Mediated Communication and the Evolving Science System: Mapping the Network Architecture of Knowledge Production

Andrés Gregor Zelman

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Mediated Communication and the Evolving Science System:
Mapping the Network Architecture of Knowledge Production

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Promoters:

Promoter: Prof. dr. Stuart Blume, University of Amsterdam, The Netherlands

Co-promoter: Dr. Loet Leydesdorff, University of Amsterdam, The Netherlands

Examining Board:

Dr. Moses Boudourides, University of Thrace, Greece

Prof. dr. Kees Brants, University of Amsterdam, The Netherlands

Prof. dr. Gerard De Zeeuw, University of Amsterdam, The Netherlands

Prof. dr. Klaus Schönbach, University of Amsterdam, The Netherlands

Prof. dr. Donald Theall, Trent University, Canada

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Chapter I: Introduction – Key Concepts

The Problematic:

Most contemporary communication depends upon a range of media forms required for its transmission. The relationship between humanity and its technological media has a very long and rich history and arguably the question of how particular media impact social communications is of increasing importance. Current changes to humanity's modes of information communication far outweigh earlier circumstances, and with today's accretive use of electronically biased media for communication the need to understand these changes has never been more salient.

Media are central to communication. We use media in every facet of our lives: gestural, oral and written communications, mnemonic techniques, and rules of language can all be considered as media, and they should be understood as mutually implicated phenomena. Media use does not occur in a vacuum but in situated contexts and along historical contingencies – whereby social relations are networked (Meyrowitz 1985, 1994). The phenomenon of mediation is therefore best understood historically. Understood in this broadest connotation media are central to social organization, and by extension they are central to processes of knowledge production.

Isolated events (or communications) can be measured, analyzed, and compared, but it is in understanding their social and historical interrelation that we gain perspective on the impact that media have on different social processes and institutions. This study provides a diachronic analysis of the distribution or *sequence* of selected mediated communications, and thereby provides an additional system of reference than purely synchronic analyses of singular, or individual cases. The central thesis of the dissertation is that print and electronic media foster unique types of media environment, and that an analysis and comparison of the respective distributions of keyword use, publication behaviour, and threaded email messaging behaviour of academic communications will demonstrate the role of each medium in processes of knowledge production and meaningful exchange.

The functioning of all social institutions depends upon information and the communication of said information. Melody (1996) argues that *information* can be considered as a 'stock' concept, and *communication* as a 'flow' concept – both provide a particular perspective upon processes of information transmission. 'Stock' is best understood here as an 'archive' of shared knowledge, or information, and 'flow' as the process of knowledge production and exchange. Information and communication, thus defined, thereby provide different analytical positions on essentially the same phenomena. We use this differentiation as an initial perspective from which to frame this study.[1] Knowledge production is best defined as an achievement and codification of meaning through the communication of information.

[1] Importantly, for Melody, attempts to assess long term social implications of technological change in the fields of information and communication are especially difficult because of the complex methodological problems of network analysis – in particular, that new networks are differently

The print medium is essential to academic performance and this renders it a central place in questions concerning knowledge production. And importantly, there is an increasing use of electronic communications in academe to distribute and exchange information via web-pages, email list-servers, electronic archives, etceteras. The central problematic identified here concerns the centrality of media to human communication, and the ability to assess the impact of different media on the academic environment given their overlap. The focus throughout this analysis will be upon the primary differences between print and electronic media form. Poster (1990, 1995) identifies the differences between print and electronic media in terms of the 'modes' of communication they foster. This study emphasizes the impact of media on processes of academic knowledge production, and by extension, focuses on the different modes of communication implied within the use of different communications media.

The analysis is limited to the use of several specific media in the context of a research project funded through the Fourth Framework Programme of the European Commission. The Self Organization of the European Information Society (SOEIS) research project[2] incorporates a series of studies among six European research institutes.[3] The SOEIS was selected specifically because it employed a diverse set of media in its manifestation, and because it both relied upon and challenged theoretical reference points similar to those addressed herein.

