

KNOWLEDGE DIFFUSION

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Abstract: Knowledge diffusion may be considered as “the adaptation of knowledge in a broad range of scientific and engineering research and development The growth of scientific knowledge is largely due to a diffusion process in which new ideas are transmitted from person to person”. Chen et al (2004). We have conducted studies on scientific and commercial documents, in other words traces of knowledge within a research and development institution and its commercial / spin-off counterpart. Observational and systematic (corpus-based) studies – through analysis of specialist text, can support research in knowledge management. Since text could be assumed to portray a trace of knowledge. In this paper we are to show how knowledge diffuses in a specific environment, and thus could be modeled by specialist text. That is dealing with the satellite manufacturing domain, and having embedded within the knowledge about the business sector and knowledge domain.

1 KNOWLEDGE DIFFUSION IN SPECIALIST DOMAIN

In order to investigate the gap in knowledge diffusion within an organization we did carry an observational study, within an SME (Small to Medium Enterprise) in satellite manufacturing, a specialist domain. Inline with a study of the language used in satellite engineering in general, and that stemming from SSTL (Surrey Satellite Technology Limited) and Surrey Space Centre in particular. Both studies have an empirical basis. The observational study (mainly questionnaire-based) was designed to ask questions related to knowledge diffusion within the company during 2002-2006 period, as part of my doctoral research coverage. The questionnaire-based studies were not based on intuitions on how knowledge is managed, rather based on a set of empirical questions, partitioned under five sections namely:

- 1- Awareness and Commitment
- 2- External Environment
- 3- Information Technology
- 4- Knowledge Maintenance and Protection
- 5- Organizational Issues

We have investigated the diffusion of knowledge within SSTL, based on the practice within SSTL, as articulated through the questionnaire. There were

two sets of questionnaire-based observations. The pilot study was conducted with managers and whereas the second run of the questionnaire was intranet-based, and more widespread. SSTL, is a small knowledge-based organization. In a rapidly developing, high-technology field like satellite engineering, it is important to communicate, share and validate knowledge. We have examined how knowledge flows and is adapted between commercial and research types of corpora through such research. One of the major results deduced from the observational study was that knowledge diffusion is paramount within the lifetime of an organization, and could be supported by information systems. Leading us to investigate on how knowledge diffusion takes place, in an empirical way. Our analysis shows that research papers (created within educational institution) and commercial documents (created within spin-offs of such higher education institution) can be distinguished rather on the basis of single word and compound terms. These two specialist lexis show the potential for identifying points of mutual interest in the diffusion of knowledge from the research institution to the commercialization process, thus to application(s) within a domain.

2 METHOD

Nonaka et al's (1995) knowledge conversion model is intuitive. It is based on long experience and judgement. Such model emphasizes the importance of practice, knowledge amongst knowledge workers. The case studies produced were between researchers, practitioners, and managers. There was transfer of knowledge from researchers to knowledge workers. Such has yielded a contingency table for the transfer of knowledge, so-called *knowledge conversion model* that generates four knowledge conversion modes. Such model is plausible but remains largely intuitive. Our interest is tacit to explicit knowledge conversion (externalization) and explicit to explicit knowledge conversion (combination). The reason we have studied an SME (Small to Medium Enterprise) because it would appear that knowledge would be shared because smaller groups would get together easily, i.e. no logistics involved. As well as it appears that in a SME knowledge bottlenecks which are characteristic of large organizations would not exist. Consider an organization like SSTL, we focused on the interaction between knowledge engineers and knowledge practitioners, and were aiming to see how knowledge is shared. In order to investigate the gap in knowledge diffusion within SSTL, we did an observational study, and a study of language used in satellite engineering in general. Both studies have an empirical basis. A bimodal research method was followed within the specialist domain of satellite manufacturing applied within SMEs [Small to Medium Enterprise]. Inclusive of: Observational study: questionnaire and interview based and Corpus-based studies: analysis of text repositories.

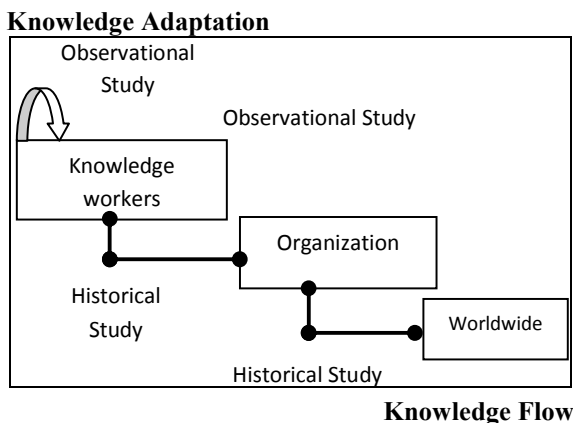


Figure 1: Knowledge diffusion through flow and adaptation processes.

Figure 1 represents a relational view of the methodology, integrated within the possible set of agents for knowledge diffusion, being composed of a 2-tier process. Whereby knowledge is assumed to flow among or across from knowledge workers, to the organization, then to worldwide (horizontally), but the adaptation phase comes into place once knowledge is personalised and applied (vertically). However, such methodology was implemented in the specialist nature of the domain of investigation. Yin (1994) identified five components of research design that are important for case studies: the study's questions, its propositions, its unit (s) of analysis, the logic linking the data to the propositions, the criteria for interpreting the findings. The above components were integrated within the observational study, as guidelines to the formulation of the different stages involved within the conduct of this research, from the pilot run of the survey study, to the intranet-based survey and historical studies. In which the intranet-based survey seemed to generate interest, impact and a set of internal actions. Supported as well by over 30% participation rate for the intranet-survey, and being composed mostly by middle to senior managers. Evidence of knowledge diffusion and support for it was manifested as outlined in the table below. Table 1 shows how knowledge bottlenecks have been looked upon during the flow and adaptation of knowledge amid agents involved in its diffusion. Through the observational study and the historical study, behaviour between agents was modelled using the techniques prescribed below.

Table 1: Knowledge diffusion in the environment of a small organization.

Agent A	Agent B	Artefact	Technique
Person	Person	Opinion, practice, know-how, organizational structures	Questionnaire-based study
Person	Organization	PhD Dissertation, Research Publications, technical reports	Text Analysis
Organization	Organization	Specialist documents (i.e. technical documents, technology-specific documents, missions documents)	Text Analysis
Organization	Worldwide	Specialist documents (i.e. technical documents, technology-specific documents, missions documents)	Text Analysis

The intranet-based survey study had 5 sections, stretching to cover possible areas of applications and

implications for knowledge diffusion within an organization, namely - Knowledge Management Awareness and Commitment, External Environment, Information Technology, Knowledge Maintenance and Protection, and Organizational Issues. On the other hand, for our historical and special corpus, we followed where applicable and pertinent, Atkins et al's (1992:2), five principal stages for corpus building. Outlined in table 2:

Table 2: Stages for building a corpus (Atkins et al, 1992:2).

Stage	Description
Specification and design	Corpus type is identified taking into account sample size, language varieties and the time period to be sampled.
Computer Hardware and software	Hardware and software needs for the corpus project are estimated.
Data capture and mark-up	The data/texts are captured and transformed/transferred to electronic form, keyboarding, or audio transcription. The captured files are then marked-up with embedded codes containing text features.
Corpus processing	Includes basic tools, i.e. word frequency lists, concordance, and interactive standard query tools and tools for lemmatization, tagging, collocation etc.
Corpus growth and feedback	New materials may be added to the corpus or some of the old materials may be deleted according to feedback from previous analysis to reach a balanced and enhanced corpus.

Specification and design of a corpus and its processing are the most important steps in building the corpus and for any kind of subsequent study. Studying the state of the specialist terminology is considered important for the study of the language discourse. Corpus-based studies are empirical and depend on both quantitative and qualitative analytical techniques (Biber et al, 2002).

The observational and historical studies carried out, have provided better understanding into the field of investigation. Such studies provided the basis and validation for inferences made. Based on Nonaka et al's (1995) terminology used within the *knowledge conversion model*, portraying creation of knowledge and corresponding conversion processes. It is believed that knowledge undergoes a combination and socialization conversion process (for knowledge flow) within an organization or across a (sub) domain (s), and undergoes an internalization and externalization conversion process (for knowledge adaptation) within an organization or across a (sub) domain (s).

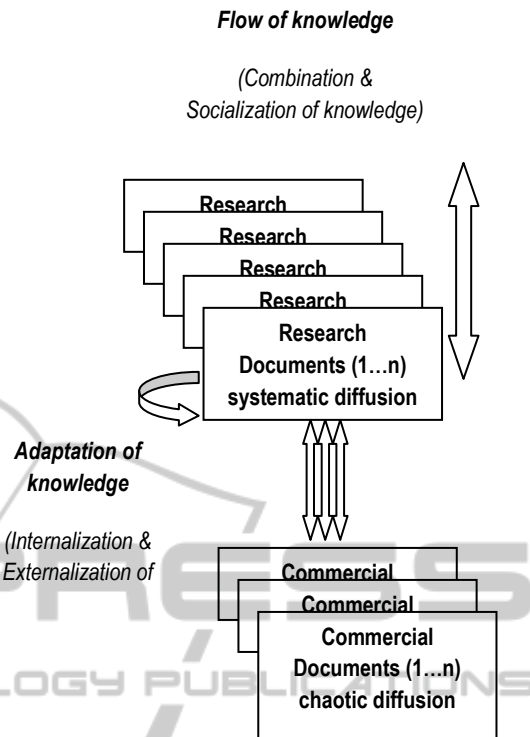


Figure 2: Knowledge diffusion through the *knowledge conversion model* (Nonaka et al, 1995).

Figure above expands Nonaka et al's (1995) knowledge conversion model, to include consideration for how knowledge flows and is adapted within research and commercial documents. Within the case of an SME, Small to Medium Enterprise, such knowledge flow and adaptation through a *knowledge conversion model* may be a framework that could stimulate innovation through conversion of knowledge amongst the *Knowledge Creating Crew* (Nonaka et al, 1995) and stemming from an organization.

3 REMARKS & INSIGHTS

The case study is a method of learning about a complex instance through extensive description and contextual analysis. The product is an articulation of why the instance occurred as it did, and what may be important to explore in similar situations, in our case the specialist knowledge and its diffusion is the product. As the observational study laid the framework for the conduct of our research, it was focused on examining knowledge flow, and corresponding practices and information technology support in place. Results from the observational

study have indicated that knowledge bottlenecks may exist, in particular where technological support could be needed. The transmutation of science into technology is a complex process when one sees unique ideas highlighting the past scientific landscape and beneficial technological artefacts in the present. The notion of satellite technology or space technology, with variable scope and scale, was an ostentatious idea that has led to a range of remote sensing and earth observation instruments for instance. The *unique idea* is a key reference point for forecasting how the idea will metamorphose into an artefact. Knowledge is communicated through so-called semiotic systems: written text, images, mathematical and chemical symbols, and so on. The knowledge of emergent domains is yet to standardize its symbol systems which simply add to the (creative) chaos inherent in such emergent systems. The analysis of change in written text, amongst the most changeable semiotic system at the lexical level at least, may reveal a consensus or dissension in the use of terms. Terms denote concepts and textually help us to understand how knowledge evolves in an emergent domain. The emergent domain of small satellite technology was studied as an exemplar. Our analysis shows that research papers and commercial documents can be distinguished somewhat on the basis of single word and compound terms that were generated automatically. These two lexical signatures show the potential for identifying cross-over points in the diffusion of knowledge from the research arena to applications domain. The metamorphosis of science into technology is a complex process when one sees innovative ideas highlighting the past scientific landscape (i.e. in the form of PhD theses and state-of-the-art research papers) and beneficial technological artefacts in the present. The analysis of change in written text, amongst the most changeable semiotic system at the lexical level at least, may reveal a consensus or dissension in the use of terms. Terms denote concepts and textually help us to understand how knowledge diffuses in a domain. The specialist domain of satellite technology or space technology, specifically an organization in such a domain was studied as an exemplar. This is our attempt to establish a method, which covers a broad range of texts, PhD theses, journal articles, technical reports, and state-of-the-art review papers, to observe the emergence of a domain and hence specialist diffusion of knowledge – and thus possible creation of an *enterprise knowledge cloud* (Delic et al, 2009).

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