *READWARE* by Ken Ewell (1995) and, for use in qualitative data analysis there is a growing number of packages such as *NUD•IST* (Weitzman & Miles 1995).

Having located what may be of interest, by whatever means, the researcher is now confronted with the task of 'processing' the possibly relevant items: and it is here that there is very little help being provided by current information technology – HIMS, and this author's hypertext techniques as embodied in HIMS, aims to fill this gap.

Discovering Links

Despite having only these traditional methods and ideas as 'helps for the intellect', but with the emergent hypertext techniques already embedded in a word-processor supported methodology, and now armed with what was considered to be useful data, the ethics and morality topics could be progressed by careful study of the retained material.

One discovers, for example, that "ethics" and "aesthetics" are juxtaposed in the mind of Gary H. Merrill (1993). In a discussion on good philosophy books he writes:

"Prentice Hall publishes a (generally) excellent series of short (< 150 pages for the most part) books written by well known philosophers in their areas of expertise. These are good introductions to the jargon and concepts of a variety of "fields" in philosophy. Some of these are:

Metaphysics by Richard Taylor

Theory of Knowledge by Roderick Chisholm

Philosophy of Natural Science by Carl Hempel

Philosophy of Biological Science by David Hull

Philosophy of Logic by W. V. Quine

Ethics by William Frankena

Aesthetics by (I think) Monroe Beardsley"

This juxtaposition is not entirely surprising in retrospect, for a definition of aestheticism is "the acceptance of artistic beauty and taste as a fundamental

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standard, ethical and other standards being secondary"²⁵. The point, however, is that the initial construct or research design did not admit a concept based on the term "aesthetic" as relevant. Research may now proceed in the light of this new and expanded concept. We begin searching anew through all the previously discarded material in case "aesthetic*" or its alternate spelling "esthetic*" appear. As can be imagined this is a laborious task, and one to be repeated for each newly admitted expansion of the original conception of the research problem.

It is rather obvious that if, in the quote above say, the terms ethics and aesthetics were highlighted in some way, that the reader's attention would be more readily attracted, even if they were not directly adjoining. Consider the following from the viewpoint of claiming the reader's attention (Merrill 1993):

Philosophy of Logic by W. V. Quine

Ethics by William Frankena

Aesthetics by (I think) Monroe Beardsley"

Under this or similar scheme, the two terms would be juxtaposed in the reader's mind due to the form rather than the meaning of the words, even if they were not directly adjacent in the original text. As long as the terms are presented to the reader on one screen or page, or perhaps within the space of a few pages being serially accessed, the link is likely to be made in the reader's mind. And this link between ethics and aesthetics could, if it proved to be of use, be considered a discovery – something new and innovative. **Highlighting** is one of the **key features of HIMS** (Figure 25). The highlighted terms are the names of *HIMS* concepts or terms (strings of text) associated with the concept. A mouse-click on such a highlighted terms immediately brings forth the related *HIMS* concept.

²⁵ From *The Macquarie Encyclopedic Dictionary*, Macquarie University, Australia, 1990.

Perform ANY scientific experiment without the use of philosophy.

This is impossible. Without metaphysics, there can be no entities to examine, there can be no scientist to examine and reason, there can be no existence of ANYTHING. Without the law of causality, there can be no action, by the entities being examined nor the scientist. Without epistemology, there can be no scientific method, and even if something were to occur, there would be no objective methodology for interpreting it. Without **ethics**, this "experiment" could consist of the destruction of a continent with no **moral** ramifications. Without an understanding of the mind itself, the scientist would no more recognize the data he should record than his own imagination.

Now someone try to tell me that philosophy is 'impractical.' Philosophy has veto power over science.

Figure 25: Highlighted terms in HIMS

Emerging Concepts

A decision to discard what is thought irrelevant, in an effort to attenuate the vast amount of possibly relevant material confronting the modern researcher, can subsequently prove to be erroneous. As one gains an understanding of the material at hand, one's view of relevance can change. The human mind, as we have seen in the discussion on hypertext, builds webs of associated chunks of knowledge connected by trails which can be followed at will. HIMS does exactly this too, albeit not as elegantly as the human mind. Link making leaves the unwanted text out of view but accessible in the future, and creates a web with that which is relevant. Links can be made from relevant words (or strings of text) to a chunk of knowledge in which the emerging concept is being developed. This is referred to as the *HIMSconcept* in HIMS terminology. Pursuing the example above, the *HIMSconcept* with name "ethics" emerged as :

```
.FRAME ethics
.TITLE ~TgPress 'b' to return to previous frame~Ty
This is my major thrust as at 8/6/94 10:21am
I'm wanting to keep a track of all "ethics" related stuff in the
Sci.Phil.Tech newsgroup.

.FRAME aesthetic
.TITLE ~TgPress 'b' to return to previous frame~Ty
now I seem to be interested in aesthetic and how this term is used in the
discussion of "ethics"
```

Figure 26: The *HIMSconcept* with name "ethics"

*Note: the ".FRAME", ".TITLE", and the one or two character sequences introduced by a "~" are hypertext markups for **HyperShell** (Taylor & Dreher 1991), the hypertext development system in which HIMS is implemented. These markups are very similar to HTML, the "Hypertext Markup Language" used to create WWW hypertexts.*

The chunks of knowledge, frames, or nodes named "ethics" and "aesthetic" are pointed to by a link attached to these terms, and any other nominated variants, in the research data itself. In this way the emerging thoughts are expressed in the researcher's own words in the *HIMSconcept* with name "ethics" containing (at this stage) two frames named "ethics" (also) and "aesthetic". The researchers own words comprise the emerging portrait of the new knowledge. For example, it may describe the nuances in meaning of the terms ethics and aesthetic. Where there is a reference to any of the terms comprising the frame names, a link can be followed to the target frame. Thus in frame "aesthetic" the term aesthetic will link to the current frame (perhaps not such a useful eventuality) and the term "ethics" will link to the frame "ethics" (probably a more useful connection). Also, anywhere in the vast data repository being scrutinised, the same linking can be followed.

Snapping instantly from one item to another, regardless of how much data (knowledge, text) separates the two is a characteristic of the human brain. Linking is also characteristic of all good hypertexts and **linking to new knowledge** is the second, **key feature of HIMS**. It brings a whole new dimension to juxtaposition. However physically distant two items may be they can be logically connected at will, with little effort so as not to distract the

creative and knowledge generating work being done, and the connections can be remembered (even selectively) for future sessions in what is termed a 'history' or 'back-track list'.

Making a discovery – using the newly acquired knowledge

During HIMS' development and initial testing, a visiting professor asked for an explanation of HIMS. Since HIMS operates in a hypertext environment, a somewhat 'unruly' mode when compared to the logico-deductive paradigm in which we are schooled, this author opted for explanation via demonstration. The point is that in a hypertext mode of thought so much happens everywhere at once that it is difficult for the unaided human mind to grasp even a linear explanation. Since the visitor was interested, broadly, in ethical issues with respect to Information Systems Methodologies, the "SPT Case Study" could serve as the demonstration vehicle.

Our first step is to select a possibly fruitful knowledge repository – the six months of SPT NewsGroup downloads was a good starting point. The visitor was instructed to scan (quickly browse) each of the 1500 articles in this set, or whatever subset he thought might be useful. This is done with a pre-processing feature of HIMS which presents each article's one line header (the user may call up the full article if desired) and permits the user to accept or reject it for inclusion in a first-cut view, web, or properly named, a hypertext, of the targeted subset. The user may also assign a string of up to 40 characters which may subsequently act as a quick categorisation scheme. Usually a word or even a code is sufficient here. The visitor used "ism"²⁶ for "information systems methodologies" and selected out 34 of the 1500 articles – he was rather focussed in his interest. One may allow say five seconds per article for this process. He therefore invested 5*1500 seconds to complete the HIMS pre-processing phase – a little over two hours of concentrated work. He later exclaimed how enervating the experience was and troubled himself at the prospect of missing possibly important items. In response to this one may offer:

²⁶ "ism" is equivalent to "ISM" in case-insensitive text searches.

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- 1) How much time would be required to process 1500 header articles via any other strategy (for example select and move or delete in a wordprocessor environment working on a 4.5 megabyte document) and preserve each article in its entirety for further manipulation?
- 2) He had now created a subset of a very large dataset which could be added to, or adjusted in any manner desired.
- 3) The articles which one may judge at a future point, with hindsight, to have been relevant, may still be connected into the evolving hypertext.

In HIMS terminology, the hypertext thus far created is known as a *hyperfolder*²⁷, and in this case its name was SPT_MTHD.H, and was 195,382 bytes long comprising 34 articles.

Next (the next day) came the detailed work of finding and connecting possibly useful pieces of text (textual or literary subsets of the articles). This created a knowledge web, intermingling the researcher's emergent ideas with those of the authors of the data. The *HIMSconcept* named "ethics" introduced earlier was the visiting professor's starting point. With the aid of another of HIMS' features, that of recording word synonyms, or variants of other type, and associating them with the "ethics" *concept* – the following list emerged:

ethics Ethics Ethical ethical moral morals Morals Moral Morality morality

It is important to include all possible spellings and character forms which may appear in the data itself, although one can easily imagine using an artificial intelligence software module to help in this arduous task. In fact, another hypertext system called SmarText marketed by Lotus, gives just this type of support for its link making function. This list usually changes as the researcher becomes more aware of both the operation of HIMS and the meaning in the data.

Now it is time to *BROWSE* the *hyperfolder* with the *HIMSconcept* (or multiple *concepts*) activated so that highlighting and linking will be automatically invoked. This phase of HIMS usage is where the maximum likelihood exists for generating new knowledge. Everything that went before is laborious and preparatory, and all specifically geared to this stage which has been termed

²⁷ For a definition of hyperfolder see page 163.

Generative Conceptualisation. Before we move to this exciting stage however, let us take a look at a sample of the contents of the 34 articles in *hyperfolder* with name SPT_MTHD.H, and one which resulted from another similar investigation. Three posted articles are presented in their entirety, and with *HyperShell* hypertext markups inserted as the first two lines and the last line of each article. The first two articles are from the *hyperfolder* whose construction has just been explained and the third is from another *hyperfolder* also constructed from the 1500 article SPT dataset but this time specifically focussing on morality rather than ethics.

First article

```
.FRAME vax7 sci.philosophy.tech: 10308 .TITLE ism
X-NEWS: vax7 sci.philosophy.tech: 10308
Path: info.curtin.edu.au!uniwa!munnari.oz.au!constellation!osuunx.ucc.okstate.edu!
moe.ksu.ksu.edu!vixen.cso.uiuc.edu!uwm.edu!wupost!math.ohio-state.edu!
news.acns.nwu.edu!casbah.acns.nwu.edu!jcc
From: jcc@casbah.acns.nwu.edu (Jeremy Caplan)
Newsgroups: alt.philosophy.objectivism,talk.philosophy.misc,sci.philosophy.tech,
sci.philosophy.meta
Subject: Scientific Challenge Date: 8 Aug 1993 16:40:35 GMT
Organization: Northwestern University, Evanston IL
Lines: 22 Distribution: world
Message-ID: <243aa3$$9so@news.acns.nwu.edu>
NNTP-Posting-Host: unseen1.acns.nwu.edu
Xref: info.curtin.edu.au alt.philosophy.objectivism:3170 talk.philosophy.misc:7074
sci.philosophy.tech:10308 sci.philosophy.meta:6762
```

Perform ANY scientific experiment without the use of philosophy.
 This is impossible. Without metaphysics, there can be no entities to
 examine, there can be no scientist to examine and reason, there can be no
 existence of ANYTHING. Without the law of causality, there can be no
 action, by the entities being examined nor the scientist. Without
 epistemology, there can be no scientific method, and even if something were
 to occur, there would be no objective methodology for interpreting it.
 Without ethics, this "experiment" could consist of the destruction of a
 continent with no moral ramifications. Without an understanding of the mind
 itself, the scientist would no more recognize the data he should record than
 his own imagination.

Now someone try to tell me that philosophy is 'impractical.' Philosophy has
 veto power over science.

```
$$ "Man by nature wants to know." | Jeremy Caplan jcc@casbah.acns.nwu.edu $$
$$ ARISTOTLE | Philosophy Northwestern University $$
$$-Metallica-RUSH-Sting-Bird-JAderly-Trane-BMarsalis-Miles-ASandoval-Monk-$$
$$ "We are born unarmed. Our mind is our only weapon." Ayn Rand $$
```

.END

Second article

```
.FRAME vax7 sci.philosophy.tech: 10310
.TITLE ism
X-NEWS: vax7 sci.philosophy.tech: 10310
Newsgroups: alt.philosophy.objectivism,talk.philosophy.misc,sci.philosophy.tech,
sci.philosophy.meta
Path:info.curtin.edu.au!uniwa!munnari.oz.au!news.Hawaii.Edu!ames!elroy.jpl.nasa.gov!
swrinde!cs.utexas.edu!math.ohio-state.edu!magnus.acs.ohio-state.edu!
csn!yuma!lamar!hurben
From: hurben@lamar.ColoState.EDU (Mike Hurben)
Subject: Re: Scientific Challenge
Sender: news@yuma.ACNS.ColoState.EDU (News Account)
Message-ID: <Aug08.174940.14383@yuma.ACNS.ColoState.EDU>
Date: Sun, 08 Aug 1993 17:49:40 GMT
References: <243aa3$$9so@news.acns.nwu.edu>
Nntp-Posting-Host: lamar.acns.colostate.edu
Organization: Colorado State University, Fort Collins, CO 80523
Lines: 47
Xref: info.curtin.edu.au alt.philosophy.objectivism:3171
talk.philosophy.misc:7081 sci.philosophy.tech:10310 sci.philosophy.meta:6771

In article <243aa3$$9so@news.acns.nwu.edu> jcc@casbah.acns.nwu.edu (Jeremy Caplan)
writes:
>Perform ANY scientific experiment without the use of philosophy.
>
>This is impossible. Without metaphysics, there can be no entities to
>examine, there can be no scientist to examine and reason, there can be no
>existence of ANYTHING. Without the law of causality, there can be no
>action, by the entities being examined nor the scientist. Without
>epistemology, there can be no scientific method, and even if something were
>to occur, there would be no objective methodology for interpreting it.
>Without ethics, this "experiment" could consist of the destruction of a
>continent with no moral ramifications. Without an understanding of the mind
>itself, the scientist would no more recognize the data he should record than
>his own imagination.
>
>Now someone try to tell me that philosophy is 'impractical.' Philosophy has
>veto power over science.
>
>$$ "Man by nature wants to know." | Jeremy Caplan jcc@casbah.acns.nwu.edu $$
>$$ ARISTOTLE | Philosophy Northwestern University $$
>$$-Metallica-RUSH-Sting-Bird-JAlderly-Trane-BMarsalis-Miles-ASandoval-Monk-$$
>$$ "We are born unarmed. Our mind is our only weapon." Ayn Rand $$

Implicit in your argument is that we scientists use the "correct" philosophy,
not just ANY philosophy. Of course, you hold that YOUR philosophy is the
correct one, therefore it is YOU hold holds veto power over MY life's work.
No thank you. I agree with your fundamental idea that one must have a
philosophic base to build science upon. That much is clear, and I have made
no assumptions otherwise. But which philosophic base shall we use, eh?
Lets suppose I create some sophomoric, half-assed philosophy and then demand
that it correctly describes the world. Then I go out and do experiments
that directly violate my philosophy. Can I then proclaim "Philosophy has
veto power over science." ??? Of course not. Reality doesn't give a damn
about your philosophy. Reality is what is. Rand made such a big deal about
how HER philosophy was so damn flawless because it is supposedly based on
objectively observing reality. But I disagree. I find her metaphysics too
limiting and restrictive. Thus I do not accept your vetos over my results,
because I do not recognize Oism as being a valid tool for comprehending the
universe. The only philosophy that can veto science is a CORRECT philosophy.

Mike Hurben "Why does it happen? Because it happens...
Roll the bones...." - Rush

Dept of Physics
Colorado State University
-----
.END
```

Third article

```

X-NEWS: vax7 sci.philosophy.tech: 9229
Xref: cujo sci.philosophy.tech:9229 sci.philosophy.meta:5571 sci.skeptic:35952
Path:cujo!uniwa!munnari.oz.au!news.Hawaii.Edu!ames!elroy.jpl.nasa.gov!sdd.hp.com!
crash!ryptyde!snodgras
Newsgroups: sci.philosophy.tech,sci.philosophy.meta,sci.skeptic
Subject: Consciousness and morality and all that/Re
From: snodgras@netlink.cts.com (John Snodgrass)
Message-ID: <agNylB5w165w@netlink.cts.com>
References: <C4ALCs.L6J@dcs.ed.ac.uk>
Date: Thu, 25 Mar 93 01:12:57 PST
Organization: NetLink Online Communications, San Diego CA
Lines: 48

.FRAME vax7 sci.philosophy.tech: 9229
.TITLE morality
pdc@dcs.ed.ac.uk (Paul Crowley) writes:

> >[snip] and on that basis define these assumptions as themselves not an
> >ethical system, but a physical or natural system. [snip] In other
> >words, I'm claiming that the struggle for stability is a physical-level
> >process, whereas ethics is just an area of philosophy or sociology.
>
> Since I think that there is more to what is good than stability I have
> to disagree. If you believe that any system which is stable is good,
> your ethics and mine differ considerably.
>
    Indeed they must. Unstable societies are simply disassembled
    and swallowed up by stable societies. Stability is equivalent to
    existence. However, the environment is chaotic, and human nature is
    highly inventive, so the attempt to create a genuine science of
    ethics is somewhat futuristic. The point I'm trying to make is that
    if you want to discuss ethics, you are in effect discussing social
    stability and ways to create it. That's my thesis, anyway. Bringing
    it into the world of genuine science would first of all involve a
    general agreement that such is indeed the case! But I see nothing
    terminally self-referential in arguing that case by pointing to the
    context of nature. To me it is self-evident. An unstable system, no
    matter what it is, disappears. Nothing could be a
    better argument against it.

> > I'm not sure whether you have an axe to grind, like me, or
> >whether you're just averse to social organization. Perhaps you will
> >make this aspect of your position clearer.
>
> None Of The Above. I've said nothing about social organisation at all;
> I'm just annoyed that you called me "naive" so I challenged it.

    I said something like: "I wonder how widespread such naivete
    is?" Let me rephrase that. I wonder how widespread the view that
    ethical systems are aesthetic rather than function?

>
> \o/ Paul Crowley pdc@dcs.ed.ac.uk \\\ //
> \_/ Trust me. I know what I'm doing. \X/ Fold a fish for Jesus!

    SnOdGrAsS

--
INTERNET: snodgras@netlink.cts.com (John Snodgrass)
UUUCP: ...!ryptyde!netlink!snodgras
NetLink Online Communications * Public Access in San Diego, CA (619) 453-1115
-----
.END

```

Chapter 5 - Associative thinking and the hypertext paradigm

A cursory scan of this data does not reveal whether it admits a fresh perspective on the research question. Of course, a careful reading of it will, but the point is that it represents but 3% of the already vastly reduced 6-month SPT Case Study downloads. Can one read all of this thoroughly? Consider these statistics. If the 34 articles were printed, single side, single spaced, on A4 paper with similar margins to this document and in 9 point Arial font one would require 70 or more pages. There are in excess of 26,000 words to be read, 4210 lines of text in some 3000 paragraphs. And this is a small *hyperfolder*. The reader can see that help is required for the human intellect in dealing with such a data-mass. Understandably, much creative knowledge-work has remained unattempted, because our naked capacity, supported with existing tools, has not delivered enough power to permit the mere contemplation of even a start on the task.

For our visiting professor, researching ethics and information systems research methodologies, we now display the HIMS screen in *hyperfolder BROWSE* mode, and for the reader of this report we reproduce the screen in monochrome and on paper.

Here is what the first and third articles reveal in HIMS:

First article displayed in HIMS

```

MENU:  Help   File   Contents  Search  Goto  Notes  Other  Quit
  ▲   ◀   ◀◀   ▼   PgDn PgUp   ▼▼   Hyperfolder Management  Concept  ?
-----
Article : [vax7 sci.philosophy.tech: 10308]
Subject  : [ism]
-----
Perform ANY scientific experiment without the use of philosophy.

This is impossible. Without metaphysics, there can be no entities to
examine, there can be no scientist to examine and reason, there can be no
existence of ANYTHING. Without the law of causality, there can be no
action, by the entities being examined nor the scientist. Without
epistemology, there can be no scientific method, and even if something were
to occur, there would be no objective methodology for interpreting it.
Without ethics, this "experiment" could consist of the destruction of a
continent with no moral ramifications. Without an understanding of the mind
itself, the scientist would no more recognize the data he should record than
his own imagination.

Now someone try to tell me that philosophy is 'impractical.' Philosophy has
veto power over science.

$ "Man by nature wants to know." | Jeremy Caplan jcc@casbah.acns.nwu.edu $
$ ARISTOTLE | Philosophy Northwestern University $
-----
Page 1 [ Home, PgUp, PgDn ]

```

(Note how "ethics" and "moral" are highlighted)

It is immediately obvious from an inspection of this screen that the article's author has used the term "ethics" and "moral" in the same sentence. The two concepts are intertwined. This caused some wonder in our visitor, which immediately led to the creation of another *hyperfolder* specifically making links to "morality" and like terms. We note that this connection was not made as strongly at the outset of the research on ethical issues with respect to Information Systems Methodologies.

As the research progressed into the third day, the following article appeared on the screen. It is important to understand that the displayed articles do not just appear by chance, or by random, even serendipitous occurrence (although the latter is always welcome). They have been chosen by a sophisticated but probably unrepeatable process from a huge repository. Whilst the process cannot be reproduced exactly as it occurred, an equivalent process could obviously be followed and would yield similar results.

This "third article" reproduced as displayed by HIMS is populated with many references to the wordform "ethic", and rather curiously juxtaposed with "aesthetic" in the one sentence. It was this discovery, reinforcing the earlier juxtaposition of these two terms which led our visitor to take a third cut at the 1500 articles in the SPT dataset, this time creating a *HIMSconcept* based on :

aesthetic Aesthetic Aesthetics aesthetics aesthetical

The visiting professor was rather surprised at the use of the term "aesthetic" with the term "ethic", and eagerly explored this concept further.

Third article displayed in HIMS

```

MENU: Help  File  Contents  Search  Goto  Notes  Other  Quit
▲  ◀  ◀◀  ▼  PgDn PgUp  ▼▼  Hyperfolder Management  Concept  ?

Article : [vax7 sci.philosophy.tech: 9229]  √ Match
Subject : [morality]

pdc@dcs.ed.ac.uk (Paul Crowley) writes:

> >[snip] and on that basis define these assumptions as themselves not an
> >ethical system, but a physical or natural system. [snip] In other
> >words, I'm claiming that the struggle for stability is a physical-level
> >process, whereas ethics is just an area of philosophy or sociology.
>
> Since I think that there is more to what is good than stability I have
> to disagree. If you believe that any system which is stable is good,
> your ethics and mine differ considerably.
>
  Indeed they must. Unstable societies are simply disassembled
  and swallowed up by stable societies. Stability is equivalent to
  existence. However, the environment _is_ chaotic, and human nature is
  highly inventive, so the attempt to create a genuine science of
  ethics is somewhat futuristic. The point I'm trying to make is that
  if you want to discuss ethics, you are in effect discussing social
  stability and ways to create it. That's my thesis, anyway. Bringing
  it into the world of genuine science would first of all involve a
  general agreement that such is indeed the case! But I see nothing
  terminally self-referential in arguing that case by pointing to the
  context of nature. To me it is self-evident. An unstable system, no
  matter what it is, disappears. Nothing could be a
  better argument against it.

> > I'm not sure whether you have an axe to grind, like me, or
> >whether you're just averse to social organization. Perhaps you will
> >make this aspect of your position clearer.
>
> None Of The Above. I've said nothing about social organisation at all;
> I'm just annoyed that you called me "naive" so I challenged it.

  I said something like: "I wonder how widespread such naivete
  is?" Let me rephrase that. I wonder how widespread the view that
  ethical systems are aesthetic rather than function?

```

Perhaps one should take a moment to explain the unintelligible terms near the end of the third paragraph. These characters are termed "noise" and indicate a transmission error occurred at some point in this posting's travel around the globe. This happens on infrequent occasions and can usually be rectified by inspection. The context here informs us that "disappears" is very likely the correction.

The highlighted terms, see "ethical", "ethics", "aesthetic", in the above example, can be switched on and off at will in HIMS, via a *concept activation* function.

This permits the reader to make a quick visual scan of the articles to determine if they contain possibly useful new information.

Browsing the articles via HIMS with *concepts* switched in, is analogous to leafing through a paper based repository of knowledge looking for the words in the set of key terms developed to date. In this author's experience, the latter is very difficult to do accurately, speedily and over the prolonged period of time needed to deal with the potentially thousands of pages of text comprising the research data. Such effort on the means detracts from the researcher's ability to achieve the desired end – *Generative Conceptualisation*, the creation of new knowledge.

The notion of *Generative Conceptualisation* is returned to in [Chapter 6 – Empowerment through a hypertext environment](#), giving numerous examples as it occurred with respondents in the field, and again in [Chapter 8 – A hypertext paradigm – the environment for *Generative Conceptualisation*](#). In the meantime our visitor, who was delighted with the fruit of his HIMS labours wanted to learn more about it. We provided him with the HIMS hypertextual tutorial which presents all the features embodied in this application of hypertext technology.

Having seen an example of HIMS in action we now proceed to consider some HIMS design issues.

Design of HIMS

Through the case study above we now have a glimpse of what HIMS does and how it may be used. In a nutshell, HIMS dynamically builds a special purpose hypertext from textual data. Upon instruction, it creates categories, highlights terms of interest creating the possibility for a visual association to be made, forges and remembers links and trails of access thereby juxtaposing that which has previously not been associated. HIMS stores user notes about the data or about the links – it does what the human mind does, dynamically makes sense

of data in ad hoc fashion. Its recording and storage avoids the ephemeral nature of remembering.

In [Figure 27](#) we see the four aspects of what has been termed *Generative Conceptualisation*. At the base is the 'information space', representing the sort of data we considered in the SPT Case Study above. Data such as that posted to the Internet NewsGroups – voluminous, constantly changing or increasing, repetitious, but data which may yield 'gems' for the researcher. In the process of *uncluttering the wafting information* HIMS implements a broad categorisation of targeted articles. The user is permitted to quickly review the original selection of articles and accept their inclusion into the hypertext (*HIMSHyperfolder*) being built, and to label each according to some broad category. This process is supported by HIMS' *AddArticle* function, being one of its numerous information management capabilities (*DeleteArticle* being another obvious one) and forms an important first step in the ultimate *synthesis* of something new.

The *attention getting* aspect of the *Generative Conceptualisation* model is supported by the HIMS function of highlighting, although this and (initial) link-making are achieved simultaneously and in conjunction with the formation of new ideas known as *HIMSc Concepts*. The fact that all of these activities appear to occur at once and are intermingled may at first seem unhelpful, but HIMS supports the user's mind, augments the intellect, and encourages the simultaneously organised and 'unruly' progress the mind makes in solving a problem or creating something new. These are essential and deliberate design features. Actually, in this author's experience this is essentially a characteristic of hypertext technology, and it is in this sense that one speaks of thinking and working in a *hypertext paradigm*.

By these means, in addition to any other extant capabilities and eventualities, the HIMS supported user achieves *conceptualisation*. He has done something

'more' with the data than was possible with the naked intellect. Knowledge has been generated. Of course, the unaided brain does this all the time, but what is being achieved here (arguably) is that this type of hypertext support permits the human to do it 'more', or 'better' or 'faster'.

Generative Conceptualisation

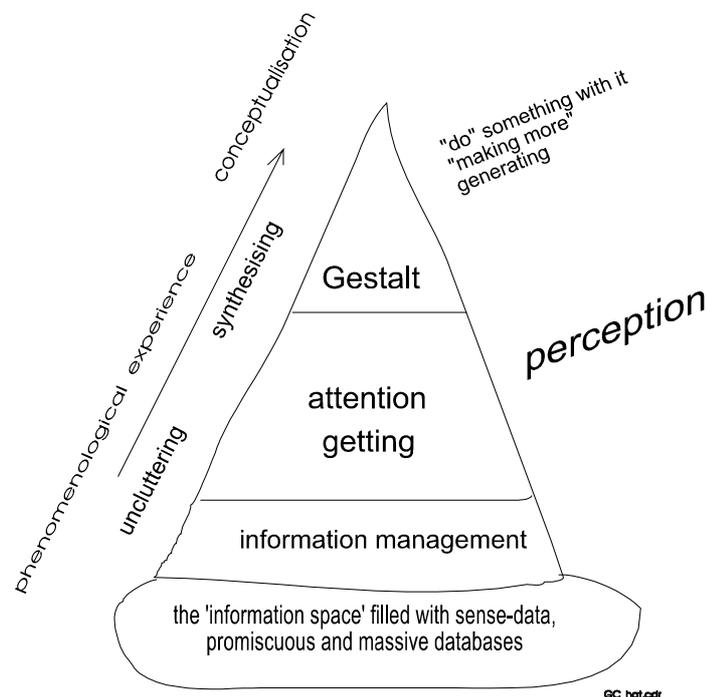


Figure 27: Generative Conceptualisation

In supporting and managing the uncluttering and synthesis, HIMS permits its user to immerse himself in a *phenomenological experience* and allows him to form conceptualisations which may, in the absence of such experience, not have emerged.

HIMS Functionality

Articles are the basic entity from which all work proceeds. An *article* is some text about a subject, perhaps an e-mail, or NewsGroup item, which is manipulated by HIMS according to the user's emerging ideas/classifications/concepts and is physically added to the *hyperfolder* via the *Hyperfolder Mgt* function. Each *article* is assigned a category or *subject* in the early stages of HIMS processing. The *category* may also have a string of characters appended which identifies the *article* to permit re-visiting it in its original position in the source data.

Subjects elaborate or categorise, and possibly identify articles. The string of text comprising the *subject* provides the user with a quick view of what the associated article is about and how it fits into the emerging scheme being developed by the researcher and HIMS user. A *subject* is the name for an idea-category which is found in many *articles* (usually). The *subject* is the basis of a view or collection of *articles*. Creation of *subjects* is done by HIMS in the work which precedes the formation of *concepts* but may be done or re-done at any time.

Concepts are the embodiment of the knowledge being created or synthesised by the HIMS user. They are superimposed upon and linked into the set of articles. Their content is dynamic and changes or grows as the HIMS user forms his ideas about the content of the source data stored in the *articles*. A *concept* is a piece of HIMS-user generated text which forms a bridge or is an elaboration/explication of information found from among the collection of *articles*. In this sense it is knowledge about knowledge or meta-knowledge. Creation of *concepts* requires the use of an editor or some sort of 'writing' tool.

A **hyperfolder** is a group or collection of *articles*. It is the web of knowledge emerging from the interplay of the HIMS user's thoughts about the underlying data in the *articles* and his formation of *concepts*. It includes the associative links binding these entities (*articles* and *concepts*) to permit further review and

study. All this knowledge comprises a hypertext, which in HIMS terminology is known as a *hyperfolder*.

A *session* is a period of time during which HIMS is used. Certain details regarding work-in-progress status, such as name of current *hyperfolder(s)*, activated *concept(s)*, and current node or frame being displayed on screen, together with frame annotations (called "noted references") and navigation information, may be preserved in a re-start file at the conclusion of a session. This permits the knowledge worker to resume work at some future point in time with the saved status being used to recreate a previous work session's environment. *Sessions* can be used to keep track of individual projects or individual project work.

Typical hypertext functions

HIMShyperfolders are fully fledged hypertexts, and exhibit all the typical hypertext functionality provided by good hypertext systems:

Contents lists, dynamically generated upon call and reflect the current contents of a hypertext, or 'society of hypertexts' if more than one is in 'scope';

Views, or cross sections by category (a *HIMSsubject*), created on demand;

Searching – normal Boolean searches (although not implemented via the usual – and complex – AND, OR, and NOT operators) and are delivered by means of 'refining', 'extending', and 'complementing' a hit list. This uses a special case of dynamic **contents list** and **views** capability;

The results of the above three functions may be saved for future use, if desired in a **re-start** file, a special form of which is used by HIMS in its *session* control component;

Navigation is supported by keeping track of a history of articles visited, permitting backtracking, and if one desires, a log reflecting the navigation path taken through the hypertext. This 'frame logging' feature permits the collection of data for further study, for example by psychologists, educators, and epistemologists interested in learning and knowledge acquisition;

An obvious function is **help**. Both context sensitive help and structured or indexed help exist;

For users who must get it out onto paper, a **print** function is provided, but this is also extended to permit 'printing to a file', and connections to 'send' the body of knowledge (a file) via e-mail to a remote collaborator;

Appending one's snippets of information (**annotations**, marginal notes, footnotes, endnotes) is a fundamental aspect of knowledge-work and is catered for in all good hypertext systems, including HIMS;

Connections to files **at the operating system** level is often desirable.

Perusing directories, file details (name, size, date, etc.) or even contents, is often required. All good software packages, especially hypertexts, are 'open' in this sense;

HyperShell (Taylor 1988, Taylor & Dreher 1991), the hypertext system with which HIMS is built, is an elegant and above all an open system, the latter meaning it uses a non-proprietary file encoding scheme (ASCII text). The package of features which HIMS delivers its user, is powerful indeed.

User interface issues

When information systems, tools, or any methodology become difficult to use, we run the risk of losing sight of the goal, spending much effort on acquiring the skills needed to use or 'drive' the tool which purportedly supports or empowers the endeavour. System developers speak of user-friendliness, or usability in this context. HIMS achieves a high degree of usability through its configurability. First, one may 'connect' to any writing tool, editor or wordprocessor, and use a familiar environment to 'write' or create the strings of text forming the links, concepts, annotations (marginal notes, footnotes, endnotes) and so on.