The Literature

The study itself is motivated by a number of current debates concerning the impact of electronic media on the academic environment.[4] A central assumption here is that with changes in the mode of communication one can expect changes in the networked relations among those communicating. Thus the key point here is that new electronic means of communicating one's research are perceived to supplement already existing relations between scholars, and this is expected to impact the exchange dynamics of information and knowledge producing institutions. Print writing, for example, can be understood to incorporate architectural, network, and systemic properties. An essential point of departure for an analysis of changes in the mode of academic communication or changes in modes of knowledge production in academic environments must therefore compare the architectural, network and systemic features of print *and* electronic communication.

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structured than mature, developed networks (1996;269). In this study we overlay old and new networks and through their interrelation aim to discern differences. It is important to acknowledge that new electronic media disrupt the institutional structures into which they are inserted, and in this sense the networks fostered via print have not yet adapted to the new conditions either. Also see: Freeman & Perez (1988)

[2] Targeted Socio Economic Research (TSER) program, European Commission: SOE 1 - Dt97 – 1060.

[3] Three Japanese institutes were also associated with the SOEIS via its sister project: the Self-Organization of the Japanese Information Society (SOJIS).

[4] For debates concerning the impact of electronic media and the changing nature of academic research, see: Melody 1994, Lubanski 1998, Geser 1996, and The Information Society, Volume 11, special issue on the Harnad-Fuller debate, 1995.

Similar concerns have been addressed from a sociological perspective. (Gibbons, Limoges, Nowotny, Schwarzman, Scott & Trow, 1994) These authors describe the changing nature of scientific research as a shift from Mode I to Mode II knowledge production which indicates a move away from knowledge produced in traditional research contexts to an environment in which knowledge is created in broader trans-disciplinary social and economic contexts. This development, they argue, is related in part to the introduction of electronic media into academic environments. Similarly, two significant OECD publications (1996, 1997) recognize these changes in the academic environment as part and parcel of the introduction of new Information and Communication Technologies (ICTs). The current study is grounded by such claims, and aims to assess the impact of ICTs on the science system through an analysis of the collective SOEIS research endeavour.

Metric analyses concerning the relationship between the dynamics of mediated communication and of the changing science system have been performed in recent years. This type of analysis is central to this thesis; the metric approach itself stretches back hundreds of years, and the body of literature addressing metric approaches is growing extremely rapidly. Addressed here are those analyses that concern changes in the modes and media of communication and the accompanying impact on processes of knowledge production. In particular, the concern lies in those approaches that pursue metric analyses to address these issues, as they provide the means to *operationalize* the theoretical perspectives that ground this study as a general heuristic lens to aid in the analyses. By way of an introduction to metric analyses a brief history of textual analysis is provided – it was the early development of textual analysis techniques that eventually led to what became known as bibliometrics.

Historically speaking, bibliometrics and scientometrics are both products of our receding print mode of communication and cybermetrics is a product of the emerging electronic mode of communication. Together they form a long lineage of metric techniques, each of which are relevant to our inquiry into the commensurability between metric approaches and varied theoretical priorities. Stated another way, this analysis rests on the cusp of those approaches which view mediated communication as a symbolic phenomenon and the metric approaches that aim to model its properties. This relationship is addressed in *Chapter II: Theoretical Grounding* where the relevant theoretical literature is reviewed, and again in *Chapter III: Materials & Methodologies* where individual metric techniques are aligned with the respective communicative domains of the SOEIS selected for analysis. For the present, the concern lies in observing those studies that employ metric approaches for their respective strengths and weaknesses.

Briefly defined, textual analysis is the examination of texts for underlying structure; it entails the search for patterns of word use which are then used to determine the cognitive influences upon an author's text. Hermeneutic procedures are often used to settle arguments concerning authorship; some obvious examples include the Testaments, and Shakespearean works. Medieval Scholarship aimed to find parallels between the Old and New Testaments by finding places where words used in the Old Testament would pre-shadow a passage in the New Testament (Bradley & Rockwell, 1997). Indeed, many of Christ's parables referred to older teachings appearing in the Old Testament. It became clear that it would be useful to group words into categories

and then develop indexes that pointed to occurrences of those words in the different books of the Bible. Using this technique, early hermeneutic researchers formed an understanding of the various influences upon Christ's teachings. Formally this process is known as *thematic concordance*; it involves finding the co-occurrence of names, places, events, etceteras, in the Bible. Hermeneutics has a rich history that includes not only examinations of biblical texts, but the extensive analysis of other texts such as Homer's Iliad and Odyssey (Luria 1976, Ong 1977 & 1982), Shakespearean and Joycean works (Theall 1997, 2000), and more recently Discourse Analysis of a myriad of accessible data sets (Mehta et. al. 1997, Provencher 2000, Zook 2000, Armitage 2001, and Teevan, 2001).

