

Supporting Knowledge Discovery In A Research Organisation

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Abstract: This paper describes the creation, and philosophy of, a Department whose structure and functions were all aimed at supporting knowledge creation by both individuals and project teams for the UK's Ministry of Defence.

Underlying these services was a deep understanding gathered over 30 years of how research scientists learn, and how we need to aid that learning process. This process is demonstrated graphically by a development of Max Boisot's "Social Learning Cycle".

1. Introduction

The Defence Science and Technology Organisation (Dstl) is the UK Ministry of Defence's research and development organisation. Created in 2001 following the partial-privatisation of the Defence Evaluation and Research Agency (DERA), its primary functions are to carry out research considered best done within Government and to provide the UK's Ministry of Defence with impartial expert advice.

The division of DERA meant that Dstl lacked virtually all the library and information services needed to support a research organisation some 3,000 strong. Our challenge was to create a new Department – Knowledge Services – to meet the research scientists' requirements and develop tools, facilities and services that would encourage knowledge creation and sharing. Fundamental to the problem we faced was discovering their needs, understanding how they learn, and thus how they create knowledge.

2. Knowledge Transfer

Firstly, what is knowledge? We used a standard dictionary definition that "knowledge is the sum of what is known". New knowledge is created in a person's brain, and its creation is a function of a variety of factors; what that person has read, his education, his societal upbringing, his working environment, in short everything that has gone into creating him as a person.

My contention is that that knowledge itself can never be transferred from one person to another (and as a consequence can never be managed, except by its creator). The knowledge that is created in someone's head is limited to, and unique to, that individual. When they attempt to transfer that knowledge to another person, all they can actually transfer is an imperfect image or subset of what is in their head – an information product. These information products may take the form of a conference paper, article, report, presentation, teaching lesson, conversation, letter, television programme, videoed lecture, web site or whatever. What you can be certain of is that what is transferred via that information product will not be "the sum of what is known" by the person imparting it, but an imperfect and incomplete subset of their knowledge.

We can take cooking recipes as an example. Chefs develop new recipes through practice, experience and trial-and-error. The first way that recipes were transferred from the chef "researcher/inventor" to another person would have been as hands-on one-to-one tuition. This was, and probably still is, the most effective way of learning, and recipes were passed down by word of mouth from one generation to the next. Even so, transfer may not succeed, as often the chef is not a very competent teacher, or may require of the student a level of pre-knowledge and ability which may be lacking - some pupils are unteachable!

So, while effective, one-to-one or one-to-small group tuition is not a very efficient means of transferring new knowledge widely or quickly.

The next stage was recording the recipe in writing, and while this allowed transfer to larger numbers than ever before, some writers were more effective than others in describing the process. While Mrs Beaton famously began her recipe for Rabbit Stew with the instruction, ‘ First catch your rabbit.’, not all are as clear. Clarity and details vary – how “hot” is a “hot pan”? I have one recipe at home that says to make dumplings “shilling sized”, not very helpful since shillings went out of use in the UK some 35 years ago.

From hand-copied recipe books we progressed to print, to recipes with black-and-white illustrations, to ones with colour plates, and thence to television programmes with chefs again demonstrating how to cook, with some being far better at getting the message across than others. Increasingly useful, but until recordings became available, such demonstrations were always very quick one-offs and separate from the kitchen. Now we can have a Nintendo DS Lite in the kitchen, showing video recipes for each stage – the ultimate so far, but still no guarantee that an amateur can cook as well as a Michelin-starred chef. In short, although the information product has improved greatly over the years, knowledge transfer is still less than perfect.

Given that knowledge transfer is imperfect, how can we support and encourage knowledge creation and aid in its transfer?

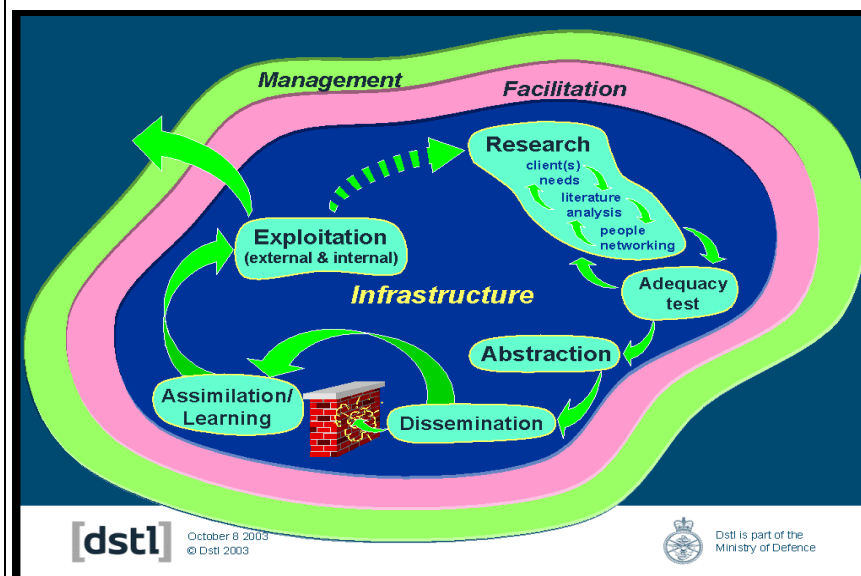
3. The Social Learning Cycle

A non-commercial research organisation operates in fundamentally different ways to either academic or commercial research. In academia, research or project teams tend to be small or based on individuals and whose primary task is educational rather than research oriented. Certainly, commercial interests come into play, but the main task is the development of the individual graduate or post-graduate student. For commercial organisations the primary interest is generating profit through viable commercial invention. Teams can be very large, and (perhaps surprisingly) internal self-interest may prevent information being shared freely within the organisation, or indeed within the team itself. In Dstl providing our security forces with the best research and technology support as quickly as possible to counter threats to the UK and our allies is more important than personal self interest or profit generation – although we have been quite successful in the latter, if only as an accidental by-product.

Creating our service from scratch was not a task to be taken lightly. In order to discover the needs of our customer base, we placed particular emphasis on the fact that we were looking at their needs and not their wants. What they wanted was for us to replicate the high quality university-style library service they had had access to in the past, but our investigations showed that what they wanted was very different to their actual needs. There has been a growing tendency within the profession to ask the user community what they want, partly because - I suspect - this is very much easier than actually divining what they need. But the users do not necessarily know what could or should be provided. Often they will ask for what they think you can supply, or what they think is fashionable. Our task should not follow slavishly the demands of the user, but by identifying their real needs and knowing what is both possible and practical, devise and revise our services accordingly to meet as much of those needs as we can with the resources we have at our disposal.

To add to our already extensive knowledge of the research requirements of MoD scientists, we carried out workshops, one-to-one interviews, on-line chat groups and semi-social events to find out how much Dstl’s requirements would differ from those of the much larger DERA predecessor. Using the hybrid scheme devised by Peter Brophy (1998) as the framework for our proposed service to meet those needs, we were able to overlay this on our own version of

Max Boisot's social learning cycle (1998) to define where each of our services and other facilities and structures provided the framework Dstl had to have.



The social learning theory shown here is a graphical representation of how individuals learn, and subsequently create knowledge in themselves and their teams. They are supported by the library and information management professionals within Knowledge Services Department through many of the steps in the cycle. If we were to do our job properly we had to support the learning process through out its cycle.

4 Dstl's Learning Infrastructure

The central element on which the learning cycle sits is an infrastructure which consists of physical and intangible elements without which the process would be extremely hard, if not impossible, for our scientists to carry out. These elements include corporate, cultural, the electronic environment and information provision.

Corporate Culture:

We were fortunate from the start to be supported by a genuine belief among Dstl's senior management that the organisation's role is to provide the best research and advice to our employers. With this came an appreciation among management of the value and cost of learning, training and sharing – as well as the ultimate penalties of not doing so.

They also not only accepted that information provision costs, but also understood research we had undertaken that showed that a former culture of "internal charging" for photocopies, books, quick searches etc. was not only an inefficient way of recovering such costs, but was also found to be detrimental to the scientific/learning process. Finally, there was a genuine acceptance that these were not short-term targets – there is no quick-fix for excellence.

Cultural Philosophy

We moved away from the usual idea of the Library as a collection-building repository of printed information – we had no funds or physical resources for such a monolithic structure, and it wasn't what was needed. Given the vast range of subjects our users worked in, there was no way that we could even scratch the surface of gathering all of the significant material of interest. More importantly our scientists would never have time to digest it all. What we provided was a welcoming reading room with a very small but carefully

selected collection of key books, current newspapers, journals and reference works. Most importantly we provide a convivial atmosphere (and coffee!) with specially selected intelligent library staff who know their stock, the customers and their interests, and how to meet their needs as quickly as possible.

We also looked closely at how Dstl's staff communicate. Although we largely have open-plan offices, with an extensive electronic intranet, much useful discussion takes place either when travelling to or from the coffee point, or at the coffee point itself. To mesh with, and encourage, this internal culture of discussion and knowledge sharing, what we put in place in terms of "physical" infrastructure are:

- One, fairly large (for a special library) conventional library;
- Three small focussed collections. - small site libraries - each with a dynamic stock and 2 dynamic staff, as part of an information sharing resource designed to encourage and stimulate thought;
- Tea Boat collections – unmanned tea room sites with small collections of books, internet terminals, white boards, relevant journals etc, scattered around our various sites which were maintained and regularly supported by Knowledge Services staff;

Some of the collections also have Anti-Bistros – the alternative to the busy open-plan office. Small, individual work areas where scientists can get down to serious thinking and study, away from the telephone and the insidious all-pervasive e-mail.

Electronic Infrastructure

Network and related infrastructures need continuous investment and development, and need to be aligned to the needs of the clients. Although Knowledge Services had no direct involvement in service provision, we were often closely involved in development requirement discussions.

Information Infrastructure

Development of the core information infrastructure - much of which either we provide directly or lead on provision - was strongly directed at providing material directly to the desktop, not an easy task in a security environment. Much of what we provided was bought in from commercial suppliers, although we set up an in-house scanning team to create e-versions of our scientific and technical reports holdings. These offerings included:

- Our reports catalogue, including over 200,000 full text documents;
- Web of Knowledge;
- Jane's;
- Electronic journals access;
- E-Learning courses;
- A portal site to many other major sources.

But the infrastructure is just that. It is developing and growing in light of our clients needs, but to limit ourselves to just to those short-term needs and not think ahead would be not carrying out our job properly. Sadly, in our experience, many libraries (and librarians) see the provision of these infrastructure service as their sole role, and go no further. For us this was merely the foundation for a far more active role in supporting the learning cycle.

5 Roles Within The Learning Cycle

Research Phase

Beyond being a key provider of the infrastructure, Knowledge Services plays a

greater role in the learning cycle, an information facilitation role. The Research phase is that in which the individual or team defines what it is that is to be researched, carries out some form of literature search, gathers together (and shares) relevant material, and utilising people networks to ensure as broad a coverage as possible.

Conventional library and information services usually support some of the *Research* phase, perhaps defining the client's needs and assisting in the gathering of literature to meet those needs. Knowledge Services however goes further than these limited aims, offering a wide range of consultancy services which can improve the efficiency and sustainability of the research process.

I was, and am still, continually surprised that many organisations provide their experts with a wide range of expensive bibliographic sources, and then leave them to do any and all information gathering, sifting, sorting and analysing themselves. Certainly, our client base contained several individuals not only capable but even expert at carrying out these tasks, but it is generally accepted that this tends to be a very expensive use of their valuable and limited time, and one for which *unless you carry out the task frequently*, the non-expert rapidly becomes inefficient. Our approach is to provide a variety of trained information specialists to handle such tasks, and to facilitate knowledge creation and sharing.

I am sure that we have all experienced a shift in the 1990's from information provision through library services to information provision at the desktop sometimes leading either to the widescale reduction of conventional library services or even to their obliteration. Yet in our case we have not only increased our information staff, but also created three small libraries – a complete reversal of the trend – for three major reasons. Firstly, and possibly most importantly, we received the support of senior management from the outset. Knowledge Services was not seen as just “the Library”, but a pool of information expertise on a par with the scientific research departments. Secondly, we were in the (possibly) enviable position of having to start almost from scratch with very few existing facilities and none of the baggage that came along with them. Thirdly, we discovered what our customers what they needed. We didn't provide them with exactly what they wanted – usually a University quality library with massive book stock and journal back-runs - but we identified from information needs gathering exercises what they really needed to do their jobs properly. Among the evidence we gathered was an awareness that while they were capable of meeting a fair proportion of their needs from a variety of sources including desktop, communities of practice, professional or newsy journals etc., they not only wanted but needed high quality information professionals on tap for those occasions where comprehensiveness, certainty and speed were essential, and where they needed to apply analytical techniques beyond their existing skills set.

To meet these needs we have four groups of information experts: Information Specialists, Information Scientists, Knowledge Agents and of Knowledge Research Team.

The Information Specialists are another term for our Librarians and Assistants. Although ‘conventionally’ trained, we expect far more from them. They must be very active among their community, and be very aware of their clients' needs and expertise. They have very little physical room to play with, so collection building has to be highly selective and effective to make the best use of the space available. They also serve various training roles, teaching clients locally on the resources available at the desktop, either in one-to-one sessions or in more formal courses organised by Knowledge Services. By making these small focussed collections (or libraries as everyone from the Chief Executive down calls them) a social and friendly environment, they make a valuable

contribution to helping create a knowledge sharing culture.

Fortunately there is an acceptance amongst the majority of Dstl that if you don't know, you buy the expertise in. Our Information Scientists are either information scientists or scientists trained in many techniques of information work. They are our true specialists, our experts in bibliometric analysis, patent analysis, data visualisation, technology roadmapping, etc., and their expertise is bought in when and where needed in support of specific pieces of work, either directly or in support of our generalists. The Information Scientists, and to a lesser extent the Knowledge Agents, analyse the information at their disposal, identifying research trends and developing technologies. They can also identify key players and groups in the areas of interest, pointing out those people that our clients should be interested in, following, talking to and co-operating with, thus supporting the *people networking* element of learning cycle.

Our generalists, the Knowledge Agents, are spread across four of our sites, but with a remit to go to the clients wherever they may be – a mobile information task force as it were. With either scientific or information qualifications – most have doctorates or MScs – they are trained up to a reasonably high level, and can be bolted into projects to handle anything from basic literature searches to handling the total information requirements of a whole research package. Although their tasks are not usually related to their individual specialism, their scientific expertise and overarching knowledge has led to widespread acceptance of the concept throughout the organisation. One, bolted into a project as a Knowledge Agent, also fills the role of inorganic chemistry expert within it. Most have received training in facilitation, and act in dual roles in team workshops as facilitators and information experts. In fact, the skills that they have demonstrated have led to them being included in a range of projects for which standard “librarians” would never have been considered, culminating recently in a organisation wide capability analysis, with the unforeseen benefit that they know more about what is going on across Dstl than some senior managers! They tend to be the most widespread public face of the Department, and key to their success is a wide knowledge of all of the skills, strengths and weaknesses of the rest of the Department. They operate singly, or as part of ad hoc teams, drawing in skills and talents wherever needed from the rest of Knowledge Services.

By using these generalists and specialists as support in the research phase our experts, either as teams or individuals, can usually gain access to far more material than they would normally know about.

Adequacy Phase

Going on from the *Research* phase in the cycle, our staff have been trained to identify whether the information supplied and sources used meet *Boisot's "Adequacy Test"*. We have all come across clients who have carried out a “comprehensive literature search”, which has turned out to a quick delve into Google that has barely scratched the surface. Our staff are trained in, and have access to a far greater range of potential sources than many clients have any idea exist, and can select from this range of material to provide the appropriate depth of research needed for the task in hand. One of our experts thought he had all of the relevant papers – just three - on his subject. An hour later he was given a stand-alone database with details of over 60 more, and 200 more related ones that he ought to know about. Others, about to embark on expensive research, have been put in touch with other experts in the organisation and saved lots of time and money in the process.

Abstraction/Summarisation Phase

They can also supply the *abstraction/summarisation* phase, producing technology reviews to a very high standard. Many of these skills were found among librarians in the past, but sadly do not seem to be taught these days in

the UK, either in schools or colleges.

Dissemination Phase

They also can assist in *dissemination*, with expertise in shared network drives, stand-alone bibliographic databases, and a range of other skills aimed at sharing information. For many of our scientists and knowledge integrators, the ability to take sub-sets of bibliographic databases or analysed data to meetings both in this country and abroad or to mount on separate networks, is seen as a real advantage.

Assimilation/Learning Phase

This is the one phase where we can offer no support, except where one of our staff forms a specific part of a research team.

Exploitation Phase

In the final phase of the cycle, we assist in the *exploitation* of the new knowledge created by the *assimilation* phase. Scientific and technical reports form the concrete product of Dstl's research, and these are recorded and indexed not only on our corporate catalogue, but also on databases and hard copy abstract journals which are made available to the rest of MOD and defence community and throughout our allies. By making this information available we are encouraging the exploitation of our research by the wider community.

Conclusion

Knowledge creation is a human activity, and as such is subject to all of the vices (and virtues) of including humans in any loop. Technological "solutions" only exaggerate the differences between the individuals involved. Knowledge Services' approach was to create an environment, both physical and cultural, whereby knowledge sharing is encouraged and facilitated, in line with both the client's expressed needs and the organisation's philosophy and strategies. In addition, the ready availability of information/subject experts in the form of the Information Scientists and the Knowledge Agents encourage effective information gathering and use, together with the informal creation of knowledge networks running in parallel to the formal ones within the organisation.

References

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