Obviously, support for a variety of pointing and selection methods is mandatory. HIMS automatically provides for the use of a mouse (real or simulated), key strokes, arrow keys, function keys – in fact whatever is possible and makes sense to the user is catered for, leaving the mind to concentrate on the *Generative Conceptualisation* which is occurring in the brain and which is being supported by HIMS.

There are some more subtle features to this problem of usability which are often ignored and force users to operate in ways which they would prefer to avoid, or in ways which arrest or divert the cognitive activity directed at the main work – the research as opposed to the use of the tool. For example, some users have a mental model which is better supported by a flat menu structure. As menu functions are selected from successively subordinate menus and eventually the desired function is chosen, the user's expectation may be to return directly to the top level menu, rather than bubbling back up through the hierarchy of menus just traversed. The HIMS menu structures may be presented as flat or layered.

Configurability

The cognitive work being done in HIMS sessions is not trivial. It is often prolonged, as we saw in the SPT Case Study earlier, taking some days. Clearly, a system needs to be devised where one may 'take up from where one left off'. But such a device needs to impose the minimum cognitive load on the researchers, leaving them free to concentrate on *Generative Conceptualisation*. HIMS achieves this through an integrated information management function. Users carry out their HIMS activities in *sessions*. A session 'remembers' all information needed to return the user to the place, condition, and settings of last use.

Even more possibilities

A very useful spin-off from sessions, is that it is possible to work on the same base data, in distinct sessions, permitting a separation of views, concepts, annotations – thus generating various sets of original thoughts, new ideas and knowledge. Multiple sessions may be 'owned' by the one researcher or belong to separate researchers. This last point is quite fascinating when one contemplates the new possibility of comparing the concepts formed by independent researchers on one and the same base data. This would permit a whole new range of psychological experiments to be conducted in the field of cognitive mapping (Eden 1988).

Whilst we have been concentrating on Internet NewsGroup source data as our repository of knowledge, HIMS can be 'taught' about other types of input streams via the source data structure definition module. The more this author works with HIMS the more possibilities seem to emerge – ones which were not conceived in the original design, but ones which owe their existence to the inherent flexibility of the hypertext paradigm.

HIMS augments the naked human intellect

The ability of HIMS to augment the human knowledge-worker's ability in information management, highlighting (to expose the association among items), and linking to achieve (logical) juxtaposition, all contribute to *Generative Conceptualisation* based on the body of knowledge being focussed upon.

In the next chapter we discover how HIMS was used in the field, and with what effect, by a small group of researchers. Their work extended over some six months (May to October 1994), during which time we see some astonishing glimpses of empowered knowledge-work and *Generative Conceptualisation*.

Chapter 6 - Empowerment through a hypertext environment

The Hypertext Information Management System, HIMS, was trialed in the field for a period of six months during which the respondents were guided in its use and in connecting it to various datasets. The initial data provided were NewsGroup²⁸ postings accumulated over a six month period in the previous year. This provided a large amount of text (many thousands of printed pages or many megabytes of text, from one to seven megabytes depending on the NewsGroup) containing some potentially relevant or useful information.

The first session with respondents was to install HIMS, ensuring it did not conflict with any other software on their personal computers, and to run through its basic operation and function. Respondents worked for the next three months with HIMS and the NewsGroup data, creating *hyperfolders* and *concepts* that related to their research interests. Approximately every ten to 14 days, this author visited each respondent to discuss advances, problems, and further features of HIMS.

ID	Knowledge Domain
R1	Political scientist
R2	Structural engineer (civil engineer) - withdrew and was replaced by rheologist (non-Newtonian fluid engineer) who also withdrew
R3	Economist (labour)
R4	Historian (political, social, agrarian)
R5	Historian (intellectual, science) - accepted overseas position
R6	Chemical engineer - withdrew
no ID	Information Scientist (three individuals participated at various stages, and were included to provide a reference point for software system use)

²⁸ See section headed *Internet NewsGroups in Chapter 5 - Associative thinking and the hypertext paradigm*.

After three or four visits it became very clear that the two engineers and the information scientists were not going to continue with the experiment. By this time they had invested from 6 to 20 hours, depending on their level of use. They saw HIMS as a software package which had inputs and outputs – and were not prepared to immerse themselves in the data and manipulate it with HIMS, but rather expected the invocation of some sort of algorithm (a program) to disgorge the 'right' answer at the end. Of course, HIMS does not operate in such manner. It supports its user in the doing of knowledge-work and does not follow a set of predefined instructions as in an ordinary computer program. Reasons for these withdrawals should be further investigated, particularly as these respondents are all, broadly speaking, from the engineering disciplines. This must be left for future research.

Another change in plan was required when it became apparent that the NewsGroup data was not appropriate in all cases. For example, R4 the historian, was working on the *Society.Culture.India* NewsGroup, but he found this to be far too chatty and did not consider it to be 'data' – it was one of the smaller volumes of data and did not exhibit the richness and diversity one finds in datasets of five or ten times the size. This simply means that not many people are using this particular Internet NewsGroup yet. But R4 had a very large volume of highly relevant data on his current major research theme of "Pearl Fishing in India" stored on microfilm, and a specially constructed index to this. The "FishyIndex", as it became known, was available as an electronic document and occupied some 250 kilobytes of disk space. A special hypertext form of this dataset was created so that HIMS could link to it. Henceforth, R4 was able to work with HIMS applied to the FishyIndex, resulting in some very productive work.

An additional set of data to which HIMS could be applied was created for the economist R3. He had been using HIMS with a very large volume of data (some seven megabytes) from the *Science.Economics* NewsGroup and after discovering some new knowledge from this he was eager to try HIMS on a more specialised dataset: The Oxford Bulletin of Economics and Finance. A special hypertext was

created from the approximately one megabyte of source material and R3 was able to use HIMS on this data in addition to the NewsGroup postings.

The political scientist wanted to engage with HIMS on his specialised dataset consisting of responses to the open-ended question of a questionnaire probing "ethics" in the public service. The 250 verbose answers resulted in some 25 kilobytes of data.

From these cases one quickly learns that there are no 'standard' datasets which researchers find useful and one must be prepared to permit the use of a variety of input data when considering empowering individual researchers in doing their research. This is in keeping with HIMS' design in supporting *Generative Conceptualisation* based on sense-data, and the promiscuous and massive databases of [Figure 27](#). The experience with HIMS supported the point that there is no common thread running through the disciplines. As HIMS was designed as an open and adaptable system it was possible to utilise the variety of input sources the respondents wanted, despite these events being unplanned.

Empowering the intellect: from knowledge-work inhibitors to doability and empowerment

Analysis of respondents' data from the second field study, the period of HIMS usage, has generated 14 issues related to the doing of knowledge-work. These issues have been organised into five categories ranging from the inhibition of knowledge-work through to working in a hypertext paradigm. The analysis has also provided a characterisation of knowledge-work and its empowerment via

devices and functions provided as part of the HIMS environment – an instance of a hypertext paradigm.

The remainder of the chapter discusses each of the issues and concludes with respondents' evaluation of HIMS in terms of positive features and areas for improvement. [Figure 28](#) depicts the layout.

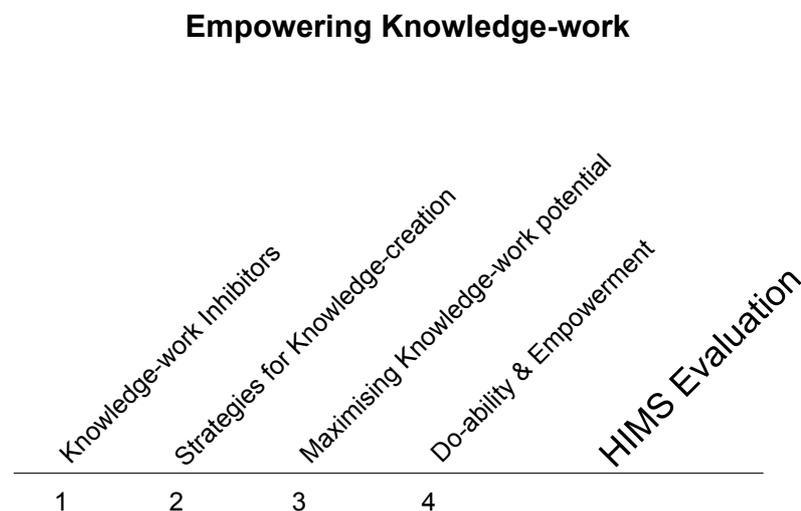


Figure 28: Issues in Empowering the Intellect

1. Knowledge-work inhibitors

There are many things that prevent one from doing work but here we discover five particular work-inhibiting factors that can be overcome by augmenting the intellect, empowerment, and progression toward working in a hypertext paradigm. The first deals with the limited aspirations caused by the un-empowered state; the feeling of: "gosh, this is such a huge task I can't even contemplate starting", causes work not to proceed at all. Then there are the

inevitable diversions from the main task, perhaps because some new thread is more interesting, more pressing, or perceived as more doable. Such diversions may provide a definite or more immediate 'return-on-investment' as it were but result in stagnation and an inability to re-start the original work. The fear of missing an important item in the raw data is a third factor affecting the researcher's output or productivity. Fourthly, in an effort to be thorough, researchers must deal with a complete or entire dataset, no matter how large, but in the unempowered state much time can be spent attempting to select out the relevant from the irrelevant. This has the potential to interfere with the completion of the entire task within a reasonable time. On the other hand, researchers are cautious when it comes to deleting unwanted data for fear that it may contain something useful. Making such decisions about data retention and usage is time consuming yet imperative to reduce the dataset to smaller and more workable proportions. Finally, we see evidence of researchers doing things the 'same way' as they have always done them; the same way as they have been taught, using the methodologies of the dominant paradigm. Such 'paradigm entrapment', as the phenomenon has been termed, leads to a failure to generate new knowledge, make discoveries, and create new insights. This activity could be called concept verification rather than generation.

We take each of these five aspects in turn and discuss the phenomena which occurred whilst HIMS was being used in the field.

1.1 Limited aspirations due to respondents' perceived lack of intellectual power or capacity

There was consistent evidence from the fieldwork of the retarding effect of a researcher's perceived lack of intellectual power. For example, in a discussion about what is involved to do research of Nobel Prize winning standard, we see a direct admission to an inability to achieve such a standard:

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HD²⁹: ... how would you get a Nobel Prize? I mean you'd have to have a big win, you'd have to do something very new and ... R3: Oh yes, yes that's right. Most of us don't aspire to that because, we feel, either knowing or not knowing, that we just haven't got the intellectual capacity to do it.

A direct consequence of such an admission would be submission to the unempowered state. Whilst R4 has not made as obvious an admission as R3, one can see however that he does acknowledge a certain 'difficulty' in doing what he sees as logical and therefore necessary or desirable:

R4: The problem of getting a logical sequence is that things are mixed up – there are several things often on one reel [referring to microfiche archive]. It may be very difficult to number them in any way that makes sense of the kind of logic you can get by saying let's look at all "Madras", or all "Bengal".

R4's desire to "number them" to permit subsequent access to the data repository is clearly evident but he simultaneously sees that any one numbering system (or logical order – and there can only be one in the linear or hierarchical structures of the currently dominant paradigm) will be adequate only for a subset of the possibilities he contemplates for the data at this time. Thus, R4 recognises the potential, but due to his limited ability, power, resources, see it how one will, he is restrained.

Political Scientist R1 was working on the APOL³⁰ data:

HD: ... could you have made the statement: it's very hard to say something non-substantial³¹ using the term "accountability"; would you have been able to say that prior to immersing yourself in this, do you

²⁹ Text preceded by initials R1, R2 ... HD are quotations from the respective researchers (respondents and the author) and are mostly verbatim, but sometimes edited for readability. Within such quoted material it was sometimes necessary to add some text. This is distinguishable by its [differing font] and the use of [] to delineate it from the rest of the text.

³⁰ APOL is the name R1 has given the set of postings to the Internet Newsgroup about Australian politics.

³¹ R1 actually used the term "substantive" – it was the author's error to substitute "substantial".

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think? R1: Ah. HD: Would you have thought of saying it? R1: I wouldn't have thought of saying it, although I think it would have been at the back of my mind. I guess the importance of it is that I know immediately that that outcome is a valuable outcome, and yet it's never something I could have undertaken manually – so I wouldn't have posed the question.

R1 quite plainly admits to the importance of this line of inquiry and simultaneously his inability to undertake it manually. His aspirations are curbed by the reality of his unempowered state. At times the perceived non-doability and curbed aspirations translate to intense frustration:

R1: ... especially as this is obviously just a first step. And my frustration at not being able to get at these in their full context was really, ... I was grinding my teeth.

Not even R1's "first step" is perceived by him to be achievable despite the strategies available to him in the un-empowered state. We consider empowering strategies in section 4. [Doability and empowerment](#) below, and in the meantime pursue the remaining four knowledge-work inhibiting factors.

1.2 Diversions prevent the work getting done

There are many occasions on which the main work suffers or is hindered, even by such banal events where:

R3: Most people get diverted by other more pressing things.

On the other hand, diversions may be resisted, or dealt with appropriately, so as not to lose sight of the main goal (generating insight and creating new knowledge), by making and saving links for later follow-up.

R1: ... one is in fact torn between wanting to do one thing and doing another and to find the exciting parts first of all. My academic prudence suggests to me that to be a bit patient and methodical and systematic and not just rush in and expect to find ...

R1's "academic prudence", his dominant paradigm, suggests that an ordered linear strategy is going to pay dividends despite his ardent desire to "find the exciting parts". The tragedy can be that to do what "academic prudence" suggests could divert the effort from generating insight and creating new knowledge. We obviously need an approach that will support both of R1's apparently conflicting sub-goals virtually simultaneously.

1.3 Fear of missing something (completeness)

A researcher's endeavour to be thorough and complete may itself act as a diversion from the main goal of creating original and creative work. For example, dealing with the vast amounts of data which are known to have a bearing on a given research question can impose a huge workload. As time can only be spent once, the time may detract from the completion of other research tasks or projects.

R4: ... a colleague belongs to one of the networks from North America on, I think it was historical archaeology, and he said "I'm really beginning to think I'll get off, because every day I come in there are 20 or 30 messages I have to clear, and most of them are just things that don't matter, and people sending odd notes to each other, but because I'm part of the network I get all of this stuff dumped on me." HD: The chances are he won't get himself off for fear of what he might miss. R4: Ah yes, indeed, indeed.

Such a diversion, as in this case monitoring the historical archaeology discussion list, has the potential both to bring great reward and to stymie the research itself. What a conundrum! In fact, it is this very desire to be as thorough and complete as possible so as not to 'miss anything' which, in part, spawned this author's research into the empowering aspects of hypertext.

1.4 Tendency to delete (remove items from focus or view)

When faced with very large datasets a common strategy is to select out that which is perceived as relevant in an attempt at making the entire task more

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manageable. Bibliographic searches report the number of hits and ask the user to refine the search if the hit-list is too large (whatever that may mean). An immediate problem is that many researchers are still of the mindset that the output of a given task is a (printed) report. The dominant paradigm reinforces this time and time again. Consider the concepts implemented in modern wordprocessors to manipulate and create documents (reposing in electronic form in the first instance). All paths lead to "printing" the document. It is virtually impossible to even obtain a rendition of the body of knowledge on a computer screen without having a printing device assigned. And, this device with its physical or logical characteristics (for example: the type of paper – A4 or legal; the available fonts; and numerous other settings) affects exactly what can be seen on the computer screen, what it looks like, in addition to what can be printed onto paper. Searching a dataset is a common method for culling the unwanted but since only relatively few of the items found in a search can be printed, we are directed into further refining the search in some manner or other. This is simply to suit the dominant paradigm. By contrast, were we to have an electronic document in mind as our ultimate form of output, preferably a hypertext, the five and ten megabyte document sizes with which the participants in this study worked, would be perfectly acceptable quantum to further manipulate.

The strategy to refine a dataset by successive passes, gradually reducing it to a more pertinent set, is evident in R3's thinking:

R3: Right, so should I get rid of that one altogether? HD: Just leave it there, it won't hurt to leave it there.

Selecting out and deleting the unwanted is a strategy for handling large volumes of data. Making successive passes of the data, each time refining it further (for a specific purpose) by deleting those items not germane to the issues, purpose or focus, may bring results but the price is very high. If the culling process is automatic one runs the very real risk of excluding possibly relevant material. If the process is a more considered manual approach then it is arduous and time consuming and possibly constitutes a diversion from the main work. Even worse

(in the manual case) is the effort expended in reviewing and deciding to delete an item. It may be argued that this effort, especially in an unempowered state, should be directed at working with the relevant rather than the irrelevant data.

In a hypertext paradigm, by distinction, one creates links to that data which appears relevant. The researcher may 'view' this subset (of the entire dataset which is still available) via the trails afforded by the hypertext links. The 'view' may itself be adjusted and amended by the inclusion or exclusion of data. In this sense the 'view' is completely dynamic – this being a salient property of hypertexts in direct contradistinction to the frozen pages of a (paper based) report (whether it be actually printed on paper, or be in its Linear Paper Based Document form – LPBD – as a computer file).

Whilst this issue has only surfaced very obviously on one occasion it is a strategy which this author has adopted (is forced to adopt) to make his task more manageable (when not working in a *hypertext paradigm*)³².

Considerable evidence is mounting that existing paradigms can constrain us for the worse³³ when attempting to do creative and original work. The final aspect of knowledge-work inhibition, which results from the investigation of respondents using HIMS has been termed paradigm entrapment. The evidence provides numerous examples of how the respondent researchers have succumbed to this phenomenon, realised what was happening, and on occasion, transcended the

³² *It is a curious experience to be researching, thinking and acting, in a hypertext paradigm, and yet be forced to express one's thoughts, as I do now, within essentially linear constraints - the (temporal) unfolding story, as it were. Just recently it has occurred to me that the process of writing (as authors do it) is essentially a process of converting the webs of knowledge reposing in the brain, along with the myriad of trails passing amongst them, into a primarily linear path which the reader may follow and understand. Does the author do the thinking for the reader? If the brain is more akin to a hypertext than a straight line, why do we make so much of the latter? Some tentative answers to these questions have been formulated but their discussion would constitute a diversion from the main task.*

³³*This does not deny the many positive aspects of working within existing paradigms, even if they are not hypertext oriented.*

constraints and freed themselves of the inhibiting shackles of paradigm entrapment.

1.5 Paradigm entrapment – doing things the same way

R3. the economist has realised he is “steeped in doing things the same way” but acknowledges that HIMS may provide a partial release from this propensity:

R3: Well, you know, probably because one gets steeped in doing things the same way; I suspect if you use the system constantly for all your different areas of interest, you'd probably use it a bit differently.

HIMS may help him achieve some of the latent goals, one of which may well be to generate entirely new ideas and concepts.

The historian, R4, using HIMS on the FishyIndex³⁴ concedes (perhaps realises is a better term) that a fresh approach (the HIMS or hypertext approach) exposes new possibilities:

R4: ...well I think it was useful because it actually showed up, as it were, the relative weakness of what we've got at this moment; for there's so much stuff in there that is about Bengal, Zamindars, Jalkar, and so on. I know, because I've read a lot of it, that one would be very surprised if a proper way of searching this material didn't in fact produce a large subset ...

In assembling this data (the microfiche archival bibliographical database – note: *database* signifies an implied order according to a previously conceived scheme or design) R4 subsequently realises a deficiency. The carefully developed methodology used to capture the data (and of course the form in which it is cast) has resulted in its being ‘frozen’ into a state not entirely suitable to his current purpose:

³⁴ “FishyIndex” is the name given to identify the body of knowledge in hypertext form and comprising the specially created index to the microfiche archival bibliographical database which R4 has accumulated for his ongoing research into his current major research theme of “Pearl Fishing in India”.

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HD: Would you see your possible concern at this perceived disorder (unordered state), which is manifest through your desire to sequentially number the material, as an example of a drive to 'order'? R4: Oh yes, yes, I think it's certainly driven by that because what has happened is that this set of films have come in several lots at different times. They missed things out, ... The problem of getting a logical sequence is that things are mixed up – there are several things often on one reel. It may be very difficult to number them in any way that makes sense of the kind of logic you can get by saying let's look at all "Madras", or all "Bengal".

One can clearly see R4's motivation now: he wants to relate entities, or things ("let's look at all 'Madras', or all 'Bengal'"), that he did not conceive of at the time of assembling the data. The dominant paradigm prescribed order, rigidity, careful design, a static methodology, and the following of a prescribed path. Suddenly, in the light of new circumstances, which inevitably present themselves with the passage of time, the order has become disorder, and the data's form precludes the application of a different "kind of logic". R4 has been trapped by the dominant paradigm.

The overwhelming nature of paradigm entrapment can be seen in the following where R4 lapses into a mode consistent with the Input→Process→Output model, or a procedural paradigm:

HD: Right, and what you are going to do is to create the article on the comparative theme you developed from HIMS interacting with the data. R4: Yes, yes. Now how am I going to do that? I mean at the end of the day is there going to be a printout or a thing that says here is basically the material from this paper ... HD: Right, right, Ok, there will be, but of course you have to create the words in the printout. That comes out of your brain. The place where you put that would be in the *HIMSconcept* frame, where you are writing, and/or in the 'noted reference list' if you wanted to keep track of particular articles to chase up. As you read, HIMS has highlighted for you this particular chunk of knowledge upon which basis you can create some 'output'.

Perhaps one may even refer to this as paradigm imprinting. The ubiquitous notion that there has to be a printout, a linear rendition of the outcome of a

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process which transforms inputs to outputs is so ingrained in the mind, we often do not even recognise its presence and therefore cannot judge the magnitude of its (possibly constraining) effect.

HIMS, a cognitive support environment that attempts to create a hypertext paradigm, frees the researcher from the dominant paradigm's constraining shackles. Obscure data and ideas can emerge through the use of *HIMS* concepts:

R4: Say we want to take a major concept in the Bengal thing, the idea of Jalkar, which is the right to benefit from the produce at ... It's not the kind of thing that people in this correspondence are going to write about. HD: However, do you feel that there is information relevant to this Jalkar? R4: Well there is within the microfilm material we are working with, I know for sure, but that means it hasn't been lifted to the level of being used as a label [by a researcher working in a given paradigm] in what is written between government officials [i.e. in the microfilm database, the FishyIndex].

R4's discovery that it "hasn't been lifted to the level of being used as a label", through the use of "a major concept in the Bengal thing, the idea of Jalkar, which is the right to benefit from the produce" has permitted him to embark on a new research theme which was not at all obvious from pre-HIMS research activity.

Of course, we are not claiming here, or at all, that HIMS is the first and only instance of a hypertext paradigm. In fact, R4 has been using hypertext techniques for some time and to a considerable extent, albeit without recognising them as such. Having recognised what is possible with HIMS, R4 now offers a detailed example of how he was (may have been) 'trapped' by the prevailing paradigm and then transcended its bounds:

HD: Yes, so it seems to me you're saying that through straight searching (using existing methods & techniques & tools) it isn't possible to ... because sometimes there's an interplay of terms in context that you want to bring to the fore and other times not. Now that's your specific link making. This 'aggregation', I like that term, and the constellation of

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ideas, and ... R4: and of materials, you see, it's the constellation of materials that actually takes place. But what that is doing is, it's pulling these out and in a sense keeping them there in front of you so that you now know that within this data there are certain things that are actually linked together round a number of connectors. HD: Now this "linked together around a number of connectors", that's the way you see it as a researcher, and that is what HIMS facilitates you to formalise or make explicit. Would you say that's possible with another approach. We know it's possible manually, with the naked intellect, ... R4: Yeah, that's all we do all the time, it seems to me. HD: But I think you've explained that HIMS can help with that. R4: Well it looks to me as though it can certainly help with that. HD: Now, these links you are talking about, I see them as hypertext links, and incidentally I think this is a very natural thing that people do. I think hypertext is ... the wonderful thing about it is that it is seemingly so close to the way people use their brains. Could you say something about alternatives? R4: The big difference, I would assume, would be this: that if you're using the database approach, that is data that you've put in and then identified – within this data there is this and this and this and this; the possibility is clearly that you DON'T identify something within that data, for inclusion in the database, either because at that moment you don't see any importance in it, or because you simply make a mistake of missing it. I mean I can give you a perfect example of this manually which I'm sure could possibly happen if you were constructing a database. When I began my doctoral work, I started reading a daily newspaper. I was working on one particular newspaper, which was owned by British interests and was very favourable to the British and so on. In the period between 1920 and 1923 there was massive agitation against British rule under Mahatma Gandhi. The movement was called "non-co-operation"; I don't co-operate with the British. I was reading through this period looking for material, not about that movement in particular, but about the way the landlords, who were the allies of the British, were operating, politically, in this period of extreme agitation. On page three of this paper there used to be, virtually every day, little snippets of district view, possibly six lines long, sometimes shorter, sometimes a bit longer. These snippets came, on a sort of random basis, from the 48 Districts in the Province that I was looking at. As I was reading through I started to notice there were meetings at which landlords were present, at which they said "three

cheers for the King", and what have you, and things like this. I thought... [unclear words on tape -- what a pity -- but R4 was expressing astonishment at his discovery]. I had read through six months of daily newspapers before it occurred to me that what I was seeing but passing over, was – it was so often and so consistent – that there clearly was something actually happening. So, I had to go right back to the beginning and start to record every one of those meetings. My very first scholarly article actually came out of that. That was a Government organised anti-non-co-operation movement, mobilising the conservative forces and putting forward a claim that we stand for law and order, these people stand for disorder and so on. Now, I mean, my eye was seeing it, but not recording for six months of reading, and only when enough of it kept kind of bombarding me, did I realise that I should be going back and looking. And the interesting thing is, no one else had ever seen that link. That was not described anywhere in the literature. My article was the first time that anybody actually described this particular process of working against the nationalist movement in this way. It turned out they had a name for them: "Arminsaliser". What I'm saying is: if I had been entering data into a database from those news records, I wouldn't have actually entered that. Just as I didn't write it down on cards, which is the equivalent of entering it into a database.

HD: Yes, because the design did not call for it. R4: No, it didn't call for it, and nobody knew about it. There is no mention in the literature that one should go look for these things.

His discovery "that was not described anywhere in the literature" and about which there was "no mention in the literature that one should go look for these things" was a creation of **new** knowledge and came about primarily because he was prepared to consider moving outside the accepted research culture. R4 had realised, so many years ago, the dangers of being trapped by the prevailing paradigm, and as we shall see later, his research had regularly used hypertext-like techniques but enacted without the benefit of support from information technology.

The political scientist is also affected by paradigm entrapment:

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R1: My academic prudence suggests to me that to be a bit patient and methodical and systematic and not just rush in and expect to find ...

If R1 were truly free to do what he feels or senses is going to pay dividends, especially if he is empowered by some 'device' (for example HIMS) he may realise that he could have both the results of the methodical and the "rushing in" type of discovery. But like the historian, R1 is aware of the dangers as exemplified in his story about 'misplaced concreteness':

R1: During our talk in the last few days I mentioned the term "misplaced concreteness". I mentioned that this came from Lord Alfred North Whitehead, I think he was. He was a British physicist in the 20's and 30's, and a very good writer, a philosopher in physics in fact, and his books are still widely read today. He made an observation, which I've always found interesting. The term "misplaced concreteness" was his way of describing the way in which biologists of the day sought to emulate the physicists and/or chemists in trying to imply or ascribe more concreteness to their area of study. He argued that while the concreteness may come about one day, it would not be as concrete a discipline as physics or chemistry. No doubt it would be more concrete than others, but, importantly, the concreteness was misplaced. I think the message he was giving was that we shouldn't search for concreteness within the disciplines where we work. And we often do that. I think that's positivistic thinking, where we are not prepared to abide by what is the nature of our data and our theories.

Actually, the way in which R1 embraced HIMS and the ideas in which it is grounded was somewhat surprising, and certainly refreshing and encouraging from this author's standpoint. For example, he willingly explored new domains, even whilst he was writing and editing a book on the reasons behind the collapses of major and partially government owned financial institutions in the three southern Australian States in the late 1980's, and often broached the philosophical:

R1: The German philosopher who worked at the London School of Economics, Sir Karl Popper, whom I remember quoting in my Masters

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thesis of years ago, said about science: "A scientist engaged in a piece of research, say in physics, can attack his problem straight away. He can go at once to the heart of the matter, to the heart that is of an organised structure. The philosopher finds himself in a different position. He does not face an organised structure, but rather something resembling a heap of ruins. He cannot appeal to the fact that there is a generally accepted problem situation, for there is no such thing."

Perhaps a useful point to note at this juncture is that all respondents who have persevered with the use of HIMS have been of the philosophical inclination. Realising this, it is particularly unfortunate that R5, the historian of science from the Field_1 studies, was unable to participate in the Field_2 (HIMS usage) studies being reported presently. The engineers are also absent from the HIMS usage analysis. Whilst considerable effort was made to have them use HIMS, the chemical engineer, and a civil engineer specialising in rheology or non-Newtonian fluid research³⁵ (who replaced R2 the structural engineer for the Field_2 studies) found the HIMS environment far too lax and lacking prescription. They all chose to discontinue due to what may be termed the lack of incremental or foreseeable reward. This very probably means that those researchers who are not already operating at least partially outside the dominant paradigm are not likely to benefit from working within a *hypertext paradigm* – a case of what may be termed 'absolute entrapment', unless of course their work is already generating new insight and creating knowledge. This matter was not pursued and remains as future research problem.

In concluding this section on knowledge-work inhibitors, and in the light of the positivist engineers' stance relative to this research we briefly visit Popper (1959 p111) once again:

The empirical basis of objective science has thus nothing 'absolute' about it. Science does not rest upon solid bedrock. The bold structure of

³⁵A research note made at the time reads: "time in the rheologist's figuring appears to be related to a linear scale, on which steady incremental progression toward a goal by consuming a pre-planned quantum of resources can be measured."

its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not down to any natural or 'given' base; and if we stop driving the piles deeper, it is not because we have reached firm ground. We simply stop when we are satisfied that the piles are firm enough to carry the structure, at least for the time being.

2. Strategies for knowledge creation

There is rarely a 'given formula', the application of which results in the generation of something new. Our researchers have numerous strategies that assist in conceptualising their question. The strategies, whilst not necessarily unique, or solely due to the presence of HIMS, do appear to be fostered by working within the HIMS environment. Conceiving of analogies, for example, is not an uncommon practice in helping to explain intangible matters. R1, the political scientist, frequently creates analogies to help his thinking. Over the six months of working with HIMS he developed no less than six, all of which permitted him to further develop and better understand (give form to) his emerging thoughts about HIMS itself and also about the work of a researcher.

2.1 Creating analogies (analogical thinking)

Interstellar space and stardust

I was thinking the *HIMS* concepts here are the ones that one would pick up when you are reading. What happens when I think laterally as I'm reading something – I sort of go into a dream mode or reflective state and my mind dances all over the place, and on very productive or creative sessions can come up with a really good idea and jot it down. But the path towards reaching that point can take an infinite variety of routes, and sort of disappears into the mist and is very hard to plot. In fact I thought of the analogy of planets forming out of intergalactic dust. There is the dust in the galaxy and over billions of years it coagulates and eventually ends up as planets or stars. The stars might be the equivalent of the concepts that we're searching for here (with HIMS). The process that brings about the star is a very elongated one and so is this. We

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move away from simply finding the variations of given concepts. Often when you're reading it's not a single word that turns you on, it could be a sentence or terms in different sentences or paragraphs and they sort of clump together in your mind.

Our political scientist has been prompted by the existence of the ability to create *HIMSconcepts*, which can be thought of as a constellation of ideas, to articulate his thinking in these analogical terms, and to acknowledge that this 'process' can result in coming "across a certain phenomenon ... but which is very very original":

... and I get back to that interstellar space analogy whereby we either look closely at a given star that we've found, we look at its structure and all kinds of things about it, or else we shoot off where there are no stars at all and there's just the dust. And I think the APOL postings [[Australian Politics NewsGroup postings](#)] for example, are for my purposes the dust clouds. They still are very interesting, but for reasons different from when you actually look at a star. Some people would like to look at the stars of research, other people wander off into the dust and may go for a long while without finding anything at all. But they'll come across a certain phenomenon which is obviously not a star but which is very very original, and you'd never find it unless you're prepared to wander virtually endlessly, and you can't do both at once.

Adding brush strokes to a work of art

As the *HIMSconcept* was being developed by adding and refining its associated constellation of terms, and then applied to the data being investigated, the idea of creating a picture emerged:

This adding (additive overlaying of *HIMSconcepts*) would be an advantage I think, research-wise; to keep adding to the picture here is like putting brush strokes on but all of a particular shade as the words are related.

HIMS actually arranges matters such that its user is free to render ideas as entities separate from (but connected to) the data which has, in part, spawned

these thoughts and impressions, and then to permit the emerging concept(s) to provide a new, or another, view from which data may be considered. Releasing the researcher from the burden of both forming the concept and applying it to the data, permits a given (and limited) cognitive capacity to be directed to the task which only humans can do – generate new knowledge.

Thickness of the dust

The constellation of terms comprising a *HIMSc* concept are manifest as 'blue lights' (blue highlighting – but the highlight colour is subject to configuration). All instances of terms forming the concept, or associated with it, are highlighted in situ, freeing the user from the cognitive load associated with search and recognition and permitting concentration on substantive, rather than methodological, matters related to further developing a notion. In R1's terms, he is seeking to obtain a measure of the "thickness of the dust" through a scanning process:

I think I need to visually scan all the 'blue lights' and get the context right there, not of the whole database necessarily, but just of parts of it, to see the density of the 'blue lights' as it were. You then get the feeling for the thickness of the dust kind of thing.

The sea of knowledge

One should bear in mind that the amount of data capable of being dealt with by the unaided human intellect is but a fraction of the material with which R1 is working. The APOL data, as R1 refers to it (actually it is a hypertext, or *HIMSHyperfolder*), is in excess of 4.3 megabytes from the Australian Politics NewsGroup. This is well over one thousand printed A4 pages – in a smallish typeface! Such volumes just cannot be made sense of manually. R1 likens the situation to a sea of knowledge in which the survivors of the research turmoil have not yet lost hope or lost sight of the goal, despite their inevitable crashing through the surf before they reach the shore:

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The sea in which shipwreck survivors are bobbing up and down in the swell searching for survivors and fragments of flotsam to cling to. This is akin to the searching of knowledge (an electronic database) where the query is very well defined and the search result is known to exist and will be easily recognisable when it is found. The waves are well formed and regular, almost obviously mathematically describable – the domain or environment is 'known' or understandable. As the wave crashes onto the shore however, the previously very ordered wave transforms into seemingly endless fragments of foam. Which bit of the wave now contains the information one seeks? It is far more difficult to make sense out of this unruly set of water. The bits of foam are much less recognisable than the regular swell out in the deeper water.

Panning for gold

In another analogy, R1 uses the precious metal gold, conjuring up thoughts of wealth and riches beyond expectations, as a device to explain what he has witnessed as being possible through the empowerment of HIMS, as compared to without it:

The role of the lone researcher, alone physically, but surrounded by global contacts through the machine here [referring to Internet connections], is a bit like panning for gold, where you can pan all day and end up getting a few specks of gold. You can get reasonably wealthy that way, but, pieces of gold, so far as we are concerned, is not that linear thinking which you can pick up with other computer programs when you're going through qualitative data. ... Much of this is about a slow development of ideas, I think. A slow development and a maturation of research themes. Because it's often so thin, whether you think of that as interstellar dust or gold dust, it may take a long time for something to gel, so you've got to be prepared to work with something that develops fairly slowly and matures fairly slowly – it would be unusual to discover the equivalent of say a mother-lode of gold in the way you discovered with ... [referring to the valuable piece of information found during a HIMS familiarisation session]. What we discover more usually is a series of nuggets, and they of course

can be totally isolated. You get one, but then there's not one for another ten miles around.

The skeleton lying there

All researchers, both quantitative and qualitative, seek patterns in their data with a view to creating an explanation or a model of the phenomenon. R1 conceives of this as uncovering the "skeleton lying there":

We talked about the existence of a skeleton lying there, but you didn't know what it was the skeleton of. And it's sort of lying in a bed of sand, and that's all data as well, a bit like digging up a, I don't know what you call it, these old bones and things. ... Yes, I think the very fact that you see the blue things popping up and then you're able to move on and do something with them and establish relationships with them, and to see, what we called in one interview, the "thickness of the data" and how it might be compared with interstellar dust and the condensation of planets and so on. ... And so it was by the lateral thinking that you come up more quickly with more interesting skeletons – skeleton is the other word for pattern.

2.2 Juxtaposition

Juxtaposition is a core feature of HIMS. The bringing together in space or in time, bringing into focus, is an oft cited creative technique. Whilst one does not need support from technology to achieve this, the sheer speed with which one can accomplish the processing of large masses of data is itself empowering and has led R4 do something useful which had not occurred to him before, despite knowing his data rather well and constantly working with it:

... where we went through the FishyIndex and highlighted things, we were using the terms, "Ramnad", "pearl", "fisheries", and so on like that. That *HIMSconcept*, particularly by using "pearl", actually juxtaposed in a way that hadn't occurred to me before – and might be useful.

In the case of R1, a double or piggyback juxtaposition led to recognising a new idea or question. Whilst exploring the APOL data with HIMS, he came across an instance of “unethical” and, quite proximate on the screen, “behaviour” highlighted in blue as a result of invoking the relevant *HIMS* concept. R1 had not specifically formulated the idea represented by the term “unethical behaviour”; he had the individual terms as part of his thinking. This instance of the now obvious juxtaposition attracted his attention for it revealed that the writer (of that NewsGroup posting) was relating to the world OUTSIDE the Public Service as opposed to the more usual thinking which relates to it “from the inside”.

HD: Yeah, we have found a hit here. Whilst you can very easily find the cases where “unethical” and “behaviour” occur, say via inspection, using some automated algorithm, or via the research assistant, what can't be so easily done is to juxtapose (a secondary or piggy-back juxtaposition) the context which then claims your attention by virtue of the primary juxtaposition of “unethical” and “behaviour”. In this case the context is “... media recruiting of ...”, whereas in the next instance of “unethical” juxtaposed with “behaviour” it might be something quite different. However, that primary juxtaposition which made plain the secondary juxtaposition might help you to create something new. R1: Yes, that's true. You see this person is relating to the world outside the Public Service, which is interesting to me, whereas “unethical behaviour” would normally be used in these responses towards other Public Servants, or politicians, all of whom are inside the system – these are people in the media.

2.3 Ways of reading

In the F1_data we encountered the notion of ‘ways of reading’ as articulated by R5:

It's ways of reading; in the techniques I use bibliographic searches. Is it a mind-set? I think it's a set of questions; a set of questions and a set of possible relationships to look for.

Here now, in the data collected as HIMS was being used, R4 explains that looking for relationships, is something “that we're doing all the time”. R4 is using

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a form of manual juxtaposing technique when he asks: “what is it that keeps coming up in different places that provides kind of hooks and eyes as it were, to link them [the documents] together”.

R4: I mean HIMS is doing it because you're saying “do it”. HD: Oh yes, oh yes. It's assisting, it's leveraging your intellectual prowess, if you like. Some of these terms are highlighted, and naturally your focus is toward blue highlighting. The reading of this material now shows those highlighted terms in context, and that I think has delivered an idea. I imagine that one does this manually in one's research. R4: I think that that's what we're doing all the time. Well, when I say all the time, I mean there are times when you're simply reading for content, for meaning. That's why handling it and reading it is often very important. But once you've read a certain number of documents, the task is to say “what is it that keeps coming up in different places that provides kind of hooks and eyes as it were, to link them together?” and that's when, I think, in our way of working we tend to start generating – the possibility that there are things that are happening in each of the documents that suggest they've got something in common.

In the above example, it is clear that finding or generating knowledge (the hooks, eyes, and links) about the knowledge (in the base data) has led to something new. And it is this new thing (a hypertext in the mind) which must now be explicated and developed.

R4's ‘way of reading’, the aim of which is to discover the “hooks and the eyes”, and “to link them together” is a key to his research ability and can be thought of as the construction of a hypertext. In fact he characterises part of his work as just that:

That's the first hypertext if you like, my bringing these materials together from the archives in India and London. You see this set of materials does not exist in this form anywhere else in the world except here.

We have also seen from the F1_data that our political scientist reads widely:

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R1: ... in terms of my general reading I'm fairly athletic. ... and I cut them up and I've got very thick files at home which cover the whole area of science and the kind of thing that catches my eye. There is a huge background of reading, whether it is Shakespearian plays, English literature... I buy a vast amount of books, and seldom read them from cover to cover. I read about what's going on in other states, other parts of the world, at other points in history.

He also has a definite strategy geared to discover the interesting and new. The pre-HIMS strategy of cutting up articles and adding them to very thick files can now be described as:

R1: I was thinking the (equivalent of the) *HIMS* concepts here are the ones that one would pick up when you are reading. When I think laterally, when I'm reading something, I sort of go into a dream mode or reflective state and my mind dances all over the place, and on very productive or creative sessions you can come up with a really good idea. But the path towards reaching that point can take an infinite variety of routes, and sort of disappears into the mist and is very hard to plot.

HIMS permits the keeping track of 'interesting' material:

R1: Now, if you have a research item in mind, then you'd say to me "what are your concepts?" and we'd list them all there. And that's fine, but you're then looking for something, in which you're interested in a vast bank of data. This other way is really saying let's not look for anything in particular, let's just see if there's anything interesting.

In the HIMS empowered state, the researcher can target so much more source material with which to work, simultaneously reducing the likelihood of missing something important and more expansively exploring data for relevant ideas, whilst taking advantage of existing strategies for creating knowledge.

3. Maximising knowledge-work potential

In the section on Knowledge-work inhibitors we considered the possibility of being diverted from the main work. Knowledge-workers are susceptible to be lured into diversions, more interesting paths to follow, apparently more pressing things to do, especially when the going gets a little tough. On the one hand one wants to finish the main work, but at the same time one may see opportunities for future ventures. To desensitise oneself to possible diversions brings with it the possibility of missed opportunity. With 'help' from some 'device' it is possible to take a short diversion and preserve an entree into the potential diversionary material, and yet continue with the main train of thought. The 'help' reduces the cognitive load imposed on preserving a connection for future follow-up. Two categories where such a feature has proved beneficial are when the totally unexpected pops up, and when making a serendipitous discovery. The important point is to be able to preserve a link for future follow up without being diverted from the main task, thereby maximising the potential of the research output.

3.1 Unexpected encounters and preserving a link for future follow-up

The economist has a latent interest in a software package known as "Mathematica", and associated knowledge:

R3: This is where I first picked it up and I must admit it was a little bit by accident but only because I wouldn't have expected anything on this to be in this sort of data. But what one can do with this is you can have 20 concepts that you're interested in, and zoom them past all of it. I think probably the most interesting output, and this was only through using HIMS minimally, and obviously you could multiply this by using it more extensively, was following up leads in areas that you may not have expected. I found it useful in that area of "Mathematica" which I am trying to follow up, and I found out there is a sub-package of that which is obviously going to be particularly interesting to me which I would not have found otherwise. I didn't have a clue that there's an econometrics package which links in with Mathematica. That's the exact sort of thing that I want. So now that leads one to further ... that could save me quite a lot of time and effort.

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He was not only able to uncover relevant material amongst the seven megabytes of the Science.Economics NewsGroup data (whilst not even specifically looking for it), but was able to keep a link to this sideline for future attention.

In another case, R1 was working on his "APOL database" exploring themes related to a book he was editing when he made an unexpected and unpredictable find:

R1: The interesting thing is that I would have had no way of predicting the total outcome here. I am just amazed that these terms ("fail", "productivity", "minders" – key terms thought of at the outset of the search) turned up nothing and these ("accountability", "Westminster") turned up a lot. I mean I couldn't have predicted that.

Sometimes a researcher stumbles across something important but not entirely unexpected. This can also pose a minor dilemma in work-load management. As in the cases above, it is helpful to be able to deal with all potentially useful data, almost at once as it were.

3.2 Stumbling across data and serendipitous discoveries

R4 stumbled across data using the "Ramnad" concept (named for the kingdom that controlled pearl fisheries in Southern India) applied to his specially constructed FishyIndex dataset:

The reason it has come up is, first of all, because it's the Government of Madras' proceedings, and that's the controlling government, and so you'd expect this to be there. The date is what, can't see it there, oh 1878. What they're looking at is the question of territorial water to protect the pearl fisheries and so on. What you're seeing is some correspondence, which is about the control of pearl fisheries and would be useful if one were working on the pearl fisheries, which at the moment I am not, but it ... [R4 is now thinking about the possibilities of this sideline]

In a casual, almost impromptu session with HIMS:

R1: Once you do start a slow browse there, you realise that a lot of stuff on the network is just gossip, and it's not going to be useful for research. It's people who like playing around with technology I think, as opposed to those like yourself. But even so, that should still leave a large percentage; and you've given evidence of some very important stuff that's been loaded on these networks and hopefully we'd encounter something like that, like I did with the federal-state financial relations this morning. And that was an interesting little sideline. HD: Is that useful in your research? R1: Well, I've just written a book with a very similar table (to the one found in the federal-state relations investigation), as part of it and I'd like to compare the table from here with the table in the book. It would be interesting to say "do our tables show the same kind of data and if so are the figures identical or close. Just what is this guy saying, is he suggesting an alternative way of looking at federal-state financial relations?"

This "table" can be seen as extra data of which R1 was not aware whilst researching material for his book, and whilst the book is in press R1 is wanting to preserve this in case a review opportunity presents itself in the future.

Sometimes a discovery can be truly fortuitous; due to serendipity. In this rather odd case R1 was looking at the Q5_Ethics data [answers to the open ended question (number 5) of his survey on ethics in the public sector]. As a check on data completeness he was interested in working out the number of instances of "no response". The hypertext searching had revealed the number of instances of "NR" (the code for "no response"). He is now seeing this Q5 data in two categories from this point. One where there is no response and one where there is a response:

R1: Now we did a count of the number of NR (no responses to Q5). That's a very useful thing by the way. HD: We'll get that reflected in this *hyperfolder*, shall we? We'll search all text for instances of "nr".

Pagination through the search 'hit list' revealed 70 hits, of which two hits should be deducted because they were for "nr" in the word "unreasonable" (the code for no response was in upper case but the search was not case sensitive or restricted to targeting whole words). This, and here's the chance discovery, incidentally also informs us that there are only two instances where the word "unreasonable" appears in the data:

HD: That's a serendipitous finding. R1: Yes, interesting, Yeah. HD: See you mightn't have thought of doing that. R1: It could in fact turn out to be more important than the original question. HD: That's true, and that's exactly what HIMS is about, that's what hypertext is so wonderful at.

Now we see an ultimate purpose of HIMS being realised:

R1: In fact, it makes you want to go back and say: **what was the context of "unreasonable" ?**

Generating new insights which in this case have a bearing on the general research theme but which do not necessarily contribute directly to the precise matter under investigation is an example of what we have termed *Generative Conceptualisation*. Further, we now see how HIMS supports R1 in this tangent to the main enterprise which is to research the answers to the open ended question to the "Ethics Questionnaire" with respect to ethics, unethical, corruption, dishonesty, and behaviour:

HD: Now let's chase up your quest to explore "unreasonable". R1: Let's just look at them. "Unreasonable expectations", "unreasonable demands", yes there's quite a similarity in the two there.

4. Doability and empowerment

In this section we explore what our respondents experienced in relation to the doability of their knowledge-work in the HIMS-empowered state. We begin with the recognition for the need, or desirability, to be able to access and process vast repositories of data, and witness the transformation of a sense of un-doability into a very clear sense of achievement and satisfaction at the result of being empowered with HIMS.

4.1 *Rich and voluminous data sources*

R4: We (historians) are invariably faced by huge universes of material, which is all those records that have survived and been conserved in archives, perhaps museums, and libraries and so on. So we always face the prospect that there is very much more stuff there than we can ever know or can ever fully gain access to.

In this statement we see the desire to access as much material as possible and yet keep the data volume to a manageable level. We'll continue to be faced by the same problem, even in an empowered state, as everything is relative. But we can deal with perhaps a few orders of magnitude more data with the 'helps' for the intellect, which a device such as HIMS provides. Researchers are thus able to target more source data, knowing that the workload its processing implies is manageable. Whatever its volume, the data must still be thoughtfully assembled, as R4 reminds us:

HD: So there seems to be no doubt that the database to which you apply HIMS, indeed any piece of technology, has a lot to say about what you are going to get out of it. R4: Yes, that's right ... it will only do that to the degree that the data itself contains the means of doing it.

In contrast to the highly specialised data of R4, there are occasions on which it may be appropriate to unleash the power of HIMS on a dataset of galactic characteristics, possessing both randomness and vastness:

R1: Should we really be looking at, I don't know whether Internet is the right word for the origin of all of these postings, ... see we've got a choice it seems to me, and I get back to that interstellar space analogy whereby we either look closely at a given star that we've found, we look at its structure and all kinds of things about it, or else we shoot off where there are no stars at all and there's just the dust, and I think some of the APOL database for example, represents for my purposes the dust clouds. They still are very interesting but for reasons different from when you actually look at a star. Some people would like to look at the stars of research, other people wander off into the dust and may go for a long

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while without finding anything at all but they'll come across a certain phenomenon which is obviously not a star but which is very very original, and you'd never find it unless you're prepared to wander virtually endlessly.

Revisiting the interstellar space analogy allows R1 to think of connecting HIMS to the APOL database, with its relatively sparse population of potentially useful data (as he has discovered), but in the knowledge that it is achievable, manageable, doable, and likely to result in the discovery of something "very very original".

4.2 Unboundedness of knowledge

In the Field_1 studies we generated K_Maps for each of the respondents and saw just how interconnected the world of knowledge-workers is. For example, the structural engineer interacted with a biologist (quite a surprising fact at the time it was discovered), the political scientist with Shakespearean literature, and the historian of science drew on mathematics (not as a matter of investigation but as a model provider). Whatever the reasons (and they vary widely) for making such interconnections, the resultant webs of knowledge conjure images of the unbounded nature of knowledge.

Real world imperatives, practical constraints, and a concern for diminishing returns are very apparent to the economist:

R3: But, you know, you can see why people try to delimit and focus down onto something manageable because there is always probably something more out there, that if you search long and hard enough you'll find, but you'll reach decreasing returns to that. If time wasn't a constraint you could probably spend more time sifting through that material, but a fair amount of it is stuff, which wouldn't help very much in your day to day research. It could broaden your horizons I suppose, and it can put you in touch with people who are thinking along similar lines to yourself. But a fair bit of it is junk. I don't know how to get around that. I think with HIMS you might be able to link some of your own concepts into it, but the data is just so voluminous, it's overwhelming. HD: Well, I think

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there is no doubt, you'd spend all your days doing it manually. R3: Yeah, you couldn't do it manually.

The freshness, as it were, of data or information created a very short time ago, and its diversity of origin, both contribute to a dynamism so characteristic of the vast Internet NewsGroup data. This brings with it certain attractions:

R1: What I like about this is that it's very new data, or it could be, the APOLO data. But the idea of plugging into conversations taking place between informed or interested intelligent people, in the way you can on the Internet, is really extremely up-to-date. And its constant updating has an attractiveness.

For R1, the "attractiveness" is a stimulation to generating a new approach or new ideas. His analogical thinking helps in this, and is complemented by the process of dodging his way all through a variety of source materials:

R1: But if I was looking for ideas, I then go off and look at very different books. I say what have I bought recently that's about this? I go to there, and go to the index and I dodge my way all through the book, and sometimes I take extensive notes from the same book.

4.3 The need for empowerment

Many researchers feel the pressure to do more or better:

R4: ... one of the things that is driving us toward wanting to be able to do this is that we're all flat out, I mean none of us get the time to do research that we really need or we really feel is necessary, but we have enormous pressure on us to produce. So we have a real interest in finding a way in which we can much more quickly search that material, along the lines I've been talking about, that is of bringing things together, in order to say that will be useful for this paper or this chapter in this monograph and so on.

By contrast, sometimes the pressures to seek a change (to an empowered state for example) can come from within the researcher himself. R1 thinks of empowerment as a combination of facility and direction – and he ardently desires the former.

R1: No, well that's exactly what I am. I'm a person who knows where he'd like to go, but getting there is absolutely laborious to the extent that you sometimes give up. Now this is opening up a new, well I was going to say "freeway", but that's becoming a bit of a cliché isn't it, the sort of super highways and that kind of thing. But it is, I mean we are talking about direction and roads to get there and you can see how the freeway analogy applies.

All software systems demand considerable investment by users in gaining the required competence, the crucial question being: will the benefit outweigh the cost of deriving it? This investment has paid off for R1. In answer to the question: "how would you do this type of work without HIMS?",

R1: There's only one way if I wasn't going to use any program. You could only sit down and read it like a book, and you'd fatigue and could well miss some good ideas if you'd been doing it for an hour or two. You might be able to do an hour in the morning, an hour in the afternoon, and do that for several weeks. It would be laborious, and you may well get inclined to give it up before you're done.

This provides a positive view of the case for empowerment from the perspective of a researcher who has actually invested considerable resource in learning to use HIMS as a research tool.

4.4 Empowerment

The term empowerment has been used frequently in our discussion here and with the respondents. Despite its operational definition towards the end of Chapter 3 (page 84) it is important to know what concept this represents to our respondents now that they have (arguably) been empowered by HIMS.

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To the non-technical political scientist, it has meant gaining speed, and in a subsequent wave of empowerment he has experienced a deliberate and directed application of that speed:

R1: [tape change]... just a delight of the process, it's the kind of thing of course that delights the technician. HD: Yes, but there's more to technical things here than ... I mean, when you say it speeds you up and you get a buzz from the speed, you do really feel as if you were flying – no traffic lights up there and you can go quickly and freely. But of course it's not just the speed, it's where the speed gets us. Is that what's the important thing or is it just the pure speed. R1: Oh well, that would be even better, later. The thing is that you've taken the first step, and for me it's an important one for I'm not a technical person, so I probably get a larger buzz out of just acquiring the speed even though it may be, at that stage, directionless. But once you add the direction to it, yes, it becomes even better. HD: Well, probably the speed plus the direction is empowerment.

The economist R3 is more technical in the sense that he uses numerous econometric modelling packages through which he has experienced the speed of 'number-crunching'. That part of his research for which there was no support prior to HIMS, he did manually:

HD: So how did you do that prior to HIMS? R3: Ah, I probably would have done it with pencil and paper, but that means you can only keep a certain amount of that, a certain amount of balls in the air at a time. I think the HIMS thing would allow you to formalise that more, keep more things in play – that's helpful I think. HD: Would you go so far as to call that empowering? R3: Oh, I would, I think so. Anything like that, that improves your efficiency and the end result would have to be an empowering technique.

Efficiency and effectiveness, the achievement of the desired end-result, are part of R3's concept of empowerment. But has HIMS extended the intellect as was expected?

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HD: HIMS is a mind extender, or intellectual augments. Would you see HIMS as along those lines? R3: It could be a tool along those lines, definitely, yes. The ability to organise stuff in a way that you can comprehend, is an absolute necessity to pushing forward some particular area, and by and large you need some tool to do that, and this (HIMS) seems quite a good tool.

There are no shortcuts to doing a thorough piece of research. Despite the exigency to publish – with its concomitant focus on quantity, R3 is well aware of the pressures on him to perform, as was R4, and may now well be in a better position to resist the temptation to adopt a compendious method to achieve the necessary output:

R3: Ah well, it (HIMS) probably allows you to do a better job than you would prior, in being able to access and keep before yourself more possible avenues of information and so on. One of my colleagues suggests you don't really need to do extensive reviews and that sort of thing; all you do is you get hold of two or three seminal articles in the area. I think that's a somewhat extreme position and most people would expect you to have accessed a pretty wide range of material, if you are going to be serious about writing in a particular area.

Information management is one of HIMS's key features. The ability to "keep before yourself more possible avenues of information" which R3 found helpful is also seen as valuable by the historian:

R4: Clearly the ability to, not only go through the material, but then to save a cache of material as it were, that relates to something that you have done – that seems to me to obviously offer some valuable thing.

The political scientist especially values the ability to expose the 'bare bones' reposing in the data. Once again, in analogical terms, he thinks of a possible complete skeleton which represents the fundamental structure of an idea, but its components (the bones) are scattered throughout the data set, and are not easily pieced together.

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R1: Even if you try and go in with that so-called open mind, it would be so huge a database that you couldn't envisage the skeleton without a tool like this [here R1 is recognising the un-doable]. It's very hard to keep the mind open if you're looking for that skeleton, there's a bit of it over here and a bit of it over there, and where did I see that other bit, it was somewhere around here wasn't it. But this gives it you in one fell swoop. Certainly it helps me conceptualise what these respondents [to a questionnaire] are trying to say, by getting the visual feel for it on the screen. There is no question about that. I mean you can get a real feel and make judgements.

The multi-dimensional nature of the questionnaire data R1 was working on reveals another salient aspect of HIMS with respect to empowerment:

HD: Yes, you've got quite a nice variety there. Let's just count: You've got "ethic" (ethics, ethical, unethical), "corruption" is another one, "legal" would be a third, "dishonest" a fourth, "behaviour" a fifth, – there are at least five ideas or five broad terms there. If we now ask the question: could you keep these in mind as you read the answers to question 5? R1: No, that's the great thing about it. If I spread those out on the desk there is no way you can comprehend the variety there even though there are basically only five concepts. You couldn't keep the varieties in mind at all. HD: Well that is already beginning to be some evidence, if this works, that HIMS is useful in empowering. R1: Oh it certainly is.

This ability to assist the HIMS user with many dimensions simultaneously is implemented via the *HIMSconcept* device and uses techniques of association and highlighting (blue by default, hence the references to 'blue lights'). An alternate way to consider this is in terms of searching for concepts represented by constellations of terms.

R4: Given the hypertext now, presumably the key words are redundant, because you can search for any word. I can search for all the things about "Ramnad" couldn't I? HD: Yes, but remember what we are chasing up here is this constellation of terms which represents *concept*

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with name "Ramnad". Would the term "chank" not be included as part of that? R4: It could be, it could be, because it will occur where the pearl beds were. The pearls were actually on rock and the chank is in the mud around the rock. And what you will find is that the literature will often refer to both.

R4 has just extended his *HIMSconcept* "Ramnad" to also include the shell called "chank". Now as he reviews the data with the extended concept he begins to form a new *HIMSconcept* called "compearl" (reproduced below):

HD: I noticed as you were writing into that *concept* file that your notes (as part of the *HIMSconcept* "compearl") were more like instructions for a researcher, yourself or someone else, to go and chase things up (the content of the *concept* file is reproduced as [Figure 29](#) below. In that sense they do represent the ideas which you think are important to be considered in a comparative article. R4: Yes indeed. When you start to write this, you should realise, that this part is going to take you in that kind of direction. And you'll have to therefore, also balance it against this or take into account other things that are .. HD: Ok, now, without HIMS, how would you have done this (come up with the comparative article idea)? R4: Whether one would have thought of the comparative thing or not is another question. HD: Do you want to elaborate on that? R4: The likelihood is that you wouldn't have necessarily come up with this, at least as early, because the greater likelihood was that you would ..., I would have gone to this material, knowing as I do, that there is material on pearl fisheries of Madras, and some on the pearl fisheries of Ceylon, and probably remembering that there were several reports in there about how the Burmese pearl fisheries might be better exploited or whatever. Now what happened last week [[our previous meeting](#)] was that because you search through the thing quickly, you saw those three were all clearly in there. The one additional thing that happened last week was discovering the fact that someone thought of going to the Andamans; it became more apparent than it would have been [[without HIMS](#)]. But my normal way of working, I imagine, would have been to say let me have a look at what I've got on Madras pearl fisheries and see what that material tells me was happening, and try and develop a narrative, if you like, in the first place, of what was happening,

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and then see what that narrative suggests by way of the points that you need to take into consideration in analysing what was happening. Then you would have done Burma, then Ceylon, let's say. Then at that point you might have thought it'd be worthwhile to bring these together by way of comparison.

Seeing the material which R4 knows so well in a different light, with the newly developed *HIMSconcept* "compearl" (renamed from its less descriptive former name of "Ramnad") has permitted him to see the possibility of doing something which had not occurred to him before. He has generated new knowledge – the beginnings of it at least.

R4: Yes. I made to you the point that most would not have thought about the Burma pearl fisheries. I have been to the archives and said I want this and this and this, from having looked at them. That's the first hypertext if you like, my bringing them together. The next thing I want to do is to actually create a catalogue, as it were, because that way I believed I could get more handle on them. The cataloguing seemed to me to be an important way to get at the material, there's just so much of it, even though I'd read it all, in a sense. Because I now have the catalogue, and using your technology or one of these technologies, I can be reminded of the search for pearls in the Andaman and Nicobar Islands also – and not to lose sight of that.

A study of comparative management of south asian pearl fisheries in the late 19th and early 20th century

Keywords: pearl, fisheries, Manaar, Mergui, Ceylon, Andamans, Paravar, Tinnevelly, banks, chank

First frames suggest that in the First World War period there was some consideration being given to protection of pearl and chank beds by use of legislation (dating from 1878) for jurisdiction in territorial waters. Reference to Ceylon and to the possibility of creation of a 'closed sea' in the Gulf of Manaar. Not clear if Ceylon was to be part of the 'protected' area or whether Ceylon fishers were to be excluded from banks off Tinnevelly. Fact that pearl fisheries slump after c. 1911-12 makes it unclear why this particular discussion (from c. 1915-1918) was taking place at least in terms of 'protection'.

Figure 29: The HIMSconcept "compearl"

We should not be claiming too much for HIMS however, for absolutely nothing gets done without an initial input from the unaided or naked human intellect. In creating the research database on Indian fisheries R4 'read' through the material in the London and Indian archives. This initial 'reading' permitted him to assemble a manageable subset with which to return to Australia. Where the unaided intellect was deficient, the tried and proven 'four by six' catalogue cards served a purpose. The job is so demanding, however, that some form of 'help' would be required:

R4: I felt that you would need to be able to see it to remind ... I've got cards for all of the things, a card catalogue, which is what I made as I went through them, but, and I mean I've divided those up into Bengal, and Bombay, and so on, for my own purposes, but I thought once we had the microcomputer, and particularly once I involved John and Bob, then I needed something for them to be able to come along and say: I want to find out about X, where is it.

Creating the catalogue is the researcher's way of imposing some structure on the otherwise unwieldy mass of data. In the dominant paradigm it is the only way we know, that is to create a hierarchy out of the data. But which hierarchy? Do

we use location as the top level dimension? Or perhaps it is an administrative element, or fishery type. However, it can only be one of these at any one time. The fact that R4 did not think of the possibility of a comparative article prior to HIMS is simply due to his not having created a catalogue with fishery location as a primary feature (it was, after date, a secondary feature). What we do see in R4's thinking is a definite motive to structure the data. HIMS was able to offer support for structure but also expanded, multi-structure abilities. Through HIMS, R4 was able to structure the data into a hypertext (multiple concurrent hierarchies) and take multi-dimensional views of the data with any given dimension-hierarchy he chose.

The political scientist's discoveries were just as new, although he became somewhat more obviously excited at the realisation. We were looking through the "Ethics_Q5" dataset with various *HIMSconcepts* activated when he spontaneously exclaimed:

R1: Look at that! It would be interesting to be able to get a measure of the percentage ... if one could measure the total concepts in all those answers in some way, and then say x% of these were to do with these root words – that would be quite a statement to be able to make as a finding.

The development of the idea to measure the percentage of concepts (as represented by *HIMSconcepts*) in a given dataset is one that probably would not have come to him without HIMS. He has created a new device which will itself be empowering; discovered a new method of assessing the importance of data:

HD: Yes, well now, if I could put it this way, as a result of the current empowerment of HIMS, you're now even saying you can conceive of these extra things you want it to do. That raises an interesting question for me. Would you have conceived of that idea, the x% hits of the constellation of words representing the *HIMSconcept* with name "ethics", ... R1: **No, no, no, the answer is no to your question, no.** HD: That to me is evidence of originality, original thinking. If you wouldn't have come up with that before, but you have through HIMS, then HIMS has been in part responsible. R1: And it's responsible even though it's not possible at

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present (for HIMS to do the x% analysis directly), as it wasn't possible with my previous research experience either.

We should note that this finding has nothing whatever to do with the main goal of analysing the ethics data. That is, the finding was not part of the original design and would have been missed if R1 had not moved beyond a positivistic paradigm of inquiry.

It is clear that speeding up the research process or any of its component parts is valuable, but HIMS delivers far more than that. The ability to do more and better research, to be more efficient and effective, has been attested by the respondents. Also as we have seen, such empowerment of the researcher by HIMS has resulted in creative acts, 'ah ha' experiences, new interpretations of data and conceiving a new methodology – in short, original thinking.

The essentially isolated instances of empowerment we have considered up to now are indeed exciting and rewarding, but it is this author's contention that if researchers worked more fully in a hypertext paradigm they would achieve even more. Through empowerment, we have seen evidence of knowledge creation, the beginnings of *Generative Conceptualisation* and working in a hypertext paradigm where the dynamism and freedom permits creativity and original thinking to flourish.

HIMS evaluation

To conclude this chapter on the effect of HIMS in the field we take a look at some of the advantages and disadvantages as reported by the respondents.

HIMS' utility and positive aspects

An overall impression from R4:

HD: Were you surprised at all about what HIMS had in it? R4: Yes, in certain ways. I wasn't so knowledgeable as to be able to really know what I should fully expect, but it went I think a little further, or maybe quite a deal further than I had assumed. First up, it seemed to be largely a means of simply making the identification of the same word, which of course can sometimes be quite misleading because "fishery" used in one quote may not be the same as "fishery" used in another, and these kinds of searches don't necessarily, in that kind of way, distinguish ... HD: I'm getting the sense that you believe that there is actually something here that is worth pursuing, as opposed to throwing away. R4: Oh yeah, no, I wouldn't for a moment think that it's not worth pursuing. It's clearly worth pursuing because even with somebody as limited in applying it as I am, in one or two small ways you can see it, even with that limited sort of use, you can make some ground.

Invoking emerging complex concepts:

R1: The additive overlaying of *HIMS* concepts would be an advantage I think, research wise. To keep adding to the picture is like putting on brush strokes, but all of a particular shade as the words are related.

Preserving sidetracks:

HD: Do you remember the sidetracks you mentioned, there is this tendency to say "oh boy, that's an interesting one to follow", but yet I can't handle that [unaided]. HIMS supports you doing that in a number of ways. One is the 'noted reference list'. Have we talked about that? For example, if this article were of interest to you, you'd put the cursor there say, and press the <insert> key. R1: Oh we haven't done this. That's very interesting, because I was going to ask you this very thing. HD: Yes, press the <insert key>, then you have some 40 characters in which to make a comment to remind you of why you are 'noting' this reference. Essentially this is like a little 'PostIt Note' that you are inserting,

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but it will actually create a hypertext link for you to follow and get back to that very article. R1: Yes, I was going to ask you the very same thing. Now what to put there? "Labour propaganda" or just "labour" would be sufficient. HD: Now use the 'Notes' menu item to the top right, and 'select' the 'Noted References', there it is. It tells you which *hyperfolder* it's in, and if you click on it you'll immediately get to that article irrespective of where you are. R1: Great stuff, that is really good. HD: Now you had better save the 'Noted References', if you like it, in a file called "something.ref". R1: Great, great. That's really very good. I want to do that again then.

High hopes for HIMS:

R1: And so in this exploration you learn and you're interested at the same time, even though you're not necessarily going to use it for research. But the process that you acquire, for real concepts and real challenges, real research, is going to be invaluable, and I just hope the ideas come on the end of it. That's a bit of a worry for me, that once having mastered the process, will in fact the leapfrogging continue in the world of ideas, concepts, and that's another question altogether.

Flexibility:

R4: I think that you do become aware that it is very flexible, in the sense that when you compare it with things like Endnote – I can't really say that I use Endnote, I've only watched it being used rather than use it. So I am not doing this on the basis that I have deep knowledge of both systems, but comparing what I have seen of Endnote and what I've seen of HIMS, it does strike me that HIMS does have a degree of flexibility that maybe obviates some of the steps that you need to take in some of those other database systems like Endnote, where in a sense you are really asked to define each of your fields, and you've got to do that fairly carefully and strictly, because if you don't, then you're going to get wrong connections. As I understand it, because the data is put into the hypertext form, it appears on the face of it to be able to stay in pretty much the form that you produced it in. Then, once it goes into its

searching mode, it's able to pick up words and things of this kind, with a fair facility by the looks of it.

HIMS reflections by R1

Political scientist R1 has been intensely thoughtful and serious about exploring the features of HIMS. He prepared quite a detailed report on the usefulness of HIMS – almost as if it were a submission to a royal commission.

1] First of all it has an intrinsic attraction as a play-thing.

2] In terms of its more academically related areas of usefulness it's obviously very good for interpersonal contact ... in other words it really facilitates networking, on a global basis; it allows you to be highly selective on whom you contact in that networking process. ... HD: That "doing it on one's own terms", can you just elaborate on that. R1: Well, you can decide whether or not to contact a given person ... all you have to go by is what they have written on the network. You can evaluate an individual to some extent, and then say I won't make contact, or I will, and that's very good. It puts you in an editing position or in a control mode, you've got control over whom you are prepared to work with on the Internet.

R1's next point on HIMS' usefulness develops three aspects: R1 refers to HIMS as providing access to a '**non-reactive**' database; the '**cleanliness**' of the data which refers to its uninhibited creation and the fact that it is uncontrolled; and thirdly that it provides a '**self-organising**' system of data.

3] The next point in terms of usefulness, is the characteristics of HIMS.

a] First of all it's a non-reactive database, in my terms. Which means that I haven't asked anyone any questions, and therefore I'm not pre-determining the answers to my kinds of questions. Other people may

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have asked questions and other people may have answered those questions, but they are not my questions, so in an important sense, it's what I call non-reactive data.

b] It's also clean data, in that people are completely uninhibited and write what they say, they don't even bother about spelling errors, and often the rigour is missing, and in some way this makes it gossipy, but it is clean. By that I mean, more importantly, that it's not just clean in an uninhibited sense, it's also clean because there is no authority behind it. By that I mean, Government. There's no multinational, there's no one controlling it. It's completely freewheeling, and the only condition that you need to fulfil to engage in this is to have a computer and be reasonably intelligent, and to have something to say.

c] Something else I like about it in terms of its characteristics is that it is a self-organising system of data ... it is a system which organises itself without any help from us at all. We may have to set them up, but having set up HIMS, it is very much self-organising once you know what to do with it. The self-organising system statement implies that lying there in the data is a pattern, but you need to find it ... HD: Yes [a thoughtful soft yes]. R1: ... and HIMS allows you to do that. HD: I mean that to me is central. Once I discovered that, or felt that, that's really what drove me. Is that so important do you think? R1: I think it's absolutely vital.

R1: I felt that these characteristics may well be, in turn, characteristics of the initial recognition on your part certainly, and to some extent my own, of HIMS at this stage being the equivalent of the Wright brothers flying.

HIMS aids the lone researcher in discovering (perhaps uncovering is a better word) a pattern:

4] ... alone physically, but surrounded by global contacts through the machine here. HIMS helps you, not in that linear thinking, which you can pick up with other computer programs when you're going through qualitative data like the Q5-base [refers to the Ethics Questionnaire Question 5 open-ended responses]. It was the lateral style thinking; I

even dreamed up the word “lateraliser”, as being the key characteristic of it; it allowed one to become a lateraliser and think in a lateral way, hopefully, rather than just a linear one.

HIMS nurtures the gradual maturation of ideas:

5] ... much of this is about a slow development of ideas, I think; a slow development and a maturation of research themes. Because it's often so thin, whether you think of that as interstellar dust or gold dust, it may take a long time for something to gel, so you've got to be prepared to work with something that develops fairly slowly and matures fairly slowly. It would be unusual to discover the equivalent of say a mother-lode of gold ...

The potential of HIMS:

6] Well my final point is to do with the potential of all of this. One of the problems, I think, about dealing with a research area which is so new, it's very hard to substantiate or demonstrate that it is new. People are always sceptical about it. They are very unwilling to recognise ... being at the very early stages of a particular development; few people recognise the value of a genuine breakthrough and it's easy to trivialise. But my feeling is that while I can't nail it down, and it's almost an act of faith, that the potential in it is huge and exciting, at the same time it's unknown.

Areas for future attention

There are always challenges with software support systems. The findings showed some problems and difficulties associated with HIMS. One major area of concern centred about the learning curve. A steep or long learning curve means the software is difficult to use, or to learn to use. Naturally, a user's expectation or conceptualisation of how a given function should work, and what effect it should create, plays a role, but a software support system such as HIMS will not

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achieve its potential unless its user interface is 'usable' and its functions can be readily understood.

Relatively trivial things such as being constrained to an eight-character long filename can create barriers or downgrade a user's perception of the product:

R4: I suppose the elements are comparative, management of pearl fisheries, South Asian pearl fisheries, in the late 19th and early 20th century, is what I had in mind.

HD: Now we are going to have to find an 8character filename for this. [laughter all round !!!] Sorry about that restriction, but I'd put "compfish" or ... R4: "Compearl".

Incomplete knowledge about a particular function can create uncertainty about the entire product:

HD: The way to proceed now is for you to use the features of HIMS to see if this is empowering for you. Have we discussed how to utilise the "concepts", the menu item in the top right corner? R4: Well I don't feel that I know quite what I'm doing with that. It appears a little less finished and, I don't know whether dependable is the right word, I'm sure it is dependable, but there is a sense in which you don't quite have the sense that at the moment that you're dealing with a regular piece of software. And that may be just a little offputting until you had much more experience with it. It's no more than that, I would think.

Users will want to explore the product in varying detail:

R3: As an end user you just want to know what will it do, what does it require as input and what output do you get?

As we have seen, a hypertext paradigm does not promote a linear progression from inputs, via some defined process, to outputs. Yet, whatever its methods and techniques, they must be understandable with a reasonable expenditure of

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resources. R3 was cautious in his criticism, but the point must be heeded in future versions of HIMS.

R3: Oh, I think it's great, it's got a lot of potential. Well it takes a bit of time to get on top of, it's not that easy but ... HD: Ok, I have to say I grossly underestimated the amount of effort that people would need. R3: ... it's got a lot of features, and it takes you a fair while, or it took me a fair while, to see how all the features hung together. That's the same with any reasonably comprehensive package I suppose.

Presentation of data on the computer screen is always a difficulty. Consider this:

R3: If I activate that *concept* now, should that not highlight those words? HD: Yes, yes it will. HD: Well Ok, firstly you've got to realise that this is a multi-page frame, so you might have to do 'page-down' to see more. You would now press 'next' or use of the tool-bar icons to move around. Now this would be a way of linearly going through and finding these things, but you might also do a search. And you'd search the text for "math" for example. R3: It may well be that there just aren't any in this file because um ... Well that's what I was going to ask, see ...

Not only does R3 need to concentrate on the research task but he must know about frames, multi-page frames, how to distinguish the two, and when to use 'page-down' and 'page-up' keys – all this just to do the equivalent of turning the pages of a book. Then there is the concept of 'next'; is it a physical or a logical next; how to ask for a search; and most difficult in HIMS, the creation and invocation of *concepts*. What one can say is that with time, such tasks will become as automatic as the opening and turning pages of a book or doing the myriad things one must do to drive an automobile. Software engineers have adopted a (pseudo) standard interface for most implementation platforms, and HIMS needs to conform to these to a greater extent than at present.

Simple software can make do with a simple user interface. When the functionality increases, particularly through the product being adaptable to user and situation, the human-computer interface becomes a matter for serious attention and research. As HIMS is a prototype this work is left to the future.

Chapter 6 - Empowerment through a hypertext environment

In this chapter we have examined the field data of the respondents' experience as they worked with HIMS. The analysis has produced four categories, and their attendant properties (Glaser & Strauss 1967 p42), of respondents' empowerment in producing new knowledge. These categories have been formulated into a substantive theory of knowledge creation in the final chapter, [Chapter 9 – A substantive theory of knowledge creation](#).

The next chapter considers the evidence from the field in the light of the research objectives. The penultimate chapter formally states the Hypertext Paradigm according to the ontological, epistemological, and methodological dimensions.

Chapter 7 - Does hypertext empower researchers in doing original and creative work?

The research question and objectives revisited

Can hypertext technology, used in a definable way, empower humans in doing original and creative work?

Specific objectives were:

- 1) To discover the domain specific disciplinary matrix (Kuhn 1970 p182) within which respondents operate.
- 2) To populate the disciplinary matrix with respondents':
 - (i) symbolic generalisations;
 - (ii) shared commitment to beliefs in models;
 - (iii) values;
 - (iv) exemplars;
 - (v) tacit knowledge and intuition. (Kuhn 1970 pp182-198)
- 3) To empower human respondents with a domain specific hypertextual KBS (knowledge based system).
- 4) To study and evaluate the respondents' degree of empowerment.
- 5) To infer the degree of efficacy of hypertext technology as an empowering instrument to augment and enhance the mental capabilities and capacities of the respondent.
- 6) To propose one piece of a 'substantive theory' of knowledge creation supported by appropriate technology (Glaser & Strauss, 1967 pp32-34).
- 7) To set an agenda for future research in paradigm formation (Kuhn p10) and empowerment of cognitive activity.

Does hypertext technology empower human cognitive activity?

This study has explored how a computer software device may be used by individual researchers interested in creating original outputs – supporting and empowering human cognitive activity. The research question was: Can hypertext technology, used in a definable way, empower humans in doing original and creative work? The Hypertext Information Management System (HIMS), designed from the outcomes of the first field study and this author's own ideas, and used by the respondents as reported in the second field study clearly constitutes a definable use of hypertext technology – respondents used HIMS to explore their own knowledge creating cognitive activity. The reader may review the hypertext technology use_specification as given in [The SPT Case Study of Chapter 5 – Associative thinking and the hypertext paradigm](#).

Has this use been empowering? According to the operational definition advanced in [Chapter 3 – Research design to study empowerment of original and creative work](#), respondents have been 'empowered' if they can, by their own judgement, in addition to that of their peers, and that of an independent judge, do 'original' or 'creative' (Goldman 1986 pp247-249) knowledge-work (including problem solving):

- more 'reliably' (Goldman 1986 p26) (the knowledge has not been created in error or ignorance);
or
- with greater 'power' (Goldman 1986 p27) (producing more knowledge);
or
- with greater 'speed' (Goldman 1986 p27) (producing knowledge more quickly).

Satisfying each of the sub-objectives is a tall order. Peer and independent judgements made from first hand observations have not been systematically sought as this would have potentially conflicted with the use of HIMS and respondents' thinking, but independent reviewers of this research have indicated agreement with the documented claims constituting the self-judgements as made by respondents – that is, they say the claims for empowerment are

convincing, but the reader may make a judgement too. Independent verification of attaining the peer judgement criterion must remain for a future study.

Here, the self judgement evidence in respect of each of the reliability, power, and speed criteria is reviewed, culminating in the conclusion that it is justifiable to claim the achievement of empowerment.

Reliability

To establish that knowledge has been created more reliably, we look for evidence of the production of “a high truth ratio of beliefs” (Goldman 1986 p26). There are two aspects to this. The first concerns the production of knowledge which is in error, i.e. the production of false beliefs. This is rather difficult to verify independently in this study as we have no standard except for individual respondents’ judgements. We assume that researchers working at this level are able to adequately judge the output of their cognitive activity and, in the main, do not produce false beliefs. More cannot be said about this aspect of reliability without a further inquiry, but the second aspect, concerning the potential for production of knowledge in the absence of true belief has been witnessed in many instances. [Figure 30: Issues in the reliable production of knowledge](#) summarises the evidence presented in [Chapter 6 – Empowerment through a hypertext environment](#).

Reliability Producing Knowledge in Ignorance	Knowledge-work Issue ³⁶ reference
Diversions prevent the work getting done	1.2
Fear of missing something (completeness)	1.3
Paradigm entrapment – doing things the same way	1.5
Unboundedness of knowledge	4.2

Figure 30: Issues in the reliable production of knowledge

³⁶ *The Knowledge-work Issue is referenced to a numbered section in Chapter 6 – Empowerment through a hypertext environment.*

Power

Of the three aspects to empowerment, as it has been operationally defined, the production of more knowledge has been the most evident. Respondents have wondered, and evidenced being in awe, at this empowering aspect of HIMS.

Figure 31: *Issues in the production of more knowledge* summarises the findings reported and discussed in Chapter 6 – *Empowerment through a hypertext environment*.

Power Producing more Knowledge	Knowledge- work Issue reference
Limited aspirations due to perceived lack of intellectual power or capacity	1.1
Tendency to delete (remove items from focus or view)	1.4
Creating analogies (analogical thinking)	2.1
Ways of reading	2.3
Unexpected encounters and preserving a link for future follow-up	3.1
Stumbling across data and serendipitous discoveries	3.2
Rich and voluminous data sources	4.1
Unboundedness of knowledge	4.2

Figure 31: Issues in the production of more knowledge

Speed

Producing knowledge more quickly is closely related to producing more knowledge – the power criterion, and we find in the final analysis the categorisation of the issues somewhat arbitrary. Said differently, the qualitative data evidencing empowerment does not appear to lend itself to the mutually exclusive allocation in respect of the speed and power criteria, although evidence in respect of the reliability criterion can be more readily identified. The four knowledge-work issues which do contribute to speed, as it has been operationally defined, are given in [Figure 32](#).

Speed Producing Knowledge more quickly	Knowledge-work Issue reference
Creating analogies (analogical thinking)	2.1
Juxtaposition	2.2
Rich and voluminous data sources	4.1
Unboundedness of knowledge	4.2

Figure 32: Issues in the production of knowledge with greater speed

It has been the aim in this section to summarise the research findings in respect of empowerment – to demonstrate reliability **or** power **or** speed in relation to the production of new knowledge by respondents. The reader will observe that the relationship between these three criteria is **or** – requiring *ipso facto* the demonstration of satisfying any one of the three in order to be able to claim empowerment. We have gone far beyond that, and at this juncture invite the reader to review the extensive section 4.4 [Empowerment](#) and its prelude section 4.3 [The need for empowerment](#) of [Chapter 6 – Empowerment through a hypertext environment](#).

Whilst the empowerment objectives, as originally stated, were not completely satisfied (viz. the peer and independent judgement components) we are satisfied that this research has demonstrated the potential of hypertext technology, used in a definable way, to empower cognitive activity.

Readers of this research are invited to form their own views, as independent judges and possibly as peers, as to the degree of empowerment achieved by the respondents, but more importantly, about whether they themselves would be empowered by the use of hypertext devices and modes of thought.

Domain specific disciplinary matrices

The major objective which has not been adequately accomplished in this research, at least as originally stated, relates to the disciplinary matrices (viz. objectives 1. and 2.). We had in mind to discover for each knowledge domain (as represented by the respective respondents) what it was that was specific to each represented domain and from this infer how one might empower knowledge-work. By *discover* was meant the creation of a matrix or structure with respondents' symbolic generalisations, shared commitment to beliefs in models, values, exemplars, tacit knowledge and intuition. The result might have been represented as in [Figure 33](#):

KNOWLEDGE CATEGORY	Domain 1	Domain 2		Domain <i>n</i>
1. Symbolic generalisations			...	
2. Shared commitment to beliefs in models			...	
3. Values			...	
4. Exemplars			...	
5. Tacit knowledge and intuition			...	

Figure 33: Populating the Disciplinary Matrices

Each cell at the intersection of a knowledge domain column and knowledge category would contain data elicited from the respondents. Comparison across domains for each category was to yield information about the design of a device such as HIMS. This research did not eventuate. The first field studies quite naturally yielded connection categories of core and supporting knowledge domains (see [Figure 34: K_map: Political Science](#)) and the rather striking K_maps (one of which is reproduced below) graphically depicting the interconnectedness of knowledge within and across domains. In addition, nine issues affecting knowledge creation were identified and incorporated into the HIMS design and subsequent implementation. The nine issues were: communication and terminology; crossing the boundaries between disciplines; interconnectedness of the knowledge domains; specific techniques used; doability of tasks; creating a richly connected repository of ideas for future research; the 'loftiness' of science and the role of techniques; ways of reading, ways of 'accessing' knowledge repositories; and changing viewpoints (with time) created from the same data sources ([Issues in knowledge creation in Chapter 4 – How do researchers create knowledge?](#))

Chapter 8 - A hypertext paradigm - the environment for *Generative Conceptualisation*

The nature of a paradigm

The term hypertext paradigm has been used throughout this work and with each use a little more of its character has unfolded; the term has acquired a greater specificity through use. To conclude this research report, a characterisation of what has been termed a *hypertext paradigm* is presented.

Paradigms, by their very nature, do not lend themselves to be completely and accurately defined. For example, Kuhn (1970 p10) demands a paradigm must have at least two characteristics:

- 1) It will be "sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity".
- 2) It will simultaneously be "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve".

It is obvious that to have something sufficiently open ended requires a lack of specificity. But this absence of the definite, and of detail, does not preclude description or understanding.

The work of Egon Guba (1990 p18) suggests that paradigms can be characterised by the way their proponents respond to basic questions regarding the ontology, the epistemology, and the methodology of their research work.

Ontological questions <i>(being)</i>	Epistemological questions <i>(knowing)</i>	Methodological questions <i>(doing)</i>
What is the nature of the known or knowable?	How do we know the world?	How should the inquirer proceed to discover knowledge about the world?
What is the nature of 'reality'?	What is the nature of the relationship between the inquirer and the known or knowable?	What methods, tools, and techniques can be used to generate (new) knowledge?
<i>Source:</i> Developed from Guba 1990 p18		

Figure 35: Paradigm characteristics

We approach the task of characterising a hypertext paradigm on two fronts: firstly we provide some examples from our respondents as they worked; and secondly we answer the questions posed in [Figure 35](#) above.

Working in a hypertext paradigm

What does it mean to work in a hypertext paradigm? We illuminate this by considering examples direct from our respondents' work.

Economist R3 has realised the deficiency of the database approach in his research. He articulates this in the light of his newly acquired knowledge and experience of hypertext:

R3: From the point of view of trying to manage the amount of information that is being thrown at us today I wasn't very happy with the

existing tools. I looked at both Procite and EndNote³⁷, and things like that, and I've not been impressed with them at all. So this was an opportunity to have a look at an alternate way of doing things. It is mostly the ability to take, if I'm correct in saying this, the text material in fairly unstructured formats, and be able to search, collate, take ideas and put them in other parts of the program, which I see as a big advantage over those others. I found Procite, in particular, is far too structured. I mean you had all these 40 odd fields or something, and it was impossible without an enormous amount of effort, to get some of the existing text material into that format. It was just impossible, whereas the HIMS type format requires a lot less of that sort of formal structure.

R3 is referring here to the rigid 'boxification' the database 'way of thinking' forces on us. Considerable cognitive resource must be invested in building databases suitable to the purpose and once designed they are expensive to re-design. By contrast, the flexibility and fluidity of constructs created in a hypertext paradigm permit one to concentrate on meaning rather than method.

In R1's work we see a desire to get to the "nugget", but database thinking with its rigid categorisation is not entirely suitable to R1's purpose. He knows what he wants to do but cannot see a way of doing it.

R1: You see, my next step, if I did have a choice here, would be to read these through, print off the ones which were particularly interesting, delete some of the others, and Ok, you then end up with a hard database, or to record them on your machine – to get your machine to asterisk them in some way and maybe to double-asterisk the really important ones, to dump a few, and then you end up with one outcome which is straight text whether on hardcopy or whatever, and then to continue to integrate or synthesise or try and to refine the pattern of the skeleton, or get closer to the nugget, by that synthesising process. Now, exactly how one would go about that I am not sure. But that's what I'd like to do.

³⁷ *Procite and EndNote are well known bibliographic database software packages.*

As we shall see at the end of this section R1 has moved very much closer to his wish, in part at least, as a result of working and thinking in a hypertext paradigm.

R4 very quickly adapted to hypertext:

R4: Given the hypertext now, presumably the keywords [the ones previously thought out] are redundant, because you can search for any word, I can search for all the things about "Ramnad" [referring to the fact that the associated terms were not selected as the original keywords] couldn't I?

In fact, there is evidence that he had been thinking in hypertext structures prior to his involvement in this study. There is a constant interplay between the knowledge (or data) and meta-knowledge in the form of links and categories (of data) which R4 first formulated in his mind through working closely with the data:

R4: There is of course a point, and it will be important to my mind – if I were to call for these volumes of documents (the vast amounts of material on British-Indian Governments) and run my eye over them and see that they relate to the right year, verify there's a subject that says "fisheries", and acquire them into a computer file, I would have the data but I've done relatively little in my head. I mean one of the reasons why I believe I was able to make quite a lot of progress quite quickly on this research because I've worked fairly closely with those documents. What I would do is each night go home and write a kind of briefing paper to myself about what had actually come up. After my first fortnight there I had devised a complete project on the history of Colonial Fisheries.

R4's intensive involvement with the data resulted in the construction of a richly interconnected corpus of knowledge, suggestive of a hypertext in the mind. The research notes R4 created were his responses to certain questions he had in mind about what this data might yield. The questions about "discussions", "departments", and "places", were not necessarily pre-conceived, but emerged out of his interaction with that data.

R4: All of the information is potentially useful, but you could never have a project that said you need to know everything that is in the India Office Library. Because it would be like the world the universe and everything that you'd ever thought of. So you're always, in a sense, asking a much more specific question. For instance, when I was collecting that data, my question was, "is there any information in here on fisheries, historically?". And the answer to that question was "yes" because first of all the catalogue, the book catalogue, told us. So you start looking at that just to get some impression. Then the question was, these are published, printed and published, what is there, how do these connect with any discussion within the government or governments of British India? So you look for discussions, in which department do they take place, is there a Fisheries department, no, there's in many cases no fisheries department, where does this discussion take place, and you come back to the Agriculture department or Revenue department or something like that. So what you're doing is each time asking a question "what is there among this data that would be useful to you?" The answer is go look in the indexes to particular parts of the information. And you've moved from the index to the proceedings volume and so on, and you begin to extract material.

The constant in R4's work is the question "what is there among this data that would be useful?" Virtually everything else is generated as one 'looks at' the data. But notice that because R4 consults the index material the view he obtains is a singular one. In fact it is the same view which the creator of the index had in mind. Nevertheless, R4 is not going to be constrained by a rigid *a priori* design despite being restricted by the absence of empowering technology. He has a general direction in mind and selects out data which suits that general purpose. He referred to this, and the card-index he built for it, as the first hypertext:

HD: In fact you commented in an earlier session that that was the **first hypertext**.

R4: Yes. ... My cards, my card index, in a sense, created the first hypertext.

Despite index cards being a medium through which one may create only one hierarchical view, and would therefore not qualify as a true hypertext (although it is, as are all hierarchies, a special case of a hypertext) R4 was not conceptually bound by the limitations of a database paradigm:

HD: So what you're saying to me is that to do the truly innovative things you've actually got to be prepared to be flexible and adapt one's design as the data is being collected almost. R4: Oh yes, yes, undoubtedly. HD: Database technology does not permit you to do that. It forces you to get the design right up front. R4: That's right. Because if you are going to enter into the database the things you think are important you have to know what they are.

Now that R4 has experienced hypertext he articulates his work through that model – one with which he has exhibited considerable rapport.

R1's thinking has also grasped the freedom of the new paradigm. He describes what he has achieved in a session applying HIMS to a large set of e-mail postings from the Science.Philosophy.Technology NewsGroup:

R1: What I think I have ended up doing is to take the entire database and extract from it, or highlight in it, every related word on a given theme. It is like having the database and recognising the skeleton that is lying there. And the writer puts the flesh on, but these terms (*HIMS* concept terms and linkwords) constitute the skeleton. HD: That's a very nice way of thinking of it. But you don't know what the skeleton is before you actually get in amongst the data do you? R1: No, no. HD: And that's where this mode of research departs from the traditional mode. The traditional mode assumes that we know what the skeleton is. That's part of the design, and we even are so audacious to specifically and only go looking for data which is directed by this skeleton. Of course we find what we want to find! R1: Yes that's right, it's a preconceived one. I entirely agree. And in fact even if you try and go in with that so-called open mind, it would be so huge a database that you couldn't envisage the skeleton without a tool like this. It's very hard to keep the

mind open if you're looking for that skeleton, there's a bit of it over here and a bit of it over there. But this gives it you in one fell swoop.

The "this" which "gives it you in one fell swoop" is of course HIMS, although we really ought to recognise that HIMS is just one special case of a hypertext environment providing support for thinking in this new paradigm. But we see now just how predominant the old paradigm is,

R1: And then it would be useful to pose the question ... let's see, I can't get away from, well how many numbers of these and these and those are there. That's the total sort of body count. But that gets us into very conventional, simplistic ...

as it very nearly recaptures the political science researcher who dared transgress the paradigm boundary.

The dominant paradigm (research paradigm) constrains the researcher to a pre-defined design, with its goal, specifically selected data, completely prescribed methodology, and so on. From what we have seen so far from the respondents' own experience, an alternative research paradigm such as that offered by working with HIMS (a special case of what we shall refer to as a hypertext paradigm), has been empowering.

A salient quality of a hypertext 'mode of thinking' is the ability to move freely among dynamically created structures or logical views (as distinct from physical views) of the data. Each logical view presents an alternate outlook. Each imposes its own particular distinctive structure upon the data, but in such a way as not to interfere with any other representation.

R3: Well you probably see some distinction between that sort of searching and the 'concept' idea. Once you've formed your *concepts* and so on, then you sort of searched for those, so it's just a different type of search. I suppose the beauty of it was that you could create as many *concepts* as you like and link them, one to the other, which was something which is difficult in the other types of databases.

In HIMS, these views are primarily created and manipulated through the *HIMSconcept* facility and may be preserved for future use. Such future use may be by the same researcher or by collaborators. Since the emerging ideas or concepts are given a (hypertext) form, they may be stored and manipulated (still linked to the underlying data) by others or at other times. The myriad details needed – sessions, individual researcher’s notes, pointers to elsewhere (the ‘noted reference list’), re-start file, and so on, to convey the entire context from one session or person to another, are all part of working in a hypertext paradigm. Keeping track of these details is the task of the hypertext environment, in this case HIMS. This was put to good use by R4 when after 11 days he came back to his emerging “Ramnad” *concept* which yielded the Nicobar and Andaman Is. juxtaposition, which in turn spawned the idea of a comparative article now being further researched by creation and use of the “compearl” *concept*. HIMS remembers complex thoughts and provides a language for manipulating and discussing these. The “Ramnad” *concept* is an example as it contains or represents these terms (sub-concepts?):

R4: “fisheries”, “pearl”, “Manaar”, “Mergui”, “Ceylon”, “Andamans”, “Tinivelli”, “Paravar”, “banks”, oh and I’ll put in “chank” as well because if you remember it’s the outer mollusc that ...

With the “compearl” *concept* now activated we find:

R4: Yes, pearls are not everywhere in all of these fisheries because this material here is up in North India. It’s inland, it’s a river fishery and has nothing to do with pearls. The earlier documents there were dealing with Bengal and so on, which on the whole is not a ... there’s plenty of “fisheries”, probably “fisheries” may have been a bad word to put in because it’s too general in application. HD: Right, do you want to take that out? R4: Yeah. I think that might be an idea.

Whilst HIMS was initially conceived in terms of providing support for a sole researcher, subsequent thinking conceived of it more as a support environment for researchers working in a hypertext paradigm where time and space can be interconnected. In this sense it is virtually meaningless to distinguish between

individual and collaborative use, save where the collaboration is simultaneous (precisely at the same instant of real time) in which case there are very special and demanding problems which HIMS does not address. But the less stringent and arguably more prevalent form of collaboration in a hypertext paradigm is supported.

HD: Yes, when you collaborate you need better support as well. R4: I think you certainly do, and the point is that that collaboration, we're already showing, is exponentially valuable and is worth much more than just the sum of three of us operating.

All paradigms provide a language with which to express ideas and concepts. In many cases the terminology is so specialised it becomes meaningless or confusing when used outside the paradigm. Such rigidity brings with it precision but at the expense of not admitting new concepts for which there is no agreed standard terminology. Further, Winograd and Flores (1988 p40) recognise "that the old terminology carries within it a pre-understanding that is a trap for new understanding". In a hypertext paradigm these problems can be largely averted because linking examples or source data to an instance of a term is integral to both the reading and the writing function. In a sense, the concept being conveyed by the term emerges through its use. Winograd and Flores (1988 p40) have wrestled with this constraint in creating a linear body of knowledge (the book *Understanding Computers and Cognition*):

We introduce much of Maturana's terminology, without attempting to give definitions (indeed our own theory of language denies the possibility of giving precise definitions). The network of meanings will gradually evolve as the different ideas are developed and the links of their interdependence laid out.

One can see a glimpse of a hypertext paradigm in operation in this thinking, but the present author has seen no evidence of Winograd's recognition of this although he writes (Winograd and Flores 1988, pXII):

We found ourselves in much closer accord with writers who were far removed from the mathematico-logical paradigm, who identified their interests as *biology, hermeneutics, and phenomenology*.

In the mathematico-logical paradigm, where everything must be defined and logically deduced or linked to its antecedents, there would be no way forward in the following case in which R4 realises the limitations of the data:

R4: Hmm, Hm, that's interesting isn't it. [says R4 ever so quietly, deep in thought about this feature] Now what does this then do for us at this stage? HD: You tell me, what are you thinking? R4: Well, so Ok I The thing that strikes me is what I in one sense already knew, that is that in the Gulf of Manaar there are pearl and chank fisheries associated with banks. Now the aim of the original kind of concept was to get this comparative study. So what we really want is to find some way to ask how far were the pearl fisheries in Manaar, Mergui, and Ceylon, being dealt with at this time. What are the connections between the way they're being discussed, looked at, managed, and so on, at that time. I can see one of the difficulties is, there isn't already existing a comparative study in this database. The database though would provide the material for such a comparative study, or at least begin such a comparative study, but because each of the things is a discrete item, it will deal with a discrete part rather than with Manaar and Ceylon and Mergui.

The absence of a comparative study within the data means that if one searches the data using this (or something similar) as a keyword, absolutely nothing will show up. Alternately, if one were to browse the data, as R4 has done, with a constellation of terms linked to a *HIMSconcept*, the data would yield "material for such a comparative study".

A hypertext environment supports the searching for as yet unspecified (not exactly specified) ideas. It assists in the development of ideas and associated terminology.

HD: Prior to HIMS, with these ideas that you have just created, you would really be lost for words and the wherewithal to explain this. R1: I think

you're right. The immediate thing to do is to see this as a tool for the top class researcher.

To end this section on working in a hypertext paradigm we offer one more example of the sort of idea which characteristically emerges from research of this genre:

R1: Yes. Make an artificial respondent, is that what you're suggesting? Which is what the research is trying to do anyhow, except you're trying to conglomerate all of those responses together to get a hypothetical one. I do this in my writing; say what is the best view, what is the most pleasing. I mean these are all negative we haven't even thought of any positive ones yet ... that's interesting that, isn't it.

As R1 was articulating and expanding his thinking he suddenly realised that all dimensions he'd thought of so far were "negative"; this immediately and probably unconsciously was juxtaposed with "positive", bringing with it an entire new aspect to the research.

A hypertext support environment, such as we have in HIMS, does not provide everything which is part of a hypertext paradigm. Some of these other aspects are recognisable but are very hard to pin down:

R1: to have access to these databases, and your particular skills – hypertext skills. Yes, to have access to these databases, linked to your kinds of skills, would really set me off on a kind of a research junket. I mean, it could cause me, I think, to drop the more conventional things for the excitement of, and that's empowerment I guess, the excitement of doing something which I know no-one in my field has ever done before.

The Hypertext Paradigm from ontological, epistemological, and methodological perspectives

The researcher working in a hypertext paradigm (as exemplified by the respondents working with HIMS) is released from procedural concerns; the hypertext support environment is expected to deal with such matters. This leaves the mind free to contemplate matters which would in other paradigms not be seen as possible: a greatly expanded mass of sense-data can be explored; multiple research threads dealt with simultaneously before any newly emergent 'idea' recedes from the researcher's consciousness; gradual or incremental building of concepts and ideas with the links to the knowledge from which they emerge being 'managed' by the hypertext support environment; immersing oneself in the data and interacting with it in a flexible, unconstrained way, focussing on meaning rather than method; all of which results in *Generative Conceptualisation*, and the generation of new knowledge.

Building on Guba's (1990 p18) three levels of ontology, epistemology, and methodology (see [Figure 36](#)) the hypertext paradigm can be characterised.

Once we 'know' the hypertext paradigm, it is possible to consider how it informs the generation of new knowledge.

Dimension	Question	Hypertext Paradigm
Ontological	What is the nature of the known or knowable?	Sense-data describing the world and its phenomena is irregular and voluminous; it exists in a variety of media and forms. Knowledge is formed from the sense-data by composing them into heterarchies (multiple overlapping hierarchies) or networks of associated thoughts, beliefs, ideas - hypertexts of the mind.
	What is the nature of 'reality'?	Each human forms a (potentially) unique 'picture' of 'reality'. These pictures are shared and compared, resulting in group-views (a picture shared by many individuals) and represent the reality for that group. Reality may vary by individual and time.
Epistemological	How do we know the world?	We come to know the world by erecting (temporary and eclectic) structures through which to view the sense-data stored in the brain; the resultant <i>Gestalt</i> informs further inquiry. These networks vary across humans depending on the degree to which they attempt to regularise their thoughts. Procedurally orientated (a learned trait) humans reduce the richness in the sense-data and store hierarchies in the brain; Non-procedural, or network orientated humans form trails of associative links in the mind.
	What is the nature of the relationship between the inquirer and the known or knowable?	The inquirer seeks to discover the meta-knowledge (knowledge about the knowledge) within the sense-data; thus the knowledge which characterises the structures of the mind, and the associative trails, form the meta-knowledge which represents that which is known by and is (possibly) unique to an individual.
Methodological	How should the inquirer proceed to discover knowledge about the world?	The inquirer begins with a judgemental mindset consistent with his 'reality', as opposed to a purely procedural mindset. The inquirer proceeds on a topic of interest or concern, perhaps on a hunch; remains unconstrained by procedural limitations for as long as possible; is prepared to follow interesting and unplanned or unthought of trails. Concepts are formed by gradual linking together of 'picture' fragments.
	What methods, tools, and techniques can be used to generate (new) knowledge?	The sort of tools that are required are ones to massage vast amounts of sense-data to create networks of associative links, for example, hypertexts. The HIMS method, when used to empower cognitive activity in the creation of new knowledge relieves the mind from a huge burden; cognitive activity can then be specific to <i>Generative Conceptualisation</i> and yield new knowledge.

Figure 36: The Hypertext Paradigm

The creation of knowledge: if we can't get past the gate of Whim&Fancy we have no chance of accessing the engine of Generative Conceptualisation

As has been argued, creating new knowledge can occur in two ways: the unexpected 'discovery' or 'ah ha!' insight; and the systematic and progressive assembling of parts to form a new concept, entity, or whole. It is the latter form of creating knowledge with which we have been concerned in this study, specifically how it can be promoted through the use of hypertext technology.

A concept termed *Generative Conceptualisation* has been introduced to describe the intermingling of human mind and computer hypertext, which, it has been argued, results in a greater degree of original output by researchers. The model for this type of thinking permits concepts to be formed outside of existing knowledge parameters; to subject concepts to experimentation; and for ideas to be 'discovered' through intuitive perceptions. The intent is to generate new knowledge through the formulation of associatively linked concepts grounded in the data under investigation.

Imagine 'swimming' in a vast sea of potentially useful information. How can one possibly begin to make sense of it? Engage in a phenomenological experience in which the data are permitted to 'speak' to you. Immerse yourself, navigate around with the ability to backtrack, search, explore trails of associative thought, all with a prepared mind. The mind is prepared, or sensitised, due to the previous research and learning – the culture to which one belongs. The process will gradually cause an uncluttering of the sea of information resulting eventually in what in this thesis is termed *Generative Conceptualisation*. The tools and techniques used to do this (for it is impossible to work unaided with large amounts of data) will have provided the empowerment to generate and create. The tyranny of linear order has been replaced by the dynamically varying structure of selected, sometimes hierarchical and othertimes network views of the data, forming or exposing (primarily through juxtaposition) insights, new ideas,

and new knowledge. These are some characteristics of working in a hypertext paradigm (from this author's research notes).

The journey begins with the nascent concept X, leading to its derivatives X1, X2, ... Xn, eventually forming XX, and culminates in the generation of the (possibly) unexpected and unanticipated concept Y. In the words of one of our researchers, the work is accomplished by eclectic means – "It's ways of reading; in the techniques I use bibliographic searches. Is it a mind-set? I think it's a set of questions. A set of questions and a set of possible relationships for which to look"

Working in this way can be represented in the model of thinking introduced in Chapter 1 (Figure 1).

1. Immerse oneself in the 'sea' of data (this happens naturally very often).
2. Labour, almost in a survival manner, struggling to 'swim' and keep one's head above water.
3. Discover that there is more than mere 'survival'; begin to develop one's interest in concept X.
4. Link the first thought/experience of concept X with another related one, say X1, then X2, etc..
5. Amend the emerging concept (developed from and about the concepts X1, X2, ...) forming XX.
6. With this new vision as a guide (the mind has been prepared – by thinking about XX) perceive the data one is immersed in, possibly in a slightly new or different way, and apply this view (as determined by XX) to others' data repositories (knowledge bases).
7. A fresh idea, Y, emerges and is generated from a reformulation of XX.

Figure 37: *Generative Conceptualisation as a model of thinking*

Chapter 9 - A substantive theory of knowledge creation

This research owes a debt to the pioneering thinkers of cognitive science, among whom Piaget (1936, Ginsburg & Opper 1969) emerges as pre-eminent. His developmental theory was a contribution about humans at work, conceptualising and making sense of their world. We revisit Piaget's "picture" of intellectual functions, particularly the adaptation (assimilation, accommodation) function. In the hypertext paradigm assimilation consists of synthesising a complex of interrelated data but falls short of *Generative Conceptualisation*. Accommodation makes room for the articulation of new thoughts embracing alternate 'realities'. These two intellectual functions are manifested in the organism's generation of new knowledge (adaptation) which better suits its survival. This *Generative Conceptualisation* results in the creation of new knowledge which is sufficiently powerful to cause existing knowledge to make way in the intellectual storehouse.

Biological function	Intellectual function	
Adaptation	Assimilation	Implicative function; synthesis of a complex of interrelated data but falling short of <i>Generative Conceptualisation</i>
	Accommodation	Explicative function requiring the suspension of a previously deduced reality to make room for new and unfamiliar ways of thinking resulting in fresh ideas
Source: Adapted from Figure 3: Piaget's "picture" of Intellectual Functions		

Figure 38: Generative Conceptualisation in terms of assimilation & accommodation

Within the dominant paradigm knowledge creation proceeds in a more or less orderly fashion (aside from the 'ah ha' type discovery). A regular procedure is followed, the strict adherence to which *ipso facto* results in (is supposed to) 'guaranteed' discovery. The hypertext paradigm demands a suspension of a strict and pre-defined procedure in favour of embracing a far less definitive path. There are no guarantees; but if something is to be discovered it will surely be grounded in the experience and the sense-data. By this very fact its 'truth' value is guaranteed to be high.

Following the notions presented in the preceding work, and the conviction that it has been possible to create new knowledge through the support of hypertext technology, it is now possible to generate the contribution to theory presented in [Figure 39: A substantive theory of knowledge creation](#). This satisfies the sixth specific objective of this research. The seventh and final objective is addressed in the hypotheses column of [Figure 39](#) and constitutes a future research agenda in the empowerment of cognitive activity.

It remains for future researchers to establish whether the Hypertext paradigm satisfies Kuhn's (1970 p10) two characteristics: it is sufficiently "unprecedented to attract an enduring group of adherents away from competing modes of scientific activity", and it is simultaneously "sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve".

category <i>properties</i>	hypotheses
Knowledge-work inhibitors	<i>Recognising the factors inhibiting original thinking facilitates the development of knowledge creation strategies</i>
<p>Limited aspirations due to perceived lack of intellectual power or capacity</p> <p>Diversions prevent the work getting done</p> <p>Fear of missing something (completeness)</p> <p>Tendency to delete (remove items from focus or view)</p> <p>Paradigm entrapment – doing things the same way</p>	<p>Knowledge of an augmented intellect promotes perceived ability at discovery and knowledge creation</p> <p>Effective diversion management strategies facilitate discovery and knowledge creation</p> <p>Support from a knowledge management system frees the mind to focus on creating new knowledge</p> <p>Hypertext support in building networks of connections among relevant ideas and chunks of knowledge defers the need to simplify the cognitive field by discarding the irrelevant</p> <p>Network patterns of thought characteristic of a hypertext paradigm liberate cognitive activity from the familiar and linear patterns characteristic of the dominant paradigm</p>
Strategies for knowledge creation	<i>Deliberate employment of knowledge creation strategies promotes original thinking</i>
<p>Creating analogies</p> <p>Juxtaposition</p> <p>Ways of reading</p>	<p>Juxtaposing knowledge, analogical thinking, and 'ways of reading', including eclectic methods borrowed from other areas, facilitate the creation of new knowledge</p>
Maximising knowledge-work potential	<i>The potential to create new knowledge may be nurtured</i>
<p>Unexpected encounters and preserving a link for future follow-up</p> <p>Stumbling across data and serendipitous discoveries</p>	<p>Preserving links for future reference and follow-up increases knowledge creation potential</p> <p>Remaining constantly sensitive to a variety of stimuli increases knowledge creation potential</p>
Doability and empowerment	<i>Knowledge of an empowered intellect increases the doability assessment threshold</i>
<p>Rich and voluminous data sources</p> <p>Unboundedness of knowledge</p>	<p>The augmented intellect can explore richer and more voluminous data sources</p> <p>The augmented intellect can explore interconnections without artificially compartmentalising knowledge</p>
Developed from the "Elements of Theory" chart, Glaser & Strauss 1967 p42	

Figure 39: A substantive theory of knowledge creation

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 Subject: GOOD PHILOSOPHY BOOKS?/Re ;
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Appendixes

Appendix 1 - Potential hypotheses list to investigate the specific phenomena of this study

Subsequent research into aspects of the present work may establish social stability of phenomena reported here. Potential hypotheses are offered below and fall into three categories. The first concerns computers, thinking, and creativity in general. Second, one may formulate a particular focus on hypertext as one of the computer or information technologies, as in the present work, and lastly, and again as been done here, the research may be restricted to a particular incarnation of hypertext, in this case HIMS.

Computers, Thinking, and Creativity

1. Empowering cognitive activity fosters creativity.
2. Relieving the brain from certain thought processes, permits the use of the newly created spare capacity for higher levels of thinking and creating.
3. New knowledge can be generated through the formulation of associatively linked concepts grounded in the data under investigation.
4. Removing the constraints of linearity and 'boxification' permits new ways of working with computer data which results in alternative modes of thinking and thus the generation of new knowledge.
5. The computer is an artificial extension of our intellect to extend thought processes.
6. The computer is an instrument for empowering the mind.
7. Computers are helpful in the generation of new knowledge and in supporting original thinking.

Hypertext

8. The intermingling of human mind and computer hypertext results in a greater degree of original output by researchers.
9. Hypertext provides 'suggestions for the understanding'.
10. Hypertext supports and empowers cognitive activity.
11. Hypertext permits combining or juxtaposing objects of varying type (text, pictures, etc.) so as to admit a fresh perspective on their meaning.
12. Hypertext permits doing 'other' things with what is read than is possible otherwise.
13. Hypertext admits another dimension of perception and conceptualisation.
14. Hypertext provides an alternative paradigm within which to approach research.
15. A hypertext environment permits the tackling of 'unrealistic' bodies of knowledge.
16. Hypertext mimics associative link-making and link-following which is characteristic of human thought.
17. Hypertext is an empowering mental model, mode of thought, or paradigm in which cognitive activity occurs.

HIMS

18. HIMS extends the intellect.

19. HIMS helps overcome the inherent limitations of human memory capacity, and cognitive ability to *assimilate* and *accommodate* by providing technological support to acquire, select, store, manipulate, and generate.

20. HIMS contributes to the development of thinking, triggers and records the progressive changes in thought patterns, and prepares the researcher for the ultimate act of cognition – original output.

Reviewing the twenty hypotheses above intensifies the view that a relationship among the main concepts of this research, viz. Thinking, Intellect, Creativity, Generative Conceptualisation, Empowerment, Hypertext, and HIMS, is “influences”. Thus, one may create 49 pairwise relationships such as write: “Thinking influences HIMS”, “Hypertext influences HIMS”, “HIMS influences Thinking”. Detailed investigation of each of these pairwise relationships may cast further light on particular aspects of the general question investigated by the present research: can hypertext technology, used in a definable way, empower humans in doing original and creative work? The study of these multi-conceptual aspects must remain for a future study. In this vein, a study of the influencers of original output by human knowledge workers may well reveal that a synergistic relationship (a synergy embodied in HIMS use in the present study) exists among the “influencers” suggested above.

Appendix 2 – Derivation of a K_map

The K_maps, or maps of the knowledge domain as described by the respondents, graphically depict the interconnectedness of knowledge within and across domains. These ‘pictures’ were assembled from diagrammatic scribbles hastily created during the first field study interviews. The haste was not due to sloppiness on the part of the interviewer, but rather due to the pace at which respondents emptied their minds of the knowledge being elicited through the questions in the semi-structured interview questionnaire (Figure 11). The K_maps as used in this research were created in handwritten form during interview sessions and were subsequently adjusted, augmented and referred to by both Respondents and interviewer. In many cases the K_maps were elaborated upon during data analysis by reference to the transcript of the interview audio record.

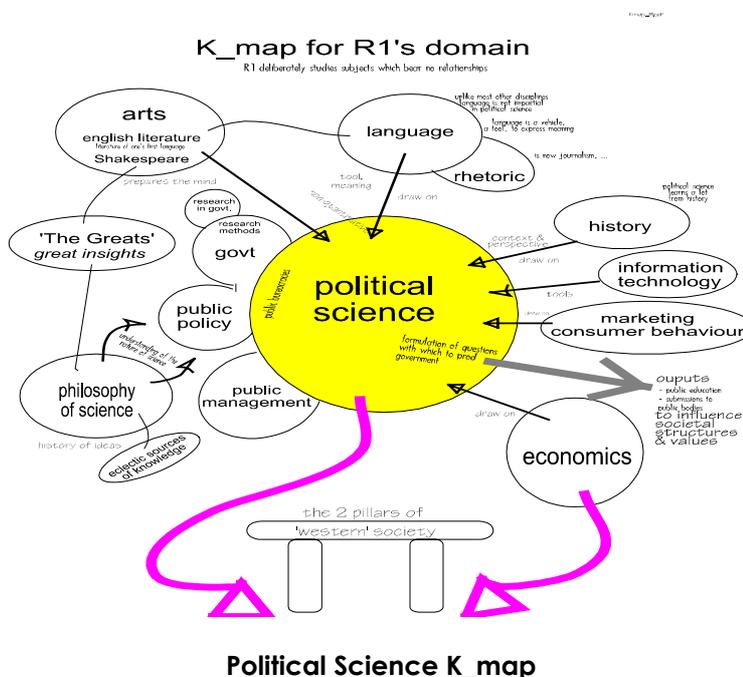
A loose set of notational rules began to emerge and was subsequently used to ‘standardise’ all of the K_maps. The notational system comprises object types as follows:

Circles or ovals ~ indicate a knowledge domain or sub-domain. Where this object type is shaded or coloured it is the domain of primary focus. Occasionally a minor domain is shaded to signify a special significance relative to other supporting domains. Circle (or oval) size is important to a degree; the larger the object, the more significant the relationship, however, in some cases the object-name demanded a larger object to accommodate it - the semantic inconsistency produced was judged to be preferable to the visually untidy result when a caption overlapped the object’s circumference. Circles are incomplete and alongside other circles to show a very close linkage to, or overlapping of, the adjacent domain.

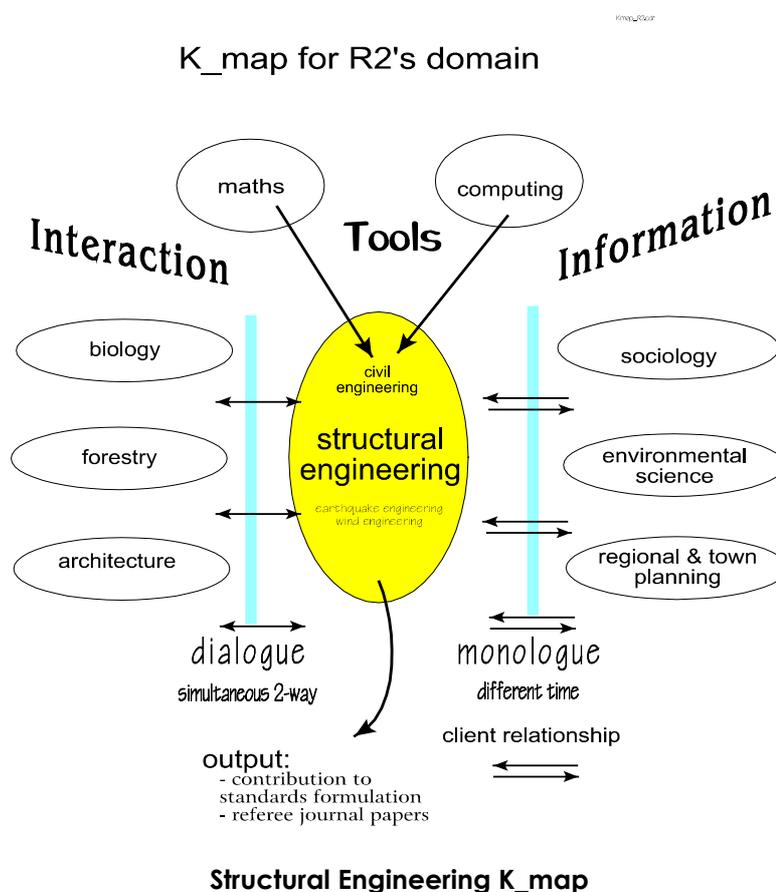
Arrows ~ indicate the direction of a connection with respect to the primary domain. The weight or thickness of an arrow indicates, roughly, the strength or significance of the connection. A dotted arrow (shaft) represents a 'tenuous' connection. Arrowhead sizes and placement are variable due to the pernicious nature of the translation of CorelDraw objects by MicrosoftWord6, but a larger/heavier arrow does highlight the relatively special importance of some links over others.

Example 1: K_maps may have an 'output' arrow to represent the intended or actual outcomes of an individual Respondent's research enterprise - and as this is 'special' it has been highlighted with a 'heavy' arrow.

Example 2: the heavy arrows to "the 2 pillars of 'western' society" in the Political Science K_map below signify the importance which respondent R1 places on this concept and its relation to his primary domain. And these very arrow heads have been subjected to the most wicked mal-alignments by MicrosoftWord6!



A double-headed arrow indicates simultaneous bi-directional communication (called “interaction” by the Structural Engineer - see K_map reproduced below), whereas a pair of single-headed arrows in opposing direction indicates a connection in both directions but at differing times (hence “monologue” in the Structural Engineering K_map below).



ArrowLabels ~ provide a description of the type of connection: “contribute to” for primary domain seen in a contributing role with respect to minor domain and “draw on” is the reverse; a variety of other labels describe the connection type and together with the arrow heads provide a directional quality. Another important connection type is “tools” and can be found in all the K_maps shown in this appendix.

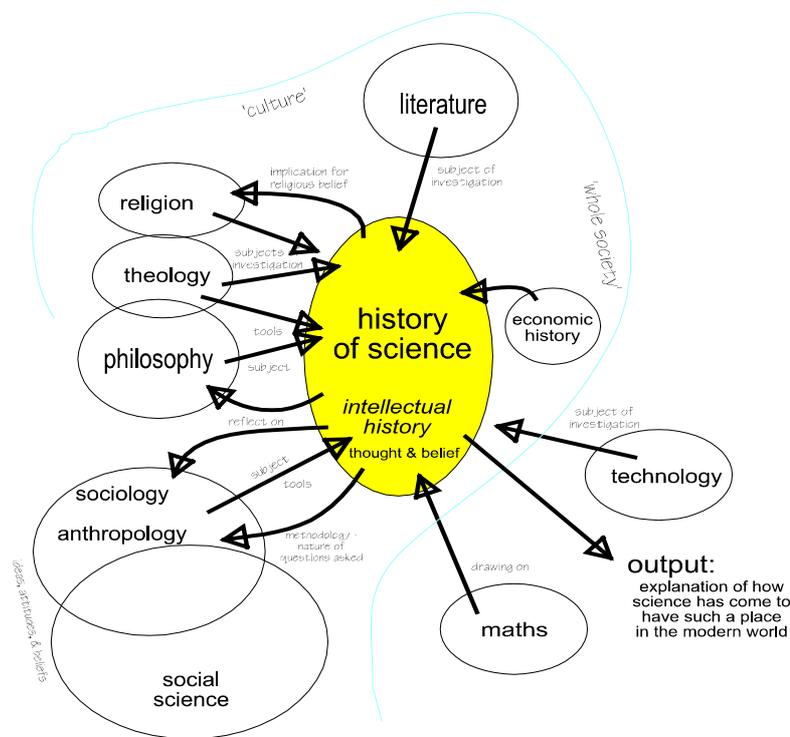
Other words ~ describe a variety of facts about the domains and their interconnectedness. There is no truly systematic method which has been applied but the reader will begin to associate such words on the basis of font-type, font-size, and font-weight, and use such associations to add to the semantic content of the K_map. An instructive example of this can be seen in the Structural Engineering K_map in the similarity of the font used for the words "dialogue" and "monologue", representing two communication types of great significance to the Structural Engineer.

Other lines ~ signify a linkage of some type. For example in the Political Science K_map, the fine solid line connecting "philosophy of science" to "The Greats" to "arts" to "language" shows that these are linked independent of the primary domain, in addition to being connected via "political science" domain - as seen by R1.

A faint and irregular line as found in the History K_map, and also in the History of Science K_map (see below), denotes an acknowledgement of the existence of a 'boundary' - the absence of such a line in other K_maps does not necessarily imply the contrary, or indeed anything.

The two thick shaded vertical lines in the Structural Engineering K_map delineate three knowledge domains on the left which "interact" with the primary domain, and on the right, three domains in which "information" provision is the main connection type.

K_map for R5's domain



History of Science K_map

To summarise, K_maps have been developed by this author as a concise and pictorial representation of the major elements of a researcher's knowledge structure - a researcher's Gestalt of the domain. The individual elements constituting the K_Maps are always the data, facts, 'thoughts', knowledge, or perceptions, of individual researchers, albeit as interpreted by the interviewer. The K_maps depict the primary and supporting knowledge domains, 'connection types', and some of the inputs to and outputs of the research in the primary knowledge domain.

Appendix 3 – Preliminary Interview with FL

An interpretive-content analysis of the interview transcript and supporting field notes yielded the following categories, issues, or questions:

1. What is your specific area of research and how does it fit into the totality of knowledge?
2. Pure research framework or applied research framework.
3. Taxonomy of knowledge structures.
4. List the areas/blobs/elements of knowledge that are part of your profession/discipline, i.e. what is your knowledge base.
5. What research field are you currently actively working?
6. What literature (k groupings) do you follow?
7. What do you read, scan, analyse, synthesise, evaluate?
8. What research papers do you produce?
9. How do you apply your knowledge in the field?
10. Show the overlap in the knowledge domains, and their relationship/interconnectedness/organisation.
11. Get respondents to state what they do. Then ask what domains of knowledge impacted on doing this; i.e. what areas/domains we drawn upon to do the work?

Prof. Whiteley, [this author's](#) research supervisor, independently created the following list:

1. Tell me what k structures apply to your discipline.
2. What characterises your discipline in terms of related k domains?
3. What specific techniques would you use in your discipline?
4. How would you draw the elements which made up the ... concept?
5. What sort of things do people research in your area?
6. What sort of applications would your discipline have?
7. What is the nearest discipline to yours?
8. Can you list the related disciplines?
9. What, in your opinion, is most often misunderstood about your discipline?
10. Describe your discipline as you would to someone from another planet.

A combined list was then created from the above two. Its purpose was to act as a framework and vehicle for generating qualitative data about individual researchers' knowledge-work – field of study; methods and techniques; sources of information; linkages to other disciplines.

Semi-structured interview question schedule for F1_data field studies

1. What is the nearest discipline to yours?
2. Tell me what knowledge domains comprise your discipline.
List the elements or components of knowledge that are part of your profession or discipline.
3. Can you list the related disciplines?
Show the overlap in the knowledge domains, and their relationship/interconnectedness/organisation.
4. What characterises your discipline in terms of related k domains?
5. What specific techniques would you use in your discipline?
6. What sort of applications would your discipline have?
How do you apply your knowledge in the field?
7. What sort of things do people research in your area?
What research field are you currently actively working
8. What literature (k groupings) do you follow?
What do you read, what catches your eye?
What research papers do you produce?
9. Describe what you do?
What domains of knowledge impact on your doing this;
i.e. what areas do you draw on to do your work?
What is your specific area of research and how does it fit into the totality of knowledge?
10. How would you compose the elements which made up the "...1 of ...4"
concept³⁸?
11. What, in your opinion, is most often misunderstood about your discipline?
12. Describe your discipline as you would to someone from another planet.

The above 12 item semi-structured questionnaire would guide the interviews with respondents.

³⁸ Perhaps an explanation of the shorthand used will make its repetitive meaning clear. The "...1 of ...4" in this question refers to questions 1 to 4, which collectively pertain to a characterisation of the discipline. Question 10 was intended to provide an opportunity to relate the answers given in questions 1 to 4 to the actual doing of the research work rather than the talking about it. Since all this is cognitive work, there is very little difference between the 'doing' and the 'talking'. It was found to be redundant.

Appendix 4 – a sample from the F1_data

Interview with R4 - domain = historian

Wednesday 12th February 1992

I arrived at room 401/310 a little early but R4 had not yet arrived. I detected that he came in especially for this meeting with me. The offices in building 401 are cramped and uncomfortable in extreme temperature conditions, so R4 works on his research at home where he recently had an extension finished.

I left a note and went back to my office where there was an ASPEN message waiting from R4 so I hurried back over to 401.

2:10pm start interview, 3:20pm end interview - 70 minutes

Notes for follow up:

Uses, or is going to use 'Endnote' , a bibliographic package.

1R4. What is the nearest discipline to yours?

>>> deferred this question a little as in the circumstances it was inappropriate to begin here. This point is taken up a little later <<<

2R4. Tell me what k domains comprise your discipline.

list the elements or components of knowledge that are part of your profession or discipline

R4: - I'm in the School of Social Sciences. As you know that School has a number of disciplines in it. I'm an historian, by training and in terms of what I do mostly. I think an historian with a fairly wide interest that ranges if you like from being interested in literature and the connection between literature and history at one end, to being interested in, I read a lot of anthropology and into that kind of thing, so I'm interested in anthropological, sociological things, though more probably on the anthropological than straight sociological. And I'm interested because the kind of history I do is about development and about change, social and economic change and so on, as well as political change. I'm interested in the economics and politics, and so on, and so I see myself as an historian in the sense that I'm interested in an examination of past, and past behaviour, change in the past. Things that have taken place in the past, but within a range of, what would you say, areas in which theory or concepts of those disciplines might actually help explain what is actually happening.

HD: - Right, Ok, so what, what um forces you to search these other areas? Is it relevance, or is it, ah, simply, um, the theoretical connections?

R4: - Well, I guess I take the view that in one sense history itself doesn't automatically explain things. History actually is a technique for looking at the materials from the past and bringing those together and thinking about how to ah, investigate, ah, how to conceptualise, how to get in to a

Appendix 4 – a sample from the F1_data

period if you like. Sometimes therefore you're going to need, you know, the help of other kinds of disciplines if the question that you're looking at is more political, or more to do with economics. Now I don't mean to say that I simply take over someone else's thing, it's just that I think that one has to read in those areas and be aware of what anthropologists are saying. I guess perhaps one other thing might make that a little bit clearer in a way. Ah, as an historian and an historian particularly of India, and particularly of modern India, by which I mean 19th and 20th century India up to the kind of present, uhm, and I think that where in this century we have to cross cultural boundaries therefore, and move as an historian out of something that is recognisably your own society into another society, I think the need is very often to look for support or (other?) entry points, and so on, is that much greater.

HD: - Uhm, do you do this to gain an understanding, and so help other people gain an understanding, add to the knowledge in that sense, or is it so that we can learn how to do things better today, based on the past.

R4: - Well, I think it's probably both. I mean given that I'm a teacher as well as a researcher then clearly part of the business of going looking for these other entree points is to enable me to teach in a way which might be meaningful for other people and to supervise graduate students in a way that might be meaningful and so on, as well as wanting to make it more possible for me and the things that I write and so on, ah to put that across, which I think, at least I'm assuming some of the things at least that I write might be useful for people in understanding better now.

HD: - Ok, so if we put history here in the middle, what's the nearest discipline to this (R4's K-Map)?

R4: - For my purposes probably anthropology, given the kind of history that I'm interested in. And I would think the other which is not far from it is politics. Those are probably the bases of where I'm coming from, er, as an Indian historian.

HD: - Ok, and all these would fit into social science presumably.

R4: - I think you could see the domain as being social science, but I mean it's hard to .., social science as a single discipline is really hard. It's more a field within in which various people work I think you know.

HD: - Yes, so the nearest then would be anthropology, um, or can you not distinguish between these two (anthropology and politics)?

R4: - They've both made a very considerable kind of contribution. I think the anthropology probably has a slightly prior thing in as much as I think reading anthropological material, that is village studies and so on, is very close to what I'm trying to do as an historian: - reading what the society is actually going through, what it's trying to ..., the politics is probably more evident in terms much of what I've written up 'till now has been about political analysis, political behaviour.

HD: - Oh, so you draw on anthropology and you contribute to politics.

R4: - I'm sure I do. In many ways people would probably see me primarily at this stage as a political historian.

HD: - Right, so, um, so it's not unfair to say that it's a one way communication, a drawing on anthropology; it's a one way communication into politics but the other direction?

R4: - I think there's two way, certainly on the politics history thing. I think the anthropology, I mean I couldn't say that I've written anything that I would assume anthropologists would immediately say was a contribution to anthropology. Lot's of, I think people in politics would recognise my work as contributing directly to the political analysis of the Indian past, in which they would also be interested. Lot's of anthropologists I think will be interested in what I'm saying but wouldn't read it immediately as anthropology.

HD: - Ok, so there is a communication this way but it's as a sort of a reference.

Appendix 4 – a sample from the F1_data

R4: - Mm, mm (yes) And I can talk to anthropologists. I mean because I've read a lot of the stuff I can talk to them. All I'm saying is that what I write, I mean I brought it along so that you could see it. This, this is, was published just last August, and I mean in a sense anthropologists will find material in there that is absolutely spot on for some of the things they will need for their analysis. Political scientists who are working on modern India, particularly this part of modern India, will immediately read this as an essential part of, I would say, of their background for understanding political developments in that particular ...

HD: - Ah, R4's just shown me his book "Landlords and Governments in Uttar Pradesh: - a study of their relations until zamindari abolition"

R4: - ... which is the end of people called landlords.

HD: - Well, very impressive, um, Ok, um, well, your discipline though is history.

R4: - Yes.

HD: - Um, these are disciplines that are related ...

R4: - and in which I find considerable interest, that was the point that I was making.

HD: - Yes, now inside here what do we find? I mean inside there, there are elements or components. Can we get into those?

R4: - Yes, well if you were, see historians can deal with a whole range of things. Some write about Pilarmedazni Institution?, some write about the economy of Hulolical Industrialisation?, and so on. Now in terms of what I've done, I would be I think thought of as a political social agrarian historian. Now those are the three areas. Political in the sense that I work on and write about what has happened politically in India particularly since say 1850 in detail. In social terms, as a social historian because I'm, the work I do on that political things is also rooted in an attempt to understand the structure of Indian society and how elements within that structure are caught up in the political situation. This (his recent book) is about how landlords respond to political pressures that are there. The landlords are a social group, as it were that I can see you can conceptualise within Indian society and that, and they are being, in the last years of British rule and so on, being put through various political pressures they have to respond to, and hence my work looks at them as a social group in a political setting. The agrarian comes because the background of those people of course is that they are landlords, that is that they control peasants, they control villages, they control, ah, things that flow from agriculture and so on.

HD: - Ok so the domains within then, you would actually call political social agrarian.

R4: - Yes.

HD: - Yeah, Ok. Um, fine, uhm, now what bodies of knowledge: - might be repeating ground here: - but what bodies of knowledge do you draw on in doing your work. Well yes, there's the political body of knowledge, the social, the agrarian perhaps but um, could we think about the form, ...

R4: - You mean how that knowledge is, um, what is it, and so on.

HD: - Yes, does it exist in books, but maybe it only exists in peoples minds.

R4: - No, no, I think you can be more exact than that. I mean the, clearly at one, and certainly an early level it's everpresent, it does exist in books. I mean that is why one reads anthropology or reads what other political scientists or whatever are saying. what geographers are saying about the nature of you know the agricultural production or whatever it might be. So yes at one level it's books, but the real point for an historian is almost certainly what I call documents. And documents can be a whole range of things. I mean if you looked at the bibliography and so on and sources of this book you'd see that I draw on documents generated by government administration and so on.

Appendix 4 – a sample from the F1_data

HD: - Oh, Ok, so acts of parliament, stuff like that?

R4: - It starts with acts of parliament, yeah I mean the period is actually defined in some ways by various acts of parliament that would uh set up the Indian political system, that abolished the landlords, that provide for agricultural land reforms and things of that kind. Uhm, the second thing though is, beyond acts of parliament, I mean ahm, and acts of different parliaments because there's the British parliament because the British were the rulers, there's the local legislature, there's the government of India's assembly and so on. But there's also, what, how would you understand it, bureaucratic documents I s'pose, that is the proceedings of government in terms of files, the minutes, ...

HD: - Right, these are sort of the equivalent to what they call here ministerial directives and stuff like that.

R4: - Yeah, but it can start at a, way down beyond that. I mean the guy ...

HD: - ... operational memos.

R4: - Yes, in the fenel? use is 'I've got this problem what do I do now?' and I mean the thing comes up and it comes back again within a department what are we going to do about rice in this district, you know when the landlords are blocking the taking of irrigation water, so there's a lot of documentation like that. Third form would be what you might call private documents, that is letters, correspondence of other kinds, diaries, journals, written by people either for their own purpose, say if it's a diary or a journal, or in order to communicate to other people. So I have quite a number of people's papers, you know the "Suttley"(?) Papers, the "Haley Papers", these are all the correspondence, in and out, to a man called Haley, one of the governors of this province and he writes to all sorts of people within the province, outside it, private and confidential, demi-official, official correspondence. So there's a whole range of things there where you're looking at what people are saying as it were on their own behalf, as well as what they might be saying in that earlier thing on behalf of the agriculture department, or the ...

HD: - Right, so, so this last category which contains three things: the acts of parliament; operational memos; and private documents; would that be primary data?

R4: - That's primary data.

HD: - And uh, the books for example ...

R4: - Secondary. There's another category I think which I'd include in primary because it's particularly important to me and that's newspaper material. The daily newspapers, because they also provide you with a continuing narrative, in effect, of what's happening. And often provide you with some examples even of the other things, that is someone will write a letter to the paper and that then becomes an expression of their view becomes important. It's tremendously significant in this kind of work.

HD: - Of course we're very well geared up to get access to the books, but I imagine this primary data that's not so easy to at.

R4: - Yes, that's what takes the time, the years of work. Now they're, a lot of those are kept in archives, uh and in archival sections of libraries. Some of them, some of the private things are actually still in private hands. You have to actually talk to people and ask permission from them to read this stuff. Uh, some of it will be kind of taken out of India itself to London, other remains in India. SO you've got a range of things like that. There's also where your kind of memos, official memos, there's if you like, a non-government version of that because these landlords, for instance, had associations of landlords. So the minutes, proceedings, record of meetings and so on, of those non-governmental organisations, what are called non-official organisations, those are also primary material. And uh, all of that kind of thing, I've drawn on.

Appendix 4 – a sample from the F1_data

HD: - Now, now, uhm, the media there is paper and the printed word, by and large, presumably some pictures diagrams and stuff like that, but ah video material, audio material?

R4: - Not in terms of anything I've worked on so far, because that's obviously more recent. I mean if, I'm doing some work with John McGuire now on the "Paratih Janatu Pery", the Hindu Nationalist Party, which would come up to current contemporary times, we'll certainly find, already people in India, you see are publishing videotapes of news. We'll be getting to a situation where we'll have to analyse those kinds of things.

HD: - Ah, and I guess in the future then also electronic mail communications would be ah ...

R4: - Mm, mn, yeah, and of course in the books area, if you like, I mean imaginative neticular(?) and so on is, can be, I mean novels about the rural setting and so on, you know. Historical or even contemporary can become part of this.

HD: - So, so it's fict as well as faction.

R4: - Yes, huhuh, fiction as well as fact. That was one reason, Heinz, why I was saying I would see literature as another of these kinds of domains, in which.

HD: - Ok, so we'd better put literature there.

R4: - Because I've fairly consistently read ever since I was a student. I mean I've read novels by Indians, poetry by Indians, you know.

HD: - So this would be a 'drawing on'?

R4: - Yes, yes.

HD: - The relationship here is 'drawing on'. You contribute towards politics and you draw on anthropology.

R4: - And literature, also, and cultural studies generally I suppose, in a sense. That is to say I mean stuff about religion and stuff about values, attitudes, you know that kind of thing.

HD: - Hmhm, ok, now what specific techniques do you use in your discipline?

>>> I have jumped over 3 & 4 as this has been covered in the above. <<<

 3R4. Can you list the related disciplines?
 show the overlap in the knowledge domains, and their
 relationship/interconnectedness/organisation

 4R4. What characterises your discipline in terms of related k domains?

 5R4. What specific techniques would you use in your discipline?

HD: - Again, we've covered a little of that, but uhm, like for example one of the specific techniques I guess is reading. Pretty obvious.

Appendix 4 – a sample from the F1_data

R4: - Well, you can go a little bit beyond that. I mean the basic historical technique was to take that range of sources we've got there and to in a sense interrogate those sources. That is to say, break those down, if you like, or the material in them down, into usable uhm, material for the reconstruction of the events in some kind of ordered manner that provides explanation. So you will, I mean, I have at home probably a dozen boxes of cards, six by four cards, which ideally each one of them is a separate entry but of course they tend to spill over and so on but what that card will be, if you can think of it in this way: top of the card- one corner is always the date to which it refers.

HD _ I'm just gonna draw ..

R4: - Yes, in this corner date. So that's my basic indexing thing since I'm interested basically in chronology date becomes important, when did it happen. I put here where I got it from, so there's a bibliographical source reference there. It's either a newspaper, it's a file in an archives, it's a letter in somebody or other's private papers or whatever it is. And all the details needed need to be there so that you could find it again. The text of whatever I want, whether it's verbatim or simply a paraphrase is then put in.

HD: - It's sort of an abstract.

R4: - And I then put here what I call a note. That is this is a sort of if you like a heading but it tells me what is in that in a brief meaningful way.

HD: - So this is a set of keywords for example, a categorisation and so on of your own making.

R4: - That's right. "Governor tells leader of landlords to get lost". 1936. The letter from the governor. And then maybe the text of a particular paragraph in this letter, er, which says "I'm terribly disappointed in what you're doing. You are all hopeless you might as well give up" So that, and those then are drawn from all of those sources. What I do is I bring them back together again then in the sense of indexing them chronologically so that I come to a point during my work in which I will have an editorial in a newspaper, a letter from the governor, a speech in the legislature, a report of a riot somewhere, and these begin then to actually come together in a way and you have to think now this is what's happening. Why was he actually telling them that? It's because in the background there's already trouble brewing and so on.

HD: - So if we try and give this um technique a name, uh what would you call it? I mean it's more than just um an index.

R4: - Oh yes. It is an index but it's indexed only so that you can start, if you like, of constructing from that, first of all a notion that at any point in time there are a number of things happening and you can assume that there may be some causal relationship between them. And then you've got to go looking for any explanatory idea.

HD: - Yeah, right, the individual entities, the cards, won't tell you, but a group of them will. And presumably different groups might give a different picture if you take a longer view or a shorter view. Ok so what, if you were at a conference and somebody was extremely interested in this, maybe it's happened already, and said well what is this technique, and it was really important for you to give it a name.

R4: - I suppose you, hm historians would call it historical analysis, I mean which is a bit redundant I s'pose in the sense that it is descriptive rather than anything else, um.

HD: - Alright let me put it this way. Other historians, do they use techniques that differ? Substantially?

R4: - I think different historians may bring in their material, get it into whatever form they want slightly differently, and they may actually use different ways of coming back to reconstruct it, to reconstitute the period, to set up their particular analysis, but I think all historians have in one sense break things down into the units that are the building blocks of particular situations and hence of particular behaviours or trends or patterns of behaviour, and ah I think they require something of

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this kind. Certainly, I have friends who do it quite differently, uh but um, I think they all are really doing something of that kind.

HD: - Ok, any other specific techniques?

R4: - Well there are probably some, if you like, ancillary things. One is to provide, and I certainly do it with cards in the same way, a control on all the people who are involved: - the biographical data. I mean anyone who's within my study will start to become a card, date of birth, death, education, marriage status, and career and you know, publications, and all that. In other words you try to construct, you try to understand any individual who comes within this, as far as you ca, I mean some people are going to virtually unknown and they never become, while others will become extremely well known because they're written up time and time again. But there's always that and there's a similar biographical control, that is all these sources have to be kept track of, I mean so every article every book, but also details of the kind of archives that you're working out of and the actual problem ensue(?) particular sets of papers and so on.

HD: - All of the material that you reference, do you actually have copies of that or are you satisfied to know that it resides somewhere. How close is that to what you need or you feel you need.

R4: - Ah, now you couldn't say you have copies of everything. I mean a lot of archives you work in, I mean all you'll have when you come away is what you've got in your notes, so they become extremely important. In some cases you'll get stuff on microfilm, you know you'll find stuff that does seem either sufficiently important to actually want to have it microfilmed, or where you know the time you've got available to work on it and your future access is such that you need too take it away. In the current work I'm doing, which is a history of Indian fisheries from 1790's to the 1940's and there's in London and there's material in India which is germane to that. Some of it I do need to have so I can keep going back to it, you need complete, so I've microfilmed whole reports, whole sets of documents in that way, ah plus the fact is I can't get there all the time, but I need to keep the work going so you know with the research funds I've got I'm constructing, if you like, an archives here in Perth which will be as full as almost anyone has anywhere in the world on the actual material dealing with Indian fisheries.

HD: - Ok.

R4: - So the answer to that is I suppose, if the material is either so important or dense or inaccessible otherwise, but a lot of the time you really depend upon what you extract at one time from it.

HD: - Um, just on that, do you think that if you did have complete and good access whenever you thought you needed, do you think your work would be different, and if so better or worse?

R4: - I don't think it would change the kind of note-taking, uh, because really when you're in this kind of thing you, I mean every time you go back to the document, ah, or had to go back to it, you are using a lot of time, so in a sense the economy of the effort is to do it as well as you can the first time round, and have it there and know that you can in fact retrieve the information from it.

HD: - Now can we just talk about that doing of it. A body of knowledge, or an archive or whatever it is, in your terminology, um, that you need access to and the notes that you take, ah, would it be the case that some time later in the view of certain things that have happened, further experiences and learning that's taken place, you would see this differently?

R4: - Yes.

HD: - Ah so the note-taking might be different?

R4: - Oh yes.

HD: - And you would sense that you'd have to get back at that with a different set of glasses so to speak.

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R4: - Yes, yes there's no doubt about that. I mean if you come back to material for another purpose, someone has asked me to write a paper which is germane to this kind of thing (pointing to his book) but is on a different, it's the history, or the politics of the particular city in that. Now I've gone through and I've extracted, I've got one whole card file, as it were, of material on that city. So for one reason or another I've been extracting a lot of that material, but I haven't recorded that in exactly the way I would have done had I had as a prime purpose of that note-taking the history of politics in Luk-Now. So I mean there are situations here where you'll feel I wish I had a bit more on that but at the time it wasn't particularly important to go beyond where you went. And you can never, I think the point is, it would be very hard unless you simply took down every, every single thing verbatim out of every record. And then of course you'd still have, even if you did that, even if you xeroxed all of the stuff let's say, and took it back with you, you haven't started the analysis of the documents until you started to break it down. It's that breaking down into these units, uh that is in fact the first crucial step in the whole of what I dare call historical analysis.

HD: - Yes, yes, Ok I'm gonna change this tape over. Ok, now, at the moment, um, do, er, what you've described is pretty much manual, do have any support from technology at the moment at all?

R4: - No, er, well, what I was saying to you yesterday was that I, this bibliographical, uh cards, what I'm trying to do is to find a way to replace those cards with 'Endnote' which is a bibliographical database, and I've, I'm trying to understand 'Dataperfect' which is a database system, uh, well enough to see whether it could replace these.

HD: - Right, yaeh, um. ok, um, ..

R4: - And in some ways, I mean from the look of it the Dataperfect thing has fields that I could put my dates and sources and so on in, and the space for the note. I just,. I need to be, you know, I'm not going to go in and do that if there's any chance that it's not going to deliver as effectively as I know I can I do.

HD: - I mean I think you've got this sorted out pretty well just manually, yeah well, one of the difficult things about technology is that's it's so hard to ascertain whether it's going to do the job, especially for someone that's got a really good system already. Um yeah ok, now let's see, um, can we get to the, part of the reason for you doing the work, uh, we sort of got to that a little before, it's to gain an understanding for yourself and for others, um, but, ... (and now to Question 6).

6R4. What sort of applications would your discipline have?
how do you apply your knowledge in the field

HD: - Aside from the teaching and the adding to the body of knowledge is there anything else there.

R4: - Er.

HD: - I mean do you see it as generating, simply generating information?

R4- No, I think it's more than that. I mean it does do that obviously, I mean in the sense, this (his book) is information now, that people will now read if they want to understand that subject in that period, but I think good history, I mean history that's more than just a chronicle just passing on that information, actually is interpretive. That is it's interpreting the period, the subject, the problem, however you want to visualize that, um, and hence it has the capacity to teach, if you like, or to both explain why present situations are like they are and to offer at least the possibility that people might learn from what happened in the past so they might do things differently,

HD: - For example, to help them construct possible futures, and evaluate them?

R4: - Mm, Mn, yes I think so. I mean this book actually argues that the present problems with land reform in this particular state of India called Uttar Pradesh, can be explained in large part, or at least in some major part, by the history that's contained in here, that is the importance of these landlord

Appendix 4 – a sample from the F1_data

people, why governments actually looked to them and didn't therefore take more thoroughgoing measures. So it is at one level trying to explain why you've not got satisfactory land reform, it also could be read by some people as saying if we were constructing a land reform programme now we would have to take some of these things into account, and maybe look more at redistribution of land, or not being so concerned with the landlords rights as opposed to getting social justice.

HD: - Ok, now as you draw on these domains, literature, anthropology, and, I mean I s'pose you really do draw on what's written in politics also,

R4: - Absolutely,

HD: - Um, so Uh, what I'm interested in is what is it that catches your eye as you scan this material? <<< this is moving on to Q8 >>>

 7R4. What sort of things do people research in your area?
 what research field are you currently actively working

>>> this has emerged or been covered in the previous material

 8R4. what literature (k groupings) do you follow?
 what do you read, what catches your eye?
 what research papers do you produce?

R4: - Yeah, there's probably a number of things. One will be congruent regional or chronological information. By that I mean if I go into the political, anthropological literature and so on, the one of the first things I pick up is stuff about Uttar Pradesh, stuff that touches on the period: - this man in this village remembers, you know back in 1920 this is what his father did or something, so you're immediately drawing on that kind of thing. Er it's data in that case. And then I've made use of trying to explain why the agriculture on which these landlords were dominant, why it's changed very slowly and so on, by being able to say "X records in this village that they only ever moved this one step along a technological thing, he knows that the first time that particular kind of instrument or that technique appeared was 1938". You know, so it's a very long time between change. So there's one kind of drawing on the congruent er regional, chronological data. Second would be um, explanations of similar kinds of patters, anthropological or political things that dealt with landlords, that dealt er

HD: - Ok, so it seems to be, could I use the term project, this (the book) is a project, it's project centred?

R4: - Yes, yes, I think so.

HD: - Or project driven. Uh what if for example ...

R4: - There, there's, but there's a third element I think which is a more theoretical kind of element. I mean the conceptualisation of what do we mean by political change. Or what do we mean by social change which anthropologists deal with, so there, I mean, I see all those three as certainly being important. I was really trying to say you can come from the most, er, pragmatic which is just picking up material that you can use, to the more theoretical conceptual which is actually going to cause you to think about how you actually view the data that you got which is important when you have got your cards and so on, and you're beginning to say well how do I explain why these things are together.

>>> this is getting at formulating ideas about the question under consideration

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HD: - Right, so would, I'd imagine then also you would, or would you? Would an article or a title having to do with somebody else's technique,

R4: - Oh yes.

HD: - Ah, about their analysis ... so do with tools and techniques, you'd pick that?

R4: - Oh yes, there's another kind of literature, I mean other historians doing that, yes, other what I'd call historiographical literature, that is literature that ...

HD: - Methodological stuff?

R4: - Methodological stuff about history, yes. I mean I can show you on these shelves, although they're not well organised at the moment, quite a lot of that stuff.

HD: - Ok, do you think, would you be representative of all historians there, well not all. Are you representative of historians there, so that do you think that they would generally speaking be interested in this pragmatic to theoretical, or perhaps you could even widen it to all social scientists, all scientists? Do you think?

R4: - I mean I think that's certainly a fair basic description of what all social scientists are doing. I mean anthropologists, you know my anthropologist friends read history in the same way. They want to get a picture of where their village fits into this, even though their project is to understand what's happening in the village when they actually recorded their material through 1990 you know.

HD: - Ok, I don't know whether this is going to make sense 'cause you've probably done this also but, um, let's just try it out. Um, can you describe what you do, so far as the research is concerned?

R4: - Ah just before I answer that can I just go back to the data part of this and so on.

HD: - Yes.

R4: - There's one other element that I didn't perhaps make enough of when we were talking about the kinds of materials, archives and so on, and that is um, oral material. That is material gathered through talking with people who were actors themselves in some way, or who saw, they may not have been very active but at least observers,

HD: - Either actors, witnesses,

R4: - Yeah, yea, so I mean uh, if I talk to one of these landlords and say "now Rajah Sub, why did you do that, you know what were you doing in 1925? I've read in this book that you did this", you know, and I get from him his impressions. Or I talk to an English officer who served in the area and say "well what did you think of these people". So there is an oral element which is a bit more like the anthropologist, you know, sitting down talking to his informant and so on. Some historians actually, it's called oral history, and some historians do nothing but that, basically and trying and draw the whole thing, I, I use it as an adjunct and as another source within my total thing. Now, how do I describe what I do.

9R4. Describe what you do?

what domains of knowledge impact on your doing this;

ie. what areas do you draw on to do your work

What is your specific area of research and how does it fit into the totality of knowledge

R4: - Um, I think there are several different points to it. I mean there are stages if you like. Never totally cut off, and I mean you can keep going backwards and forwards in some kind of, you know, almost symbiotic relationship between them. But the thing I think is you start from reading or from

Appendix 4 – a sample from the F1_data

experience or some observation with beginning to conceptualise uh a problem, an area, a set of interesting concerns, and you begin to shape, as it were, a field of study within which to move.

HD: - Ok now is this informed by your collection of materials, or

R4: - No I'm really at one stage before the actual collection of material for the, I'm really saying out of the reading, or what you've heard from other people or what you've seen in the thing, you begin to say there is a field in there which will be worth looking at. I mean I began this (his book project) many years ago by being interested in land reform, and contemporary land reform, back when I was a student in the 1950's, and I set out first of all to study that. And that was the first field, I remember when I was in that field, looking at the material I was getting I said to myself there's clearly a subject here to explain why these landlords behave like they do. So the first was my MA thesis, the second my PhD thesis. So out of what I was seeing I was beginning to define the field. More recently, this fishing stuff comes out of doing some maritime history work with some colleagues deciding to read up some stuff on fisheries and other maritime occupations, saying my goodness that's interesting, I'll do some contemporary work then saying why doesn't anyone ever talk about it in the past, in terms of pre 1950, and so I've defined now a field in there which I find no one else has even remembered, you know. So my first point is you begin by setting up a kind of field, almost like a hypothesis, you that you're setting up that here is something to be explained or to be worked on and so on. You may not have all the specific questions at that point, but you're aware that there's, one historian from the past makes a good point here: he says study problems not periods. I mean there is a, some people might well set this up as I'm going to study England between 1810 and 1850, uh, maybe because 1810 is a particular one, 1850 and, the best historians I think don't do that. I mean their problem will relate to a period.

HD: - Maybe this is why to my mind history was so dry.

R4: - Of course, uhhah, absolutely, I mean you're absolutely right and if people can get away from that and start thinking in other terms then it isn't dry at all. So that's the first, Second stage is I would say when you've thought about that you'd almost certainly go back further into the literature and see what is there, refining that problem. Then you can begin to set up both some operational questions that you're going to have to answer if you're going to do this, and that leads you to where you should look for materials. So the collection of materials becomes the next major stage. Setup your problem, refine it by making sure you haven't misunderstood totally something or that it's not already covered or something, ah in that way, maybe then shift your balance if you find other things, then set out,,,,. Collect your material is the next thing. Now you, I mean a lot of people are unsure, but I think what you do is you sit down, you collect all that material. The end of the two years or something, you then start to look at it. I don't think that's the way historians work or should work at all. What you're doing all the time you're collecting the material you, and that's why I used the word earlier 'interrogating' those documents, you're interrogating them all the time and saying "what can you tell me?", "why are you saying this?", "why is this man always putting it in this way?". So that the collection of the material becomes also a process of assessment, evaluation, leads you to other sources. If that's what is actually happening, I've got to have this other material which I didn't think was important. So it's,

HD: - Would it be fair to describe it as an immersion in the material?

R4: - Oh absolutely, but, but, never immerse yourself to the point that your not still asking the questions, or listening to the document so you're picking up questions you hadn't seen before but which now become important.

HD: - Yes, ah yes, ok.

R4: - I can give you a case if you want it.

HD: - Yes, yes.

R4: - Fisheries stuff. I had seen at first of all the field in terms of the 1860's and the 1940's because I knew from the reading I'd done that in the 1860's the British colonial government first was told they ought be taking more interest in the fisheries. And I thought the operational peer group was

Appendix 4 – a sample from the F1_data

from when they started to be told that through to the time they believed was the colonial government, so it's that last 80 years or so of British rule. I knew that there was fisheries for pearls and so on, but ah, I thought that's just a kind of gloss on the side. The work I did last year in London proved conclusively to me that it was much more integral to the whole thing. That what had happened, one of the reasons they weren't interested before the 1860's was that pearls produced a lot of revenue. They controlled the pearl fisheries in the sense that it was a state kind of run monopoly, uh, therefore this was what they saw as fisheries. They read fisheries as pearls, or pearls as fisheries. This other fishing didn't seem to them to be important and so they ignored it until people pointed out to them there were more things in there, there might even be some revenue in there and so on, then they became interested. So my discussion of the history fisheries goes back now to the 1780's when they first become involved in the areas where pearls are, and so the whole story has to now take account of their policy towards pearls and the problems that runs in. So that it's a refinement in that way. That's why I say you'll go back to re-organise the field, redefine the field when you, when some of these things may well come out. You may have to drop things off because they're dead ends as well. But it's that interaction between the collection of the material and the setting up of the thesis if you like, the hypotheses that you're working on. That goes on all the time but at some point in time is then a process, as it were having assembled material, of retrieving from that material that's valuable to answering particular sets of questions that you've got, uh, and maybe in that process, having to redefine those questions because you haven't got the right question. And from that process beginning to write two sorts of things, both re-writing as it were if you like, the specifications of the field itself and the problem, and getting the kind of explanatory mode beginning to work in that way, but also writing about particular things so that you're in possession of it. So you get an article here on the change in colonial policy on this, or why the landlords, you know, ran their elections in a particular way, or something like that. And that will then often lead you back to more material, and the same process and so on, until you reach a point where it seems to be, you're wanting to actually put it into a, it may be a thesis at some time, it may be a book, a monograph, whatever. But it's that, I see it as a totally interactive process all the time between ideas from your own reading, your own experience, your own observation, to collection of material and the interrogation of that material to redefinition of that and the product of, uh, the outcomes of your work, in terms of primarily writing, conference papers, articles, lectures, you know at different levels. Just the sheer discussion between people. I mean I've done quite a bit of work as a member of a team, and I mean you know, coming back with stuff and saying "look I've found this", you know. Or even if the person's not specifically telling(?) that he's prepared to listen, talking about the material can be another way of further refining.

HD: - Ok, well what you've described there to me is research, if we put a name on it.

R4: - Yes, that's right.

HD: - Right now just two more. (go to Q11)

10R4. How would you compose the elements which made up the ...1 of 4... concept?

>>> this Q has not been used in F1 interviews <<<

11R4. What, in your opinion, is most often misunderstood about your discipline?

R4: - I think it's partly this, if you like, this misunderstanding of the degree to which one is involved in interpreting and refining and explaining material. Now I think a lot of people think that history is just about,

HD: - a time order,

Appendix 4 – a sample from the F1_data

R4: - Yeah, and writing it out and making a kind of chronicle. And I mean they've got good reason to think that because a lot of people have done it.

HD: - Well that's how I learnt it.

R4: - Yeah, it's how a hell of a lot of people are taught it unfortunately. And of course there was a traditional, and different people of course, different cultures think of history differently. I mean for some people a re-telling of those things, you know, "so and so had two sons and those sons divided the land this way and this", you a kind of mythical history. Or some way of just ordering the material, maybe for some cultures it's important. I think for western culture in particular, or for modern culture that isn't enough, and we tend to call those people antiquarians, or chroniclers, you know we have pejorative for putting down those kinds of things. A lot of the stuff you'll read "Mrs so and so out at upper Bungadoon has written a history of the community" and what she's done, she's got everybody's farm in there and everybody's name and she gives you a couple of anecdotes and that's the history. Well of course we don't see that way. Probably is important to her, it may even be important to her committee, but it isn't history as, if you like, professional historians would want to see it. Because the element of interpretation is always there.

HD: - So, uh, the chroniclers, right, all right, and finally how would you describe your discipline to someone from another planet?

R4: - Can I just, before I answer that, I s'pose it's tied up, and you might see it as tied up with interpretist?, I think the applicability, as it were, that point we touched on before, that it can help people make futures, I think is another thing which is perhaps misunderstood. I've heard about a recent special research centre in this centre, this city, that was set up to look at Australia, Asia, and to understand change in Asia, and I understand that one of the prescriptions for getting the thing was no historians. Now, I mean, you know that is go into Asia look at the present situation but don't worry about how the historian sees it. My view is that that is totally misguided. I mean, (a) you won't understand the present if you don't understand where you're coming from and (b) historians could probably do a great deal of that kind of work, in my view, obviously, from what I've said, and tell you what those people are about, you know what the new middle class or something is about. But that's the kind of misunderstanding that I think is, history must be only about the past so it's finished, it's gone, it doesn't have any applicability. Uh, I think that's totally misled. Although I'm sure that some of my historian colleagues have helped make it (this way?). Now, how am I going to describe it to a person from another planet?

12R4. Describe your discipline as you would to someone from another planet.

R4: - Um, it seems to me what one is, would be, saying to them is this: that an important part of human culture is understanding the nature of the group in which you belong, and one important set of elements in that understanding, is understanding (a) where the group came from and how it is constituted over time, how it has constituted itself over time, and the kinds of behaviour and decisions and other sets of value judgements and so on, that have gone into that make, so that history actually it seems to be the kind of informed explanation of past human behaviour in particular communities, particular societies, I mean maybe a unit as small as a family, I mean you can quite legitimately write a history within that family. You often want the wider context. You can write it equally about the world, that is the whole of human history though, you know, your explanatory modes are different. But it's that, and I use the words advisedly because I've thought about this in the past, it's the informed explanation of past human behaviour, in particular groups, and those can range from as small as,

HD: - Right, with the aim of understanding and affecting the present?

R4: - Yes, and the future.

HD: - All right R4.

Appendix 4 – a sample from the F1_data

R4: - The nation that forgets its past has no future, that's an aphorism that is often used in,

HD: - Ok, well that's a wealth of material there, it takes me two days to get through one of these tapes.

R4: - I'm sure it will.

HD: - Thank you very much indeed.

R4: - Right, now if at any time you wanted to sort of see any of the kind of material or anything I mean I've got all of that there, and you're certainly very welcome to do that. Uh, I've, I mean I was of course as long in the DVC's office before, and I had much more of it there, but I, and now I'm back on this kind of straight academic teaching, research and so on. I've only got here the books that I use primarily for my History 112 course which is on empires and imperialists. Uhm, all my research material now is at home. I've just built a new second storey onto the house to take a new study and I've put all my stuff there. But if you wanted to see anything, I mean if it'd be useful to you that's certainly there.

HD: - Ok, it's 3:20. I've just finished with R4, had a novel little chat at the end with him there; a really good interview.

Appendix 5 – a sample from the F2_data

R1 - Political Science domain

R1 has been the most willing of all participants to explore HIMS and its application to data, even when it is not of obvious immediate relevance to his work. He has been very prepared to invest in learning how to use HIMS and explored and experimented considerably.

In the September 5 meeting R1 reported that he had been constructing *concepts* in HIMS. He was also able to express the essence of HIMS and a hypertext paradigm with his own metaphorical description.

The sea (of knowledge) in which shipwreck survivors are bobbing up and down in the swell searching for survivors and fragments of flotsam to cling to. This is akin to the searching of knowledge (an electronic database) where the query is very well defined and the search result is known to exist and will be easily recognisable when it is found. The waves are well formed and regular, almost obviously mathematically describable - the domain or environment is 'known' or understandable. As the wave crashes onto the shore however the previously very ordered wave transforms into seemingly endless fragments of foam. Which bit of the wave now contains the information one seeks? It is far more difficult to make sense out of this unruly set of water (sea of knowledge). The bits of foam are much less recognisable than the regular swell out in the deeper water.

The blue highlighting in the HIMS hyperfolder was like finding which of this bit of foam was of interest to you. The wave was the information bank or data bank.

Searching is very directed. Making the blue highlighting is not equivalent to searching.

Which data is HIMS to be connected to? R1 can see that with a tool like HIMS you wouldn't necessarily exclude any database. In fact R1 engages in special reading of the "New Scientist" (special in that R1 feels that very few people in his domain read it) in which he finds all manner of interesting articles such as about hypertext (for Heinz Dreher), on music and plants (for his daughter), and so on. This is very much like the information management function within HIMS in which NEWS articles are accepted into a variety of dynamically created subject categories, or rejected. The former become the data within a *hyperfolder* R1 is creating a web of knowledge for himself and his colleagues. This is essentially a hypertext.

HIMS is obviously on his mind for even during a week away on holiday R1 and his wife discussed it 'over a wine'. They wrote some ideas on the back of an envelope -which envelope is presently 'hiding'.

R1 would be disappointed if he found his collage of concepts/ideas were already represented in the data he was researching. I said that I would be delighted to find someone else working on the same track, and probably would lose this delight only if too many others had hit on the same idea prior to me. I (HD) rather feel that there are so many variations and nuances to be expressed that whilst one is finding direction and still formulating the (new) concept, it would be a tremendous boost to find that other researchers and thinkers are pursuing the same general lines of inquiry.

8th September 1994 working session - 11am-1pm

R1 had HIMS running and was working on the Ethics-Q5 dataset. He was having just a little bit of trouble in making the concept links and editing the link file. After I investigated the situation on the PC, I determined that a little disorientation with respect to the numerous files and types of files has resulted in the mixup. The solution here is to keep things simple and work on only one 'thing' or research problem at once.

Appendix 5 – a sample from the F2_data

R1: I was wanting to get a bit of practise in without having someone guiding me.

HD: Have you come across any more related terms for linking to the concept?

R1: No, I was going to look through the actual printout. Now I know you see that as the data guiding the research, but I am so familiar with the concepts (relating to this questionnaire) that I don't think it would lead me in a superficial way into driving this here. There is a real problem - I understand that - because it still leaves me in the field of fairly conventional research which obviously you're more interested in breaking away from, and creating an entirely new path. I feel that this is a very good vehicle for me to practise on, both for the technology as well as for the conceptual treatment of things. It seems to me, and we actually found that envelope that I mentioned ... I thought of the term "global common room", because common room conversation in British universities is really where the kinds of thinking that I think you're interested in exists much more so than even in seminars or conferences. Really exciting stuff. And I thought this is like a global common room (I think I've mentioned that thought before) and we came up with three points. And it's repetitive because one of them is "wave theory". There is actually ... I talk about waves crashing on the beach to do with chaos, but in fact there is a very powerful wave theory which came out a bout 15 years ago which is almost equivalent to Newton'sBut the interesting thought there, and one which I haven't mentioned before, is one I call the 'theory of inconsistency', which is,... there is no such theory, but it came about from a conversation I had with Warren Walker, the Head of Physics. He went to work with IBM on one of his leave periods, and he was given a particular cloud in the universe to research and look for new molecules. And he told me this over a beer there one day , and he sounded very exciting, we pulled his leg about being on cloud 9 and so on. And when I saw him the other day, and a good year later, I said Warren how's your research going on that cloud? And he couldn't recall it at first, saying what are you talking about. But then said Oh yes that turned out very well. I asked did you find any new molecules? He said yes I did. I've got one that's all mine. I found several, but one of them is a great long string ... and he got very excited and he reeled off all the names of the atoms that compose this molecule. I said do you assume in that kind of research that the same laws of physics apply out there in cold dark matter as they do here on earth. He said, yeah, that's very interesting because we have to assume that. We have to assume what we call the laws of consistency, and we test for the laws of consistency first of all and before we start our research. And the laws were borne out and so we went ahead and found this molecule. So I said how would you know if there were laws of inconsistency there how would you research it? You know it tended to be a joke really, but it raised the interesting proposition, and it's a serious question in physics and philosophy, that what if there were places in the universe where the regular laws of physics, as here on earth and most other places, did not apply. How would you know? It seems to me that we are looking for something like that here. Our regular conventional thinking, and the way I'm practising on this piece now, is very very much within the consistency syndrome. And what you're looking for, I think, is the sort of lateral thinking, I see that might be an analogy with inconsistency, you've really got to go off and start thinking without the normal laws of logic and reasoning.

HD: Yes, I don't feel uncomfortable with that.

R1: So they were our thoughts over a glass of sherry in Albany, but what it's saying to me is that I've got to go through this conventional phase and become familiar, because in order to reach the inconsistent phase, lateral, whatever phase you like to call it

HD: So if I could say, your synthesis of these terms "unethical, corruption, corrupt, corrupted", and so on, this would be through the traditional research mode.

R1: Yes, I see this as regular international research.

HD: Ok, the question is are there any others that we need to add in.

R1: Well no, I think one could leave it at this for now and see what comes of it. It becomes iterative in that I'd like to see what that turned up, and then pose the question you've just posed and then maybe go back to the ...

Appendix 5 – a sample from the F2_data

HD: So I'll just check that the HIMS concept has been properly set up. ...some work on editing the concept links file.

R1: Ok, let's put behaviour in. Honest and dishonest, um, (he concentrates on the mundane task of typing in entries)

[notice how a focus and concentration, on a part of the problem or on a subproblem (to the exclusion of the rest, with the concomitant) frees of the mind to address (apply all one's cognitive resource to that) only that one relevant part and results in more output. R1 had said we would leave the concept link term list at that (just a few minutes earlier) and is now generating more (i.e. behaviour). HIMS manages all the subproblem interconnections and breaks the problem into 'intellectually chewable chunks']

HD: R1 is now analysing or pre-analysing, going through what this research database has got in it (the answer to open ended question 5 of the Ethics Questionnaire) just from a cursory read and from his intimate knowledge of the research issue, and then use HIMS to highlight, or point to, the important issues which feature in the data and see what interaction results.

R1: Ok, (after a few minutes of typing)

HD: Yes, you've got quite a nice variety there. Would you agree that that is certainly more .. let's just count what you've got there. You've got varieties of ethic (ethics, ethical, unethical), we'll call that one thing, corruption is another one , legal would be a third, dishonest a fourth, behaviour a fifth, - there are at least five ideas or five broad terms that you've got there. If we now ask the question: could you keep these in mind as you read the answers to question 5?

R1: No, that's the great thing about it. If I spread those out on the desk there is no way you can comprehend the variety there even though there are basically only four (five) concepts. You couldn't keep the varieties in mind at all.

HD: Well that is already beginning to be some evidence, if this works, that HIMS is useful in empowering.

R1: Oh it certainly is. But I'd like to add illegal (?? HD - what does this mean ??) as well. (R1 is wanting to get on with getting to the result)

HD: R1 now activates the concept and browses the hyperfolder looking for the result (blue highlighting). On one questionnaire response there were 4 or 5 highlighted terms and not too many more un-highlighted ones, resulting in the observation that if all the terms on the screen were highlighted it would not be very helpful, certainly if it occurred on every screen

R1: Yes we tend to look for things that are fairly rare rather than ... if it were so patently obvious and so multitudinous we'd say we don't need help with that research it's just pouring out all over us.

HD: We are now browsing through the Q5 data, screen by screen , looking for the highlights.

R1: Look at that! It would be interesting to be able to get a measure of the percentage ... if one could measure the total concepts in all those answers in some way, and then say x% of these were to do with the following, or these root words, that would be quite a statement to be able to make as a finding.

[now, what I want to know is would it be likely that R1 would have come up with the idea (essentially a research methodology related idea) of investigating the proportion concepts in one subset to the set of all possible relevant concepts or root words without working in the HIMS environment. . Is this evidence of empowerment? And what is there to say about rigidly following a research design which did not include this idea. Has HIMS helped R1 develop or finetune his research methodology (yes, adjust the design) even as he is doing the research? Or would this quite possibly have happened in any case?]

Appendix 5 – a sample from the F2_data

HD: Yes, well now, if I could put it this way, as a result of the current empowerment of HIMS, you're now even saying I can conceive of these extra things I want it to do.

R1: Hm. (yes)

HD: That raises an interesting question for me. Would you have conceived of that idea, the x% hits of the constellation of words representing the HIMS-concept with name "ethics", ...

R1: No, no, no, the answer is no to your question, no.

HD: That to me is evidence of originality, original thinking. If you wouldn't have come up with that before, but you have through HIMS, then HIMS has been in part responsible.

R1: And it's responsible even though it's not possible (for HIMS to do the x% analysis directly), because it wasn't possible with my previous research experience and even with this, while it may be possible in the future (as HIMS's functionality is extended) using this, at this current time I take it that we can't actually do that. But it poses the question (which is already a finding from the data, and not part of the original research design) [the parenthesised words in the above are by HD]

HD: Yes well you're doing a number of things here. Number one you are actually specifying further function to be made available in HIMS. Another thing you're doing is you're adding to a research agenda, and the third thing I'd like to say here is that it is possible to get this answer except you have to do a bit of it manually. But, but, interestingly enough, if you had a hundred questions it's probably easy for you to do, but if you had a thousand questions I think you'd get a bit bored doing it but what you would be able to do is to teach a research assistant how to sit there and do it, and that's really what they are there for. You come up with the ideas and then get the RA to follow the instructions. Before, without HIMS there and these ideas that you have just created, you would really be lost for words and the wherewithal to explain this.

R1: I think you're right. The immediate thing to do is to see this as a tool for the top class researcher, whereas you're saying the top class researcher can pass that down the track, still see it done efficiently and go on and do something else. I think I've mentioned in one of our early meetings, that to be able to pick out all the verbs or all the adjectives or all the nouns would be the way to go. That would have to be fed in with a program like a thesaurus. ...

HD: Ok, so at this point, these terms which represent important concepts to the research are nicely highlighted for you.

R1: Yes

HD: And you can go and count these, even if for the moment, with this laborious method via the research assistant. The next interesting thing from my viewpoint is, that quite apart from the count of those sorts of things, there is the issue of, in this case we see here on article 38 "unethical behaviour" and we see them in that order, now the question is that not only is the order and the fact that this is the 15th or the xth out of 30, but in context what does it do? And that you can't count because the context ..

R1: is qualitative.

HD: well that's right. And HIMS supports that.

R1: Can you go through that again, have you still got that thought.

HD: Yeah, we have found a hit here. We have a blue highlight on the screen and it's a juxtaposition of "unethical" and "behaviour". We didn't ask for "unethical behaviour", we asked for those separately. Whilst you can find the number of instances where they are juxtaposed in that particular way very easily, via inspection or some automated algorithm, or via the RA, what can't be so easily automated is the dealing with the context in which this juxtaposition of "unethical" and "behaviour" occurs. In this case the sentence is "media recruiting of", whereas if we went to the next instance of

Appendix 5 – a sample from the F2_data

"unethical" juxtaposed with "behaviour" it might be something quite different. However, that juxtaposition with reference to the preceding one might help you to create something new.

R1: Yes, that's true. You see this person is relating to the world outside the Public Service, which is interesting to me, whereas "unethical behaviour" I think would normally be used in these responses towards other Public Servants, or politicians, all of whom are in the system, these are people in the media. ... It would be nice to be able to say "what proportion" ... I guess people outside in the field may not feel that to be able to say that a proportion of concepts used ... you'd have to devise some way of saying "that is a measure of" something. What is it a measure of, it's a measure of criticism. But you can't easily put a number on it. I'm looking to put a proportion on it to say that the proportion of concepts was this. Maybe we need to look at some other way of measuring it. Just a bald statement that all the variations of the root word "behaviour" turned up so many usages, all the words from the root word "corrupt" turned up so many, and that would be useful.

HD: Those quantitative results can be obtained more quickly from lexical and text analysers than from the techniques embodied within HIMS, although HIMS will do it too.

R1: Now you did a count of the number of NR (no responses to Q5). That's a very useful thing by the way.

HD: R1 sees this Q5 data in two categories from this point. One where there is no response and one where there is a response. We'll get that reflected in this hyperfolder, shall we. We'll search all text for instances of "nr" and paginated through the 'hit list' and noted the reported total of 70 hits and observed that two hits should be deducted because they were for "nr" in "unreasonable". Which incidentally also informs us that there are only two instances where the word unreasonable comes out. That's a serendipitous finding.

R1: Yes, interesting, Yeah.

HD: See you mightn't have thought of doing that.

R1: It could in fact turn out to be more important than the original question.

HD: That's true, and that's exactly what HIMS is about, that's what hypertext is so wonderful at.

R1: In fact, it makes you want to go back and say what was the context of the "unreasonable".

HD: There you are, he's lost his track and he's off onto ... But R1 did say that he's done with that and he's got the count of 68 NR instances and obtained the count of 225 for the number of responses in total. Now he wanted to note that answer in the HIMS-concept file. Now let's chase up your quest to explore "unreasonable". So we have found it in frame 101 and frame 120.

R1: Let's just look at them. Unreasonable expectations, unreasonable demands, yes there's quite a similarity in the two there.

HD: You could now create a concept to further research this aspect. [A session on Noted References follows]

R1: It is important to, I think it is better to begin this kind of work with a familiar database. I would hope that one would want to go on. I would certainly be much more at home in the Internet data. I may even go for some very unusual databases, not the politics one at all, you know my own field. It would be nice to splash around in that, but for some perhaps quite serious research, to say what are the various databases. What does an engineering database turn up for example? What about a biology database? What are people talking to each other about in these other databases? And you just go there and browse first of all because that's where it's really unfamiliar. Here (the Ethics Q5 data) I don't need to browse. The browsing is done, so I can go on with the hop-step-and-jump. But start by browsing and saying it's turning up nothing at all, it's all gobbledygook to me, too specialised. But that's where you might pick up the potential Nobel Prize (refers to Harvey

Appendix 5 – a sample from the F2_data

Wheeler's article as an electronic book to do with the impermanence of electronically published material, the concept of fungibility).

HD: Alright, well this has been a wonderful session.

R1: Yes, it's picking up speed I think. Just while you are here, can you tell me about the mouse clicks again.

HD: [end at 12:20pm]

20th September 1994 - 9am - 10:30am (HD was ill with flu)

R1: I was thinking the HIMS concepts here are the ones that one would pick up when you are reading. What happens when I think I laterally think, when I'm reading something. I sort of go into a dream mode or reflective state and my mind dances all over the place, and on very productive or creative sessions you can come up with a really good idea, jot it down. But the path towards reaching that point can take an infinite variety of routes, and sort of disappears into the mist and is very hard to plot. In fact I thought of the analogy of planets forming out of intergalactic dust. It's very like that where you've got dust in the galaxy and over billions of years it coagulates and eventually you end up with planets or stars and the stars might be the equivalent of the concepts that we're searching for here (with HIMS). The process that brings about the star is a very elongated one and so is this. To move away from simply finding the variations of given concepts, and I agree with you there that the concept of corruption in its various forms there is a grammatical form, and I guess you could get out the thesaurus and plug in a whole lot of other words, which is what we've done anyhow. But often when you're reading it's not a single word that turns you on, it could be a sentence or terms in different sentences or paragraphs and they sort of clump together in your mind.

HD: Yes, well would you call this creating a juxtaposition?

R1: It could be. It could be a juxtaposition of opposites. Or it could be some extreme similarities. It's hard to say, I haven't really thought about it in any great detail. But my feeling was, what would I have asked of this if I wanted to undertake the same thing. I mean, firstly I probably wouldn't be reading even my own file for really creative stuff. This is simple empirical data (referring to the Ethics Q) which when processed quantitatively will produce interesting results. But if I was looking for ideas I then go off and look at very different books. I say what I have I bought recently that's about this? I go to there, and go to the index and I dodge my way all through the book, and sometimes I take extensive notes from the same book. But those terms, or those notes are the things that prompt me later. And they are much bigger than just a few words. So I thought now if I was looking to be really excited over this, I think this is what you're after is, not just ordinary research producing ordinary results even if through a lateral kind of thing, I think, if I understand you correctly you're looking for more the things that question paradigms, rather than simply solve puzzles to use that Kuhnian language. In other words in talking about the actual process, rather than the software here, I would tend to say a more interesting database, if there was one would be a philosophy of science database. Do philosophers of science talk to each other?

HD: Oh yes they do. I have data to match that on Aus.Politics.

R1: Have you really.

HD: There is about 2.5 Mbytes. In which I just happened to discover Michael Zeleny having a discussion with some others. Quite an interesting guy. He actually visited us some time ago. He's written on economics, philosophy, information systems, all manner of things. I think he would probably be described as a philosopher - very eloquent and the passages which he just 'sprukes' would take me ten times as long to formulate. But most of your discussion to this point has to do with how you work without technological support, that is with an un-aided mind.

R1: Yes

Appendix 5 – a sample from the F2_data

HD: Well HIMS is very rudimentary. It would be nice for this constellation of terms which comprises a concept to be able to represent much more than just the syntactical and grammatical variants of the main term. This will have to be left for the future. Then it would be much more akin to what your mind does. But at the moment we just have to work with these much more simple means. This constellation of terms then, can be set up such that wherever they appear, any one or combination, 'blue lights' are turned on to highlight the instance and attract one's attention. From there on your mind has to do the rest of what you explained needed to be done. In other words you have to see that in context, and juxtapose that with what you read in the New Scientist and so on. I've been thinking about this New Scientist reading of yours and you are actually doing what HIMS does. And you have just described it again not so long ago where you reach for some recent book acquisitions.

R1: What I like about this is that it's very new data, or it could be, the APO data. But the idea of plugging into conversations taking place between informed or interested intelligent people, in the way you can on the Internet, is really extremely up-to-date. And it's always being updated and has an attractiveness. There is the gossip side of it. But I also wanted to mention Heinz, that I didn't want these thoughts of mine to take you away from what you would like to be the mainstream efforts here. I take your point that we've got a certain steep that's at a certain stage of technological development and we've got a database and we should be using that to see what happens.

HD: Well, in terms of the practicalities, you've explored the APO data to some degree, and through that learnt a considerable amount about HIMS. Now you've got this Q5 Ethics qualitative data. Do you feel as though you're done with that?

R1: Not finally. I think I need to visually scan all the 'blue lights' and get the context right there, not of the whole database necessarily, but just of parts of it, to see the density of the 'blue lights' as it were. You then get the feeling for the thickness of the dust kind of thing. And then what ..

HD: Well, we can make a plan together about how to treat that, and then you'd spend one or two or three hours or whatever, doing that. The other thing is that we can get the SPT (Science.Philosophy.Technology) data. The way to proceed in both of these cases is to ... We haven't actually talked about this before but these concepts can actually be hierarchical. What's one concept with which we are working now?

[work with HIMS now to demonstrate this]

R1: This adding (or additive overlaying of HIMS concepts) would be an advantage I think, research wise, to keep adding to the picture here is like putting brush strokes on but all of a particular shade as the words are related.

HD: And then eventually out of all that you are going to be able to take those words which appear there on the HIMS concept screen and you are going to be able to rewrite this whole thing in your own terms. And that's where the really new work gets done.

R1: Because what you've ended up doing, what I think I would have ended up doing then would be to take the entire database and extract from it, or highlight in it, every related word on a given theme. It would be like having the database and recognising the skeleton that is lying there. And the writer puts the flesh on, but these terms (HIMS concept terms and linkwords) constitute the skeleton.

HD: Yes, that's right. That's a very nice way of thinking of it. But you don't know what the skeleton is before you actually get in amongst the data do you?

R1: No, no.

HD: And that's where this mode of research departs from the traditional mode. The traditional mode assumes that we know what the skeleton is. That's part of the design, and we even are so audacious to specifically and only go looking for data which is directed by this skeleton. Of course we find what we want to find!

Appendix 5 – a sample from the F2_data

R1: Yes that's right, it's a preconceived one. I entirely agree. And in fact even if you try and go in with that so-called open mind, it would be so huge a database that you couldn't envisage the skeleton without a tool like this. It's very hard to keep the mind open if you're looking for that skeleton, there's a bit of it over here and a bit of it over there, and where did I see that other bit, it was somewhere around here wasn't it. But this gives it you in one fell swoop. And then it would be useful to pose the question ... let's see, I can't get away from, well how many numbers of these and these and those are there. That's the total sort of body count. But that gets us into very conventional, simplistic ...

HD: It does, but that still is useful. But there are much quicker ways of doing that than through HIMS. Lexical analysers will spit that all out for you very quickly.

R1: Which is why I get a bit concerned sometimes that what I'm thinking my way through here is fairly elementary. I'm perhaps not getting the best out of what you've designed here.

HD: Ok, shall we make a plan about how to proceed with this data?

R1: Yes

HD: The first step is to begin making a concept ... You have a start, the terms unethical, corruption, improper behaviour, unlawful, and illegal as the concept as the constellation of terms to represent the concept "ethics". Through your browsing of the data with the concept activated, i.e. highlighting in blue those instances of the terms forming the concept you discovered the term unreasonable was used in an interesting and related way by one questionnaire respondent.

R1: And then we said how many more unreasonables are there and got the answer two.

HD: Right, so you even start asking new research questions. Could I say you're designing your research as you go along. Well that's qualitative research so far as I read it.

R1: Yes, yes. And I'm not suggesting it's weak, I find it extremely useful for my own purposes, but I feel it's low key for your purposes.

HD: No, no, not really. It's whatever leads you wherever. So the first step would be to get our concepts nice and organised. The second is then to apply these concepts one after the other or in organised fashion against the question 5 data, the 225 of them, looking at the highlighted terms and making notes etc.

R1: The word highlighting is interesting because you could well imagine yourself going through those questionnaires one by one and highlighting (on paper) these very words.

HD: Then the third step - as a result of applying these concepts and reading and I guess juxtaposing things from your mind and from here in the data and in the concepts and this is where I think new things are happening.

R1: Juxtaposing. What do you see juxtaposing as being again?

HD: My definition of juxtaposition is that you are putting things proximate, in space or in time or however, maybe just bringing into focus, where they would not normally be so and through that you are generating new insight.

R1: Certainly it helps me conceptualise what these respondents are trying to say by getting the visual feel for it on the screen. There is no question about that. I mean you can get a real feel and make judgements.

HD: If we turned the whole thing around and you now had an opportunity to say what would be a world shattering finding, what would be the Nobel laureate type finding that you're after, and now imagine that there is one respondent that said all those words and put it together for you. This one

Appendix 5 – a sample from the F2_data

respondent of course is not there except hidden away in amongst all the other responses. What you have to do now is to bring that out and make this imaginary artificial respondent's concept real by expressing it in your own words through the research process

R1: Yes. Make an artificial respondent, is that what you're suggesting? Which is what the research is trying to do anyhow, except you're trying to conglomerate all of those responses together which you could in fact, to get a hypothetical one, which is one I do in my writing is say what is the best view that one extracts, what is the most pleasing, I mean these are all negative we haven't even thought of any positive ones yet ... that's interesting that isn't it. [HD later interpretation: this is a nice little example of the research process, that of using HIMS techniques, permitting an analysis of data and thinking about that data in ways which might not normally be done, viz. to consider that we have only used negative words to help define an emerging concept and could indeed proceed similarly with positive ones.]

HD: Now I can probably explain it in another way as well. I have this idea of what I call 'GroupMan'. In a meeting we want to come to some consensus or make a decision asoasf, if everybody said X, whatever that represented, then everybody would be in agreement with X, and then X would be the view of GroupMan. It could be that there is one person in the group that had the view X and could persuade everybody else that this was the right one. So whether it comes from one person, or a little bit from many or from everybody, the point is that we have it. I think what makes groups, where the dynamism comes in, is that it's never as simple as I've described, there will always be people who are offput, dissatisfied, concerned, feeling down-trodden, and so on. I think this GroupMan concept could be what one is chasing in this questionnaire type data.

R1: That what's happens in juries. There is a famous film about that where someone gets murdered and the jury goes through the case, get locked away, and the film is about what happens in the jury room. Only one person thinks the guy is innocent and it takes half a film but in the end he convinces the entire jury that the guy is innocent, and he happens to be right of course. So people can persuade others of their point of view by being involved, articulate, persuasive, and we're looking for that kind of artificial person in this data. You see this is fairly conventional, this is original, it's useful, I find it very interesting, but it's still conventional. It's the puzzle solving stuff. You see, where I would find the process invaluable, if it existed in that way, and again I shoot off on what is possibly another tangent and hence my suggestion before, to look through the philosophical stuff, is that I look at the lecture that I deliver and I say which database would I really like to get into to make some very original comments on that kind of thing and I give one lecture on policy disasters. Who writes about disasters the best of all? Well I know even from the books it's engineers. They write about disasters best of all. So why don't I zip into this database by engineers, plug in the words disaster, policy, catastrophe, all those kind of terms and see what happens. And I do the same with all my other lectures too.

HD: Well I have engineering data, science.biology data, science.philosophy.technology data (SPT), economics, and the Australian politics(APO). But there is lots more to be had. And I have a subset of the SPT data which contains only and all the 'methodology' related articles or postings, and I think it's here where I discovered the Zeleny discussion referred to earlier. Now if you wanted I will make one of those for you but I think it would be useful if you seriously tackled this first.

R1: Should we really be looking at, I don't know whether Internet is the right word for the origin of all of these postings, or should we be ... see we've got a choice it seems to me, and I get back to that interstellar space analogy whereby we either look closely at a given star that we've found, we look at its structure and all kinds of things about it, or else we shoot off where there are no stars at all and there's just the dust, and I think some of the, the APO database for example, are for my purposes the dust clouds. They still are very interesting but for reasons different from when you actually look at a star. Some people would like to look at the stars of research, other people wander off into the dust and may go for a long while without finding anything at all but they'll come across a certain phenomenon which is obviously not a star but which is very very original, and you'd never find it unless you're prepared to wander virtually endlessly, and you can't do both at once.

HD: It's true, but remember your comments from a week or two ago, viz. it probably is best to start this HIMS type research with something familiar.

R1: Yes, to get the process right. Fair enough.

Appendix 5 – a sample from the F2_data

HD: You know I spent two months solid preparing that NEWS type data for HIMS. There is 50Mbytes in all. That's 2 months full-time work.

R1: Just preparing the data

HD: Yes, making sure that it's all manageable within HIMS, and that it all works. See most people don't work with 2 and 3 megabyte sized documents. I know this. I actually know this because if people were working with documents that large they would be facing these problems that I find. Print times being incredibly long, in Word2, and possibly in Word6 although I haven't tried it, you can't outline documents beyond a certain size well short of that possible in MS-Word5 for DOS, so we've gone backwards in going from Word5 to W4W2. So we just have to be a little careful that we don't spend too much time on this wafting information. And it would be nice if it was up to the minute but just the collection of it took quite a deal of resource as well. But a sensible approach would be, after you work on EthicsQ5, is to take out in a very cutting way, those things which are of interest. Methodological issues I presume are of interest.

R1: Look I agree, my original comment that one must get this process right and use this as a way of familiarising myself with HIMS. Perhaps we should open another folder, and instead of following my research interest, plug in to terms like methodology.

HD: In this EthicsQ5 data?

R1: No, I think it was the .APO one I must say.

HD: Is that what you want to do?

R1: Yes, Hm. Hm

HD: Ok, why don't we do that, although I'm going to go and get a Sudafed or something for the runny nose etc. In the meantime you could map out on a piece of paper what it is that you are going to do.

R1: Yes, If I can do it on paper while you are gone ..

[the remainder of this session covered various options and features of HIMS

22nd September 1994 - 9:30am - 10:30am

[In the meantime over some 10-15 hours I have prepared a SmarText HTX of all the .APO data, some 5 MBytes of text, in addition to one large file of all the APO data, incorporating some 1191 articles or postings. R1 had given me a set of 24 key words for which I generated the the occurrence frequency statistics using the SmarText model, to help answer the question "will this endeavour be fruitful?" This was reduced to 6 keywords for the ensuing case study during which R1 will use HIMS on the entire APO data. The subset comprises: accountability, fail, productivity, minders, reform, and a later addition, Westminster.

This meeting presented R1 with the ready made hyperfolder and we began creating the concepts]

HD: What we need to do now is to begin using HIMS to see what it tells us. Now there are many ways to start this, what are you thinking about?

R1: I'm thinking about keying in one of the concepts, say Westminster.

HD: Are these keywords related in any way?

R1: No, not directly.

Appendix 5 – a sample from the F2_data

HD: Well I think a very good way to start would be to create a concept for each one of these 6 keywords, and with the name of the concept being the name of the keyword. These may undergo a transformation as you proceed and the process is not one which can be done in an hour. I estimate probably a good solid 2 days. One of the things I am interested in is how would you do this in other ways, without HIMS?

R1: There's only one way if I wasn't going to use any program, no SmarText etc.

HD: Well, no hypertext software, put it that way.

R1: You could only sit down and read it like a book, and you'd fatigue and could well miss some good ideas if you'd been doing it for an hour or two. You might be able to do an hour in the morning, an hour in the afternoon, and do that for several weeks. It would be laborious, and you may well get inclined to give it up before you're done.

HD: I think what's happened is that many people don't do it because they see it as 'undoable. In other words they don't even launch on this.

R1: Yes, I think some academics would say that it is too vast as task and we should concentrate on a few little building bricks there, not try and tackle what is in fact in many ways the big picture. But it's not a cohesive picture, this is the interstellar dust. And I view this database in a similar way and it could be not dust there but pieces of gold and the idea is to do that browsing even though there's a huge amount, and see what the value of the gold is.

HD: Right, why don't we begin with these keywords in order.

R1: Now it would be useful if we could, ... you obviously want to find the gold as quickly as you can. I mean one interesting question, and in some ways a silly one, is to say are there any (I call these messages by the way) messages there which contain all those words. Show me the messages which have as many of those words as possible. Perhaps that is unreasonable.

HD: No it's not. Traditional searching software can do that better than HIMS but a way of doing it is to begin a search for the most frequently occurring keyword which is "fail" or "minders".[we then begin doing a search]

R1: Is that what we are actually doing now?

HD: Yes

R1; I just said it was an interesting question because ... one is in fact torn between wanting to do one thing and doing another and to find the exciting parts first of all. My academic prudence suggests to me that to be a bit patient and methodical and systematic and not just rush in and expect to find ... that's why I said my question might be a bit unreasonable. In a sense, I don't expect to find very many where there is a combination, and I wonder now is that really what I want to find first of all.

HD: Well, indeed, "AT ALL?"

R1: Because once we start this thing going it's going to have to work away for a while and I don't want to ??? where it's not being the most effective.

HD: But not only that. I suggest what happens as you work over this you will find that maybe these terms will change a little and you'll come up with other terms, and so I suppose I reacted very quickly there in my eagerness to show that HIMS was capable of doing the traditional type of searching too.

R1: Yes, you know I did a library search just yesterday and what I'm suggesting sounds very much like that is you put in the key words about the author, the title, and I'm merely mouthing what you

Appendix 5 – a sample from the F2_data

say is a very simple well known approach. But what makes it different is that we are not dealing with the library, we are dealing with this interstellar dust, and that's a very different situation. I wonder for example, a better way might be for me to read those (pointing to the SmarText hit list of selected words and their one line context) and tick the ones which seem interesting and then call them up, and then start flagging them and making notes on what I saw.

HD: Ok, let me just spend a moment or two making sure that you have a doable workplan. What you would do here is you would make a concept now for each of these. Let's call it accountability, or whatever, ... [we now create a concept with its link words and concept narrative ...and use HIMS to help discover the important pieces of knowledge in the entire APO dataset of 2.5Mbytes with respect to these 6 keywords. R1 discovers the name Brian Coombs from ANU and begins to wonder at Coombs' voluminous contribution in the Internet's Aus.Politics NewsGroup. R1 now needs to repeat this exercise, making a concept for each of the remaining 5 keywords.

7th October 1994 - 9:30am - 11am

R1: Interestingly, - I don't know the hotkey for "up", what's it?

HD: Oh, there are two sorts of 'up' [meaning up the screen, i.e. back into what is before in some sense]. Physically previous, and logically back, so hotkey "p" will take you to 6866 if this one is 6867.

R1: That's the one. Yes. No, you see there's another guy who is a bit bored, and he's trying to start off on a favourite area of mine, so I was very interested in that. And when I went on to see what else he was saying I get this thing on drug trafficking in Malaysia, then we go back to this fellow. Now that's a separate message?

HD: Yes, yes it is. [check out the date of posting messages, and note that but hours has passed] What you are seeing there are snippets of people's thinking separated by four hours. [we are exploring some of the messages and their prompt replies] But, how did you discover these?

R1: Well I was browsing. What I did was to 'activate' the 'concepts' and thumb through.

HD: Which concept? We have "Account" and "Q5", which one did you use?

R1: I did "Account", and it was for the big APO file. And I was paginating [meaning advancing frame by frame, or article by article] through it to see what the volume of the catch was.

HD: Ok, and you noticed some highlighting.

R1: Oh yes.

HD: And that's how you picked up this thread did you?

R1: Well, I picked up quite a lot of highlighting, especially at the start. Then I felt it was going back and began taking note of the [article] numbers, and it wasn't going back. It was simply as you'd expect, paginating through and through. And what drew my attention to that one was the fact that it was tabular data, and immediately it was obvious it was federal-state financial relations. But in the paginating there are just the odd words that catch your eye. I mean, I saw "Alan Bond" there and I thought "hey, better get back to Alan Bond".

HD: Right, so that wasn't highlighted?

R1: No, no it wasn't.

HD: ... but you saw it anyway?

R1: ... yes, yes that's right.

Appendix 5 – a sample from the F2_data

HD: That to me is a nice example of where you mightn't, in a traditional search, you might not have thought of using "Bond" as a key.

R1: No you wouldn't.

HD: And it's more specifically "Alan Bond", for it is not any "Bond", but it might not just be Alan, it might be his son John Bond and a few others like that, not all of which you can so clearly think out at the beginning. But when you immerse yourself in the data, as I call it, these things become much more clear.

R1: Yes, in fact there were several concepts which came there - quite a lot of interesting stuff on republicanism which would flash across and then I'd go back and just have a quick read of that, having to remind myself the whole time not to get sidetracked, but at the same time the sidetracks can be very interesting. And so in fact there's almost an invitation to paginate through before you do your concepts so that you can say "well what kind of stuff am I likely to find here" and er zap onto a sort of a random selection of numbers. In other words perhaps even make sure that you're covering the timescale fairly well. One could look at the full contents list, I think it is. What one could do is pick one at the start. You know there are 1191 articles there, so a reasonable sample might be 20, so spread them through the whole of the list. Maybe even decide on the numbers beforehand. You know, where you start here and pick on a 50 or 100 interval. If you wanted 20 you'd pick every 50th, open it up and read it and see if there are any interesting concepts there.

HD: Ok, well, all these are various strategies of cracking the nut, so to speak, but once the nut is opened, you sort of said paginate through, before forming the concepts. I think this 'before' is relative. The curious thing to me is "before what?". It's whenever you start.

R1: It's before you even list your concepts. That's unless you have a research item in mind. If you have, and I did have, then you'd say to me "what are your concepts?" and we'd list them all there. And that's fine, but you're then looking for something, in which you're interested in a vast bank of data. This other way is really saying let's not look for anything in particular, let's just see if there's anything interesting.

HD: Do you find your concepts have changed a little though?

R1: Well I would certainly add to them now, but you end up, ... I guess what determines how many concepts you want to name, is whether or not you've got something in mind to write about. Now usually you do, so that constrains my thinking on concepts. But if you put to one side a particular line of thinking, and instead start paginating, you may want to spend an hour ... probably a better way is not to go every 50, but to spend say half an hour or an hour simply paginating through, but doing it more slowly than I was doing this morning, but really speed read, and when you see something, ah ha, make a note of that one, put it in, and they'll all be unrelated, so you end up with a lot of unrelated concepts.

HD: Do you remember our, um, the sidetracks you mentioned, there is this tendency to say "oh boy, that's an interesting one to follow", but yet I can't handle that [unaided]. HIMS supports you doing that in a number of ways. I mean one is the 'noted reference list'. Have we talked about that? For example, if this article were of interest to you, you'd put the cursor there say, and press the <insert> key.

R1: Oh we haven't done this. That's very interesting, because I was going to ask you this very thing.

HD: Yes, press the <insert key>, then you have some 40 characters in which to make a comment to remind you of why you are 'noting' this reference. Essentially this is like a little 'PostIt Note' that you are inserting, but it will actually create a hypertext link for you to follow and get back to that article.

R1: Yes, I was going to ask you the very same thing. Now what to put there? "Labour propaganda" or just "labour" would be sufficient.

Appendix 5 – a sample from the F2_data

HD: Now use the 'Notes' menu item to the top right, and 'select' the 'Noted References', there it is. It tells you which hyperfolder it's in and all, and if you click on it you'll get to that article irrespective of where you are.

R1: Great stuff, that is really good.

HD: Now you better save the 'Noted References', if you like it, in a file called "something.ref".

R1: Great, great. That's really very good. I want to do that again then. That is an invitation to the pagination we talked about, the slow pagination of about one hour, prior to the starting on concepts, to get a feel for what the items are. Yes, Hm, that's very good. How do I get back to the very start? 'GoTo' the 'home article'?

HD: Yes, you could, although the 'home article' is the one which is displayed on calling up HIMS and isn't necessarily the (physically) first article.

R1: How about the 'Contents List'?

HD: Yes, and then just pick the first one.

R1: Now you see, to paginate through there in a slower way, ... activate concepts, ... [R1 now explores paginating multi-page frames and stepping through these. Uses 'Configure' to put screen into 50 lines per screen mode so that more can be seen at a glance]

[HIMS or the PC or the printer misbehaves at this point and requires to be restarted, and a lengthy period of re-orientation follows to check that all is OK]

R1: [tape change]... just a delight of the process, it's the kind of thing of course that delights the technician.

HD: Yes, but there's more to technical things here than ... I mean, when you say it speeds you up and you get a buzz from the speed, yeah, you do really feel, I suppose like we might feel if we could fly eh. You know, we don't have any traffic lights and we can go very quickly and we're free, but of course it's not just the speed, it's where the speed gets us, is that what's the important thing or is it just the pure speed? It's what happens as a result of having that speed.

R1: Oh well, that would be even better, later. The thing is that you've sort of taken the first step, and for me it's an important one for I'm not a technical person, so I probably get a larger buzz out of just acquiring the speed even though it may be, at that stage, directionless. But once you add the direction to it, yes, it becomes even better.

HD: Hm huh, well probably the speed plus the direction is empowerment. If you only had direction and no speed then that wouldn't be ...

R1: No, well that's exactly what I am. I mean I'm a person who knows where he'd like to go, but getting there is absolutely laborious to the extent that you sometimes give up. Now this is opening up a new, well I was going to say "freeway", but that's becoming a bit of a cliché isn't it, the sort of super highways and that kind of thing. But it is, I mean we are talking about direction and roads to get there and you can see how the freeway analogy applies.

HD: Yes, there's definitely quite a bit of learning, and one of the things which strikes me, particularly with software, is that oftentimes people are not prepared to make the investment to learn. And I can understand it, because it is a heck of an investment, and if it turns out that it's not a very good product, or a dead end in some other respect - the product isn't properly supported and so on, then you have wasted that learning.

R1: Er yes, but there is another reason which is probably far more common I think, and that is that the languages and the processes change so much. I mean I've been into so many, and I'm into my

Appendix 5 – a sample from the F2_data

5th different language now and I'm already behind the rest of the School. They're all into Excel. I get tired of learning new languages, and there's a fatigue factor. And what was it Janet Homes a Court said in her speech yesterday, it's probably in the newspaper, where she said she talks to a lot of people in business in Australia and overseas in all kinds of capacities, in board rooms, ordinary people, she said "and they are fatigued with change". They just don't want to change any more, because everyone has been forcing change on them from all directions. And often it doesn't bloody work either. It isn't as if it is all successful change, it damn well isn't. And I feel that way about many of the computer related things that I've been through.

HD: Yes well for that reason I think products have to be very carefully thought out and you have to pay a lot of attention to human-computer interface. So in other words, the doing of things like configuring and so on, ought to be where you would want to find them, or where you would expect to. But given that everybody is slightly different, the way you handle that, I think, is that you make the thing configurable. And that's one of the beauties of hypertext, I find, or certainly this implementation of hypertext, is that you can actually, if you go on and learn a little more, you can make these changes for yourself quite simply. Whereas in products like EndNote as a bibliographic manipulator or repository or whatever, you can't so easily make those changes. You can't decide what menu item will be where. ... Now when you say you're behind the rest of the School, there is no one else in the School that has HIMS you know.

R1: Oh no. I was thinking just of wordprocessing languages, no, and I'm particularly pleased with this, I boast about it in the office. And they're all impressed with the very word, you know, ...

HD: What, HIMS?

R1: No no, hypertext. It really turns them on. So when I say, as I did last time, I've had a session with Heinz Dreher on hypertext ... they But look this is, and I know I'm saying it more often now, but that's because there are so many breakthroughs to make and many of them are quite small ones by your terms I'm sure, and you know I feel I am making them, and if I go back now to the HIMS tutorial I can engage my own learning skills which will be a time saver for you and will make it stick with me.

HD: Gosh it's half past 10 ... Now there's one other thing I'd like to just revisit, that we haven't done for a while. If you remember that acquiring these articles into a hyperfolder was something that we did at the beginning. We looked at the heading line and we decided yes that one is going to be in a hyperfolder to do with this term and that's going to do with another term and so on, so all the way through, even as you get these things off the network you can begin to categorise and make links to them. The process that we've gone through is definitely an iterative one I think. You get hold of, and you classify one way, for the moment. It doesn't have to be fixed because all of this is so dynamic, and then you can view this in the light of the concepts and when you narrow it down a little more you can view it with a refined concept or a different concept and you can use a combination of searching and this highlighting. And it might just be that you press "n" for 'physically next', instead of "m" for the 'matched list', or "p" for 'physically previous' and you look at one that you might not have intended to look at and you say "hey, boy, there is something interesting there". That's just a serendipitous discovery. So you add that to the list. ...[discussion and demonstration of the 'matched list' follows] Yes, well I'm delighted how you're really getting on top of all this.

R1: In fact, I think, for the first time I would rather go back now and go through the tutorial with both the APO and the Ethics Q5 data. ... Good. Well look I think the kind of questions I'm asking myself now are really aimed around these notes that we made here, and I can get those from the tutorial, and I'd rather do that.

.....[lengthy session on searching etc.]

R1: And so in this exploration you learn and you're interested at the same time, even though you're not going to use it for research. But the process that you acquire in that process, for real concepts and real challenges, real research, you know are going to be invaluable, and I just hope the ideas come on the end of it. That's a bit of a worry for me, that once having mastered the process, will in fact the leapfrogging continue in the world of ideas, concepts, and that's another question altogether.

Appendix 5 – a sample from the F2_data

HD: Just on that, the only reason it won't is because there's nothing there stimulating it. I mean if the data is there, it's got to happen, doesn't it?

R1: If it is there, yes. Once you do start a slow browse there, you realise that a lot of stuff on the network is just gossip, and it's not going to be useful for research. It's people who like playing around with technology I think, as opposed to those like yourself. Um, but even so, that should still leave a large percentage and you've given evidence of some very important stuff that's been loaded on these networks and hopefully we'd encounter something like that, like I did with the federal-state financial relations this morning. And that was an interesting little sideline.

HD: Is that useful in your research?

R1: Well, I've just written a book with a very similar table, as part of it and I'd like to compare the table from here with the table in the book which is actually Ian Kerr's - he's done a lot of work in that area too. It would be interesting to say "do our tables show the same kind of data and if so are the figures identical or close. Just what is this guy saying, is he suggesting an alternative way of looking at federal-state financial relations?"

HD: Ok R1, I'll leave you to it.

27th October 1994 9:30am - 11am R1 reflecting on HIMS use, etc.

R1: Now do you want me talk about HIMS, and my thoughts on that?

HD: Yes, basically that's the broad subject matter. It's questions like, what has it done to you, just an emptying of your mind of all HIMS things.

R1: Yeah, Ok. Well I made some notes and you're right, I think I would appreciate the opportunity to add to these later, and I appreciate you giving me another tape to deal with.

So my thoughts on HIMS - and I've asked myself just what are my basic thoughts.

First of all it has an intrinsic attraction as a play-thing, a fairly trivial comment because it denotes that a play-thing is of fairly superficial interest and we are treating this as a game. I guess games can be, and are, taken very seriously by, among others, economists, but here I'm simply saying there is this attraction in the same way that people get attracted to time zone or something, not that I've been there but I do enjoy playing around with the visual experience of HIMS there.

However, in terms of its more academically related areas of usefulness, the first point I'd make is that it's obviously very good for interpersonal contact, in that when you tap into an APOL database [Australian Politics NewsGroup], in the way that we have, if you find interesting items you can immediately identify the source and make contact if you wish. So you can explore data, you can locate the source of the individual, you can make contact, and you can do it on your own terms. And that's very advantageous. You don't have to make contact if you think I'll just take that idea and expand it myself. If someone is sufficiently interesting then you may end up with ... in other words it really facilitates networking, on a global basis. So it allows you to be highly selective on whom you contact in that networking process.

HD: That "doing it on ones own terms", can you just elaborate on that.

R1: Well, you can decide whether or not to contact a given person. And you can contact them because, ... you don't know an individual, all you have to go by is what they have written on the network, and you can make a decision on the basis of that. You may know more about them, I mean if it's the name like "Coombes" and some others, you may recognise them, and say he or she is a big name in this area, or maybe you heard something else about them which makes you wary, for example, about contacting them. And you may want to wait a while and see if they plug into the network again, rather than make a judgement on a single message. So you can evaluate an

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individual to some extent, and then say I won't make contact, or I will, and that's very good. It puts you in an editing position or in a control mode, you've got control over whom you are prepared to work with on the Internet. Because once having made contact it may be difficult to unmake it.

And that's the point I'm making. The second point in terms of usefulness, is the characteristics of HIMS.

First of all it's a non-reactive database, in my terms. Which means that I haven't asked anyone any questions, and therefore I'm not pre-determining the answers to my kinds of questions. Other people may have asked questions and other people may have answered those questions, but they are not my questions, so in an important sense, it's what I call non-reactive data. It's also clean data, in that people are completely uninhibited and write what they say, they don't even bother about spelling errors, and often the rigour is missing, and in some way this makes it gossipy but it is clean. By that I mean, more importantly, that it's not just clean in an uninhibited sense, it's also clean because there is no authority behind it. By that I mean, Government. There's no multinational, there's no one controlling it. It's completely free wheeling, and the only condition that you need to fulfil to engage in this is to have a computer and be reasonably intelligent, and to have something to say.

Something else I like about it in terms of its characteristics, and this is still on my second point of usefulness, is that it is in a way, a self-organising system of data. And I go back to cybernetics here, and Stafford Beer in particular, who first introduced me to self-organising systems, in that we are surrounded by systems that organise themselves without any help from us at all. We may have to set them up, but once we've set them up, and you probably feel very warm towards this idea because I think you do this all the time with regard to your software development, in fact HIMS is very much self-organising once you know what to do with it. But there are some grand examples of self-organising things, so it's not just another analogy I'm using. We've used a lot of analogies in our discussions together. I think some of them, looking back, have been very good, and I'm going to make another one shortly, but, self-organising systems is not an analogy, it's a good rigorous theoretical statement that is not just qualitative, it's heavily quantified in fact, and that I think, once you can bring maths to bear on those kinds of theoretical constructs, you're engaging in a fair amount of rigour. It also, switching from Stafford Beer, who introduced me to self-organising systems, I felt that these characteristics may well be, in turn, characteristics of the initial recognition on your part certainly, and to some extent my own, of HIMS at this stage being the equivalent of the Wright brothers flying. It's very difficult to convince people that there is a major breakthrough in the offing, and that often doesn't happen until people, you know, when the Information Super Highway comes to be so widely known, in fact as you say you were doing it yourself ten years earlier, or more, and only when you look back do you realise that. And I think back to the cybernetics writers who continually go back to Norbert Wiener, and his book "The Human Use of Human Beings", and he was the guy who saw the implications for cybernetics and the use of computers in the world in relation to human beings, in the view of many, and it was only long after he had done it that people seem to recognise what he had done.

It doesn't quite finish my second point, because I'd like to just add that the self-organising system statement implies that lying there in the data is a pattern but you need to find it ..

HD: Yes [a thoughtful soft yes]

R1: ... and HIMS allows you to do that.

HD: I mean that to me is central. Once I discovered that, or felt that, that's really what drove me. Is that so important do you think?

R1: I think it's absolutely vital because, I think we touched on it, looking back through my notes over there on the desk, when we talked about the existence of a skeleton lying there, but you didn't know what it was the skeleton of. And it's sort of lying in a bed of sand, and that's all data as well, a bit like digging up a, I don't know what you call it, these old bones and things, um, ... Yes, I mean, I think the very fact that you see the blue things popping up and then you're able to move on and do something with them and establish relationships with them, and to see what we called in one interview the "thickness of the data" and how it might be compared with interstellar dust and the

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condensation of planets and so on. And another way of thinking about this, um, but I've made it part of this second point actually and I hadn't done it, the characteristics which I like, of HIMS.

Past my third point will help me elaborate on that skeleton idea, because I think the third point for the usefulness of HIMS is to do, is what I think we've been concentrating on, and that is the role of the lone researcher. Alone physically, but surrounded by global contacts through the machine here, and it seemed to me, and this is my umpteenth analogy, a bit like panning for gold, where you can pan all day and end up getting a few specks of gold. But you can get reasonably wealthy that way. But, pieces of gold, so far as we are concerned, is not that linear thinking which you can pick up with other computer programs when you're going through qualitative data like the Q5-base [refers to the Ethics Questionnaire Question 5 open ended responses]. It was the lateral style thinking, I even dreamed up the word "lateraliser", as being the key characteristic of it, it allowed one to become a lateraliser and think in a lateral way, hopefully, rather than just a linear one. And so it was by the lateral thinking that you come up more quickly with more interesting skeletons. So let's assume there is more than one skeleton there, and you're able to choose the more interesting ones from the less interesting ones. And skeleton is the other word for pattern, so you get back to your earlier question.

The third point then, is to do with the uh, getting back to that panning for gold analogy, is that much of this is about a slow development of ideas, I think. A slow development and a maturation of research themes. Because it's often so thin, whether you think of that as interstellar dust or gold dust, it may take a long time for something to gel, so you've got to be prepared to work with something that develops fairly slowly and matures fairly slowly. Um, and you probably end up, it would be unusual to discover the equivalent of say a mother-lode of gold in the way you discovered with that guy's article - and his name is in there, you have mentioned it before.

HD: Yeah, Harvey Wheeler.

R1: Yes. What we discover more usually is a series of nuggets, and they of course can be totally isolated. You get one but then there's not one for another ten miles around. God knows why I singled a nugget out of that sand all by itself. But that may well be, I don't know where this really, ... it may well depend on the database which you're tapping into. It may be that you find a huge bank of data as opposed to a series of small interesting gems.

In fact, um, my reading of those printouts, I'll just stop and get those out first of all. This is a good time to say what these printouts ...

HD: Yes, what R1 is referring to here are the SmarText analyses of the Q5 data. So he's looking at now, for example, all of the hits on "productivity" in context. [The term productivity and numerous others were created for the HIMS concept related to the Q5 data and I (HD) used SmarText, another hypertext environment, to very quickly determine if this line of attack was going to be fruitful. Essentially the printouts contain the list of occurrences of the keywords, and their derivatives, in context of the original data, and also one can see the occurrence frequencies. HIMS could have produced the same results but it requires more time to set up the 'concepts'. The HIMS advantage is that one doesn't then get all the spurious hits. For example, SmarText will target "account", "accounts", "account for", in addition to the specified term "accountability". To refine this to something more specific takes time. HIMS will target the exact term specified, and it then takes time to make it more inclusive. So SmarText can be simply instructed to discover and link a more general set of linkwords, whereas HIMS can be simply instructed to discover and link a specific linkword. The point about all this is that the hypertext tool was being used as a text analyser to give counts of instances of keyword related concepts.]

R1: But the same thing can be done with HIMS?

HD: Yes, that was actually done just as a trial because SmarText can do this very, very quickly, well I, using SmarText, can do this very, very quickly, whereas with HIMS it probably takes longer but then HIMS can go further with it. So, I decided to use SmarText to see if there was a payoff. With this constellation of terms here you'd have "productivity", "Westminster", ...

R1: "fail" or "failure" ..

Appendix 5 – a sample from the F2_data

HD: Right.

R1: Now I'm taking it that there is a relationship between the SmarText outcome here and what could be done, as you say, on the HIMS.

HD: Oh, absolutely.

R1: It's just a different way of going about it, and as you say you can get more, eventually, an extended outcome of the HIMS. Because, getting back to the idea of nugget, I looked through these, and I found the one on "productivity" told me almost nothing, the one on "failed", I've got a line through each page here I think after reading them all, again total failure. I thought, gee that's not very useful. And I get to "minders", and again, nothing. And these were the first three I looked at, uh, ...

HD: It's just worth pointing out here that these are the keywords that you as a researcher decide to apply to this volume of data. So if you did a traditional search, you'd get all those hits and they would all end up in nothing.

R1: Yes.

HD: That's what you're saying.

R1: Yes, yes. Until you come to "Westminster". And then I found the nugget, and that's just one. There's a lot on "reform" and there's a lot on "accountability", and they're all good. I mean I think that was terrific. 58 on Westminster, 102 on Reform, and 93 on Accountability. Now it's very hard to talk about accountability unless you're saying something substantive. <<<<<< I wonder whether R1 came to this realisation as a result of this research or whether this has been a formulation due to previous research>>>>>>>> It's just one of those terms. It's utterly, it's very narrow in its meaning and so people are saying what they mean. Whereas with these you can be talking a thousand things and they mean nothing.

HD: Now, is this a realisation that you came to as a result, in my terms, of immersing yourself in the data, or could you have made that statement you just did, in other words the statement about: it's very hard to say something non-substantial using the term "accountability"; would you have been able to say that prior to immersing yourself in this, do you think? <<< notice the substantive <--> substantial transposition which was my error i.e. HD>>>>

R1: Ah

HD: Would you have thought of saying it?

R1: I wouldn't have thought of saying it, although I think it would have been at the back of my mind. I guess the importance of it is that I know immediately that that outcome is valuable outcome. Um, and yet it's never something I could have undertaken manually, so I wouldn't have posed the question.

HD: So are we saying here, I mean we know that it's harder to synthesise than it is to analyse. Would you agree with that?

R1: I think that's very much a statement of fact, uh, we go for analysis because it breaks down complexity.

HD: Right, and what we've done here is we've, ... because of the volume, we've used technology to help us with that analysis so that then we can recognise, rather than synthesise, in this data. Is that what's happened here? <<< I don't know what this "absence of immersing ourselves" is getting to, I seem to be a little confused >>>>

Appendix 5 – a sample from the F2_data

R1: Well um, what the machine has done I think, is to analyse all the APOL (Australian Politics News downloads) data, but when it's presented in this way we can then think of ways of synthesising it. And that's what you do, I think, when you try and build on concepts and make notes and things.

HD: The synthesis happens after the recognition.

R1: Oh yes.

HD: The analysis happens, then it's presented to us, then we recognise this, is it true to say that you've just recognised that wherever accountability is used it's obvious that there is something substantial being said.

R1: Almost all, yes. I mean there may be a few trivial points here, and in fact there are. We've got the word like "accounts", I mean that's unlikely to turn up something that's interesting. But where the term "accountability" proper is used or "accountable", I'm expecting to find something interesting there. And hence my desire to read those.

HD: Yes. So your research focus now, may have shifted, or may have been sharpened, or indeed even been altered.

R1: Um, the interesting thing is that I would have had no way of predicting the total outcome here. I am just amazed that these turned up nothing and these turned up a lot. I mean I couldn't have predicted that.

HD: The "these" that R1 just mentioned are the terms like minders, fail, failure and productivity.

R1: Now, I would have expected a more even spread.

HD: So, this is a bit of a gem in itself.

R1: I think so, yeah. I mean it's a very sharp dichotomy in this crude output. And it is crude at the moment, but even in its crudity it's got that dichotomy running right through it, and I thought gee, you really wouldn't have expected it, I wouldn't have expected it to, this to turn up zero, and that's why I put those concepts forward. So it immediately lifts you through the heavy dross of the data field, and you're already operating at a more refined level.

HD: So in that sense, would you be happy to use the term empowering?

R1: Oh yes, yes.

HD: So it's given you power, it's made you able to do things where otherwise you wouldn't have at all.

R1: Well certainly, this isn't an outcome of HIMS, but we know that it could have been, and in fact as you say we can go further with this using HIMS, and in fact we'd know what direction to go in now using HIMS. I mean I'd go for the concepts of accountability, Westminster, and reform.

HD: Well actually, I mean exactly the same result would have come out with HIMS, um, as I said it's just that I could do it quicker with SmarText, but I could not then take it further, and since I was wanting to simply explore whether there was going to be a payoff, so that's where it ended up. To all intents and purposes, I mean, definitely this is an outcome of 'Heinz hypertext techniques' if you can call it that, which is exactly what HIMS is.

R1: Right, good. Ok. I mean for one thing you didn't tie up my machine for what would have been hours I suppose, doing these searches.

HD: Yeah.

Appendix 5 – a sample from the F2_data

R1: I take your point that we could have done the same thing, and therefore ...???... especially as this is just, obviously this is just a first step. And my frustration at not being able to get at these in their full context was really, ... I was grinding my teeth.

HD: <hearty chuckle>

R1: I though I'd really love to read through, and looking through some of these thinking gee that sounds interesting, you know, someone's actually talking about "Westminster ministerial responsibility no longer exists federally", hey I'd like to know his reasons, and ...

HD: Yeah, well I can see now why you said that there weren't article numbers, you see, because SmarText simply gives you the line in context, it doesn't treat each of the individual postings in the NEWS dataset as an individual frame as HIMS does, so it's really HIMS that you need to get further with this.

R1: You see, my next step, if I did have a choice here, would be to read these through, print off the ones which were particularly interesting, delete some of the others, and Ok, you then end up with a hard database, or to record them on your machine - to get your machine to asterisk them in some way and maybe to double-asterisk the really important ones, er, to dump a few, and then you end up with one outcome which is straight text whether on hardcopy or whatever, and then to continue to integrate or synthesise or try and to refine the pattern of the skeleton, or get closer to the nugget, by that synthesising process. Now, exactly how one would go about that I am not sure. But that's what I'd like to do. So, they were my thoughts to do, er, half way down my first page here.

Um, yes, so I then said in terms of empirical results I've, I now feel, because of that recent outcome, that I've only just got into the APOL data. I mean, I know we've been playing around with it but mainly for me to become familiar with the process. And I was at that point going to go to the APOL sheets [printouts, hardcopy of SmarText output].

I have some notes here on those sheets, and I thought I'd mention them. And I thought, whether or not you want to use them for the doctorate, they should also be considered for a prospective article. I've written down, I would expect something from these SmarText sheets, but others are useless. There's high differentiation, there's unexpectedness of level of interest in some of the concepts even from such a large database. I would like to search these, and on the basis of the contents decide what to do next.

My next point then, um, I've got a note here on the future - that I do need much more machine competence, and I'll keep working towards that. Er, to have access to these databases, and your particular skills - HD's skills. Yes, to have access to these databases, linked to your kinds of skills, would really set me off on a kind of a research junket. I mean, it could cause me, I think, to drop the more conventional things for the excitement of, and that's empowerment I guess, the excitement of doing something which I know no-one in my field has ever done before. And yet I feel sure they will do it in the future, so I may be at the position that you were in 1981 when you first began using the computer messages to students of writing the initial article together with you on the use of these software programs to analyse this kind of data.

I felt that we shouldn't just look for good news in this, and I guess my politics background comes out a little here. I do see some threats in this kind of thing. I think it would be wrong for us to assume that this can only lead to good things and that it's, you know the old saying goes "it's all for the best in the best of all possible worlds". My own feelings are that, um, every good idea, possibly without exception, undergoes a process of, of perversion, and, what politicians or governments or powerful organisations, which is what government is, will take these ideas for their own purposes and in some way make them, er, more street-wise, more threatening. Ah, now, commerce and governments are the big threat here, and I think we may be currently working at a time when we still have, what I see to be that rather pure, unsullied, database. And that may not last. Already people are trying to exploit it, like some of those law firms did in the US by advertising on it, and that's the start of commercialisation, and trying to make more money from it. And the important thing I think is the old statement that we've all heard so many times - that information is power, and this information. No-one's sort of using it at the moment, but eventually, and I heard another radio programme last night - I'm always hearing them now on hypertext and networks and surfing

Appendix 5 – a sample from the F2_data

the net and things like that. People are obviously thinking about it a great deal, and soon someone's going to hit on a way of utilising this for government purposes, and that means a recognition that all of this is to do with power, and political power furthermore. So I see a perversion process creeping in. And hopefully there will be a reaction by people like yourself in particular, once this threat becomes recognised, to either go and create your own private network where there is no government, or find some way of trying to overcome this. This is the permanent battle that goes on between authority and individuals, or the needs of the state as against the needs of the individual.

Well my final point is to do with the potential of all of this. Er, this final point is a fairly brief one, I'm just thinking aloud here. One of the problems, I think, about dealing with a research area which is so new, and I must say I'm surprised by some of the difficulties that you've encountered among your colleagues with this. I would have thought they'd have been very excited about it, and for you to tell me that there's even some negative thoughts about hypertext quite surprises me. I would have thought that with er, with marketing people in this school for example, would grab hold of a label like that and jump for joy, as would every politician. I mean it's a real 'turning on' kind of word, and it's on your license plate isn't it. I see your car there, it's great. I think Heinz is in this morning, there's his car. Um, the trouble is, apart from what your colleagues may do, that when one is onto something new like this, it's very hard to substantiate or demonstrate that it is new. People are always sceptical about it. They are very unwilling to recognise, it's a bit like being at the stage of the Wright Brothers, and I think I mentioned earlier that the problems of being at the very early stages, Norbert Wiener, and all of that, of a particular development, that few people recognise the value of a genuine breakthrough and it's easy to trivialise. But my feeling is that while I can't nail it down, and it's almost an act of faith, that the potential in it is huge and exciting at the same time it's unknown.

HD: We're building now with HIMS the concept to do with "accountability" generally.

<<< M McN came in for a while just after her promotion interview>>>

What we've done just now, I'll get this on the tape, we've set a concept up called "account" with keywords "accountable", "accountability", "answerable", "responsible", and "audit", in their various forms, and we've then, through the 1191 articles in the APOL hyperfolder, we've done a traditional search in full text for the string "accountab" and got 29 hits. Now we're browsing through those and we see that article with number 6428, which is the second one in that list, has actually, on the first page, 4 hits - one "responsible", one "accountable", one "responsibility", and another "accountable" [these are showing up in 'blue lights'].

R1: Now I know that 'n' means next article, and 'p' means go back to the previous, but what is just to paginate that?

HD: Yes, PageDown either via the computer keyboard or HIMS's toolbar icon. And down the bottom of the screen it tells you which page number you are on. Now that's page 4, so this is quite a long article. That's the end, there's the fence [a line of hyphens]. Now you see what SmarText won't do, er, SmarText gives you the line where the hit is, but it does not relate the hit to the fact that this is one article, and it won't so easily allow you to combine the chunks of knowledge in their natural form, in other words, article by article, it's more a document model that they use.

So let's just go through a few points here. You can see that because this here is on, this tick and the "match" up here, this says that the search criterion has been satisfied on this frame. If we went to article 6427, which is not in the hit list, by navigating with a 'p' for previous, this light has gone off. But incidentally, there's the blue-highlighted "responsible".

R1: Why is that then?

HD: Well because we searched for "accountab": >>>> good demo of the limitation of traditional searching.<<<< So this is one reason why, in the extreme situation you will not actually find everything through traditional searching. You actually have to browse, with our HIMS concept(s) 'activated'. But we can fix this in a minute, because we can extend our set of 29 hits, based also on the search string "responsible" and so on.

Appendix 5 – a sample from the F2_data

R1: Yes, Now the thing is, you can, if you say I just want to browse the Westminster stuff, then you can plug in "Westminster" and it will highlight the others but in your list you only get the indications for Westminster, and then you can go back and just do "responsible" and then just do "accountable" and then you could sort of combine or uncombine.

HD: Yes, what you've said is your combination of blue highlighting and traditional searching, or blue highlighting superimposed on blue highlighting, in other words blue highlighting to do with "responsible", superimposed with blue highlighting to do with "Westminster", and with searching. so there's many different ways you can do this.

R1: now look for Westminster

HD: Now that's a serendipitous discovery that you've just made there. We're looking at frame 6427.

R1: I mean we were going to plug it in, I mean that's a very interesting one - constitution as well in there, and that's another word I might follow up.

HD: Well, what we need to do now, just to remember that, is print this off. There are other ways to note all this, but for the moment printing it off is probably the simplest. Now, these hot keys we just went through R1, let me go through it again, but this is in HIMS's help documentation. The 'p' gives you physically previous, so if you're pointing at 6412 it's going to give you 6411, if 6411 is there and irrespective of which article you have already visited. The 'n' will always take you from 6412 to 6413 (assuming 6413 exists). The 'b' key will take you to the frame you have just visited, irrespective of where it is in the hypertext - it of course does exist since you have just visited it, and if it no longer exists it's time to pack up and go home! Thus 'b' is a 'logically back' navigational act.

Now with searching we have hot keys 'l', which gives you the list of frames which match the current search criteria (the matched list), and 'm' will step you forward to the next frame in the matched list, and provides a very nice way to browse through a specifically created list of frames based on search and matched list amendment via the toggle "matched flag" function in HIMS's search menu. The serendipitous discovery of the relevance of frame number 6427 could be toggled into the matched list by this function. So, combined with traditional searching, this blue highlighting gives you very very powerful juxtaposition ability.

The other thing that I'd like to point out here is that HIMS concepts may be overlaid such that extra words are also highlighted in addition to the ones first activated. Unfortunately the inverse cannot be so simply done, that is to switch out blue-highlighting - one must start over to achieve this effect.

>>> this has now resulted in a list of some 250 articles of interest, out of the 1191 in total, to which links are made within the entire database, for further treatment, and should this process indicate further exploration of the entire database, the material is of course still there and further links can be made into it. <<<

R1's self recorded audio notes transcribed

R1 to HD: Friday 27th May, 1994

Just a few thoughts that you asked me to record Heinz. One was about the usual way in which academics and other professional communicate with each other, that is, in a very proper and precise and rigorous way, whether in conversation, in seminars, or through journal articles or books or whatever. Ah, and that of course, is the way it should be. But what I appreciated about the messages which are in the databank for this project (APOL) is that they are communications by people who are communicating in a relatively uninhibited way. The face to face isn't there, and often there is an anonymity about it even though I presume some people would know each other. Others are simply sending out messages to anyone who's listening and they're prepared to be judged on the quality or whatever of those messages. It reminds me of the common rooms in British universities which are noted by many people I have spoken to about this phenomenon, whereby those who go to the common coffee room or tea room for staff at British universities that

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I'm familiar with, always find it a very exhilarating experience, and in fact it's quite hard, I don't know if it has a counterpart anywhere else, but from my experience they were always an electrifying sessions, completely informal, often humorous, irreverent, whatever, but often at the same time dealing with professional matters dealt with by people in the department. I always found them extremely good and would go to great pains not only to attend them, but to make sure that people didn't have to leave the room to fill the water jug, for example, during morning or afternoon tea. They were the most valuable sessions of the entire day.

I've sent you a journal article from the New Scientist, a book review, you may want to buy the book if it interests you, and I thought it also carried notes on a couple of similar books with alternative ideas on linear, lateral, and whatever kind of thinking.

R1 to HD: Friday 29th July, 1994

It's now a month later, the 29th of July (a Friday) [actually 2 months later if this or the first date were correct]. We had a meeting in your office today Heinz [so it was either June 22 or July 27] and which I found very interesting, and I already have some notes to transcribe into the recorder so I thought I had better make a start on some of them at least.

One is to record my observation that the data in the databank is heavily weighted towards federal government rather than state government. Why, I don't know. I think there was an election due and this was no doubt one of the reasons, but I found no reason to believe that many of those communicating via the network are very interested in state government. It's been mentioned a few times, nothing like as much as the high profile party leaders in the federal sphere.

These are ad hoc notes, so one thing doesn't necessarily lead to another. I think I mentioned that my initial interest in this project, once it started going, when I committed myself sometime earlier [yes, about two years earlier], was when I first saw the messages that came up when you first introduced me to it, and I found those very exciting, um, I've never seen those messages again and I've no doubt that they're in there. It's interesting why I should have seen two or three, which really took my fancy but which haven't shown up since. Again this is merely an observation. I'm not making a criticism at the database for this reason. In fact, in the last couple of days I've been able to exploit the databank in a way I've been trying to do for some time. It's still very elementary, but it does allow me to get a feel for it by simply reading the messages and see what people are talking about.

During our talk in the last few days one other item that we mentioned, or which I mentioned in my office was the term "misplaced concreteness". I think I mentioned that this came from Lord Alfred North Whitehead, I think he was. He was a British physicist in the 20's and 30's I think, and a very good writer, a philosopher in physics in fact, and his books are still widely read today. But he made an observation then which I've always found interesting, and that was about this term "misplaced concreteness", and it was his way of describing the way in which, I think it was biologists of the day, sought to emulate the physicists and/or chemists in trying to imply or ascribe more concreteness to their area of study. And he argued that while that concreteness may come about one day, it would not be as concrete a discipline as physics or chemistry, although no doubt it would be more concrete than others, but that, importantly, the concreteness was misplaced. And I think the message he was giving was that we shouldn't search for concreteness within the disciplines where we work. And we often do that I think. I think that's positivistic thinking, where we are not prepared to abide by what is the nature of our data and our theories. I think it was the German philosopher who worked at the London School of Economics, Sir Karl Popper, he wrote, I think it's probably the most adhered to philosopher of science there is, probably on an equal with Kuhn, and Feyerabend is of course, as we may have agreed today [in the meeting in my office], something of a radical, for what it's worth.

But I remember quoting Popper in my Masters thesis of years ago, and having seen your excitement at Bacon's statement which you showed me today, I think you might be interested in me reading out, and I've got my Masters thesis in front me now, what Popper said about science. He said "a scientist engages in a piece of research, say in physics, can attack his problem straight away. He can go at once to the heart of the matter, to the heart that is of an organised structure. The philosopher finds himself in a different position. He does not face an organised structure, but rather something resembling a heap of ruins. He cannot appeal to the fact that there is a generally

Appendix 5 – a sample from the F2_data

accepted problem situation, for there is no such thing", which is perhaps the one fact that is generally accepted. So we don't agree on what the problem is.

Another quote from Popper, it will be on page 14 of that 1934 edition, so if I haven't given it to you, I think it's one you'll be most interested in, please remind me. [tape recording is a little broken up here]

We also spoke today ... and his book on scientific revolutions, paradigms and so on, and our thoughts on puzzle solving. This is how I personally differentiate various areas of science. The lateral thinking area I think is the paradigm smashing area, whereas the puzzle solving, while it does involve a degree of lateral thinking, is more often in practice, of a linear kind in my view. And it's data driven research, not ideas driven research, although of course there are important exceptions to that. And I've always thought, although I've got no reference to back it up that I can think of, but I'm sure I've read it somewhere, that astronomy, weather forecasting, and the practice of medicine, are good illustrations of this, whereby we make heaps and heaps of observations and without any theory to guide us, and hope that a pattern will emerge from the data. And this, in fact, has occurred in all three disciplines, astronomy best of all, I mean they do have their theories now, but they began with masses and masses of empirical observations. Weather too, I think we get that pretty right, especially since we've got computer models to help us forecast it. Medicine, even the average GP doesn't really know the origins of many of the ideas ..., but they do understand the symptoms and they know how to treat them, and of course they can answer many of the questions about those symptoms, but I think there is a limit to the amount of genuinely scientific discussion that the average GP could undertake in trying to explain what it is that he's dealing with. There's nothing wrong with that, I'm not saying it's a criticism, I'm just saying it's probably less developed at the applied end.

R1 to HD: Friday the 12th August 1994

We had our session yesterday Heinz, a very productive one, and I mentioned then how I had run off a couple of the articles on the screen print for my own purposes. One was the article on, I now know is someone in the Bureau of Indian Affairs in the United States, discussing the issue of the degree of Indian blood. That was intrinsically interesting, I can't find an application for it. The other one was a particularly interesting comment on the Australian Federal Constitution. There's quite a debate on this on the network, and if I was ever writing an article, this is the kind of thing I would want to copy and to utilise, and there are many more of them on the net. I'm not going to write such an article, but if I was, it may well spur me on to do just that. I now have hardcopy of both articles filed away for future reference.

R1's concept files

the ACCOUNT concept

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.INDEX
.SHARE
.FRAME accountable
.TITLE ~TgPress 'b' to return to previous frame-Ty
accountability who is responsible answerable to parliament public for actions
decisions

initial keywords:
accountable, accountability, Accountability, Accountable, responsibility,
Responsibility, answerable, Answerable, audit, Audit, Responsible, responsible.

the ETHICS concept
.INDEX
.SHARE
.FRAME Ethics
.TITLE ~TgPress 'b' to return to previous frame-Ty
This "concept" contains links to the open-ended-answers-to-questions
hyperfolder - the initial linking ideas are:

Ethics, ethics, ethic, Ethic, Ethical, ethical, Unethical, unethical,
Corruption, corruption, corrupt, Corrupt, Corrupted, corrupted, Legal, legal,
dishonest, Dishonest, honest, Honest, behaviour, Behaviour, Illegal, illegal.

(Q.38)
Some responses relate to institutions outside the PS while most responses
relate to fellow public servants, politicians, all of whom are IN the system

Note "unreasonable" in two questions.

There are 68 NR from Q5, in 225 responses

.END
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