The current analysis concerns changes in textual expression from print writing to electronic writing. Textual analysis techniques are employed to determine the similarities and differences between print and electronic modes of SOEIS communication. Here it is important to understand that the historical development and use of textual analysis techniques stretches back to scribal culture, and that it extends to present day analyses which are enhanced by computer aided techniques. Thus, by extension, computer assisted textual analysis is more than just a 'find' function to locate words as is standard with word processing programs. It is characterized by the ability to search large texts quickly by creating electronic indexes to locate and reorganize information. With such programs one can both conduct complex searches for lists of words or patterns of association, and present the results in a way that suits the study of texts. That is, the output of textual analysis provides a visual means of interpreting results through displaying Key Words In Context (KWIC), for example.

In the 1940's the study of texts became aided by machinery. The first machine used to this effect was called the Concordance. Concordance uses essentially the same methods of co-occurrence indexing developed in the Middle Ages. In the mid 1940's, an Italian scholar named Robert Busa was examining the use of the term 'presence' in the writings of Saint Thomas Aquinas.[5] After manually searching the texts he realized that for Aquinas the meaning of the word was connected with the use of the preposition "in". He came to believe that function words (such as: 'in' or 'sum') provided clues to understand Aquinas' conceptual world through deconstructing the words he used to describe it. By the late 1940's Busa began to create a complete concordance of all of the over 10 million words in Aquinas' writings. This was done using punch cards and card sorting machines. The project lasted over 30 years since the technology then available for the electronic transfer of text was still lacking. In the 1970's technology became available for this type of large-scale project. With the help of large IBM mainframe computers and computer driven typesetting equipment the project was finally completed.[6]

By the late 1970s computing had become well established within the Humanities, and particularly within the field of hermeneutics. It became apparent that if the analysis of texts was to evolve, there were two necessary developments: in order to compare texts

[5] For additional details see Bradley & Rockwell "TactWeb 1.0; 'Midsummer' Workbook" at http://tactweb.humanities.mcmaster.ca/tactweb/doc/catahist.htm, 1997.

[6] It is estimated that over 1 million person hours were used inputting the text and creating the indexes (Bradley & Rockwell, 1997).

there was the need for a machine-readable format, and in order to share results the need arose for a standardized software package that many could easily use.

Oxford University was an early leader in this with regard to two major projects. The first is the Oxford Text Archive through which all scholars are invited to submit electronic texts. The second is the Oxford Concordance Program which serves to provide links between all submitted texts. It is important to realize that the Oxford Text Archive and the Oxford Concordance Program are primarily indexing tools not textual analysis programs in and of themselves, yet their development facilitated the possibility of doing more efficient and effective computer assisted textual analysis.

In the 1980s, computer assisted textual analysis took another great leap with the advent of desktop computing and standardized word processing. The first standard software for computer assisted textual analysis in the humanities was the Brigham Young Concordance (BYC) Program that was later commercially packaged as *WordCruncher*. The 1980s and 1990s saw the development of a myriad of other textual analysis programs, thereby extending the possibilities of bibliometric analysis techniques in understanding media bias. Bibliometrics can be understood as the quantitative study of patterns in both individual texts and their correlation with each other – it is hermeneutics enhanced by metrics, or specifically, by bibliographic coupling.[7]

In the 1990s enormous effort was put into the development of sophisticated techniques for the analysis of textual patterns. There is an emerging discourse that addresses new and sophisticated means of mapping processes of knowledge production. Indeed, significant movements are being made towards understanding the *visualization of text* itself as the new research object. That is to say, textual analysts are largely dependant upon how effective they are in visually representing their findings; different representations of research results will generate different understandings of a text's significance.[8] In the last several years the central arguments concerning scientific visualization have focused on the development of new software tools to aid in analysis. For this analysis the *WordSmith* program of the Oxford University Press was selected for its ease of use, data exportability, and sophisticated sorting logics.

Leydesdorff provides arguments both for (1989) and against (1997) the use of co-word analysis to map the intellectual development of the sciences. In the case of the former, indicators of intellectual structure and organization were found by comparing titles of scientific articles; yet in the case of the latter, a comparison of bio-technology articles revealed a document structure at the micro level, but at the level of the document set the structure was no longer discernable. Thus, Leydesdorff (1997) argues that co-word analysis cannot adequately map intellectual organization – this argument will be employed as a methodological caveat. This study will illustrate how

[7] The reader will note that bibliographic coupling has a different meaning in citation analysis; here the term is used to emphasize the comparison of textual patterns across many texts, not simply citation patterns.

[8] For details concerning the importance of visualization to the field of textual analysis see: Bradley (1991), Bradley & Rockwell (1992, 1994) and Monger & Rockwell (1999).

the combination of bibliometric and other metric techniques can provide a unique means of assessing the changing nature of research scholarship. Actor Network Theory (ANT) is also relevant here as theorists often examine co-word analysis in light of the theoretical emphases of the ANT. This forms part of the theoretical background for the study and will be addressed in greater detail in *Chapter II: Theoretical Grounding*.

Above and beyond mere textual analysis, bibliometric techniques have aided many recent attempts to develop more sophisticated means of measuring and understanding the changes in our mode of information and subsequent changes on our processes of knowledge production. In particular, Hicks & Katz (1997) argue for the use of bibliometric indicators to understand changes in the emerging knowledge-based economy, Hjortgaard (1997) imported bibliometric techniques for analysing online research publications, and Larson (1996) used bibliometric indicators to map the World Wide Web as an architecture, or 'intellectual structure'.

Scientometrics operates on the same principles of co-analysis; it is basically bibliometrics applied to scientific texts – a study of quantitative patterns in both individual texts and in their correlation. In a word, it is hermeneutics enhanced by metrics, but it is distinct from bibliometric analyses in that formal publications can be understood as indicators of scientific codification (Price 1970). Publications refer to each other, and this leads to *networks* of scientific papers (Price, 1965), which thereby provide a *geography* of science (Small & Garfield, 1985). Importantly, these networks can be examined to delineate between academic specialties (Leydesorff & Cozzens 1993), and to assess national research performance (Leydesdorff & Gauthier, 1996). Networks are established by the researcher by deciding what to measure, be it nationally, institutionally, disciplinarily, or otherwise. Indeed, Small (1973) argues for a co-citation analysis whereby the citation of two texts by a third is registered and a network delineated. Similarly, author co-citation is a measure of the frequency of the citation of two authors by others, and this provides us with a measure of proximity useful in mapping these relationships (White & Griffith, 1981).

Scientometricians not only concern themselves with the normative aspect of modelling these networks, but they contend with the symbolic dimensions of publication behaviour as well. For example, Small (1978) argued that cited documents operate as concept symbols, and Gilbert (1984) argued that references operate as property or as a means of persuasion. Further, Leydesdorff & Amsterdamska (1990) have argued that with respect to the dimensions of citation analysis, the subjective reasons of scientists to reference another paper are not equivalent to the normally assumed *argumentative* uses of cited articles.

As the field of Scientometrics matures there is a notable increase in attempts to create a macro theory of citation behaviour. Van den Besselaar (2000) aimed to discern relationships between Scientometrics and Communications Theory by developing theoretically informed indicators. Leydesdorff & Wouters (1999) argued for an emerging macro theory of Citation Culture; and Wouters (1999) provides a thorough History of Scientometrics. Finally, Fujigaki (1998) argues that the citation system operates as a recursive network which involves a process of continual re-evaluation and knowledge accumulation. It is notable that scientometric methods are increasingly

imported into other domains to understand the networked dynamics of other social phenomena. Rousseau's *Sitations* (1997) offers a salient example whereby bibliometric and scientometric methods are combined to understand relationships between linked web-sites (and hence an indicator of an emerging cybermetrics).

Like bibliometrics and scientometrics, cybermetrics shares a common emphasis on co-analysis. Cybermetrics is used here as a broad term meant to incorporate a number of notable developments; namely, infometrics, webometrics, and cybermetrics. Infometrics was formalized as a research agenda in the 1980s and differs from bibliometrics and scientometrics in that the latter refer solely to communications media and the sciences. Infometrics is neither limited to specific media nor the sciences; it refers to the quantitative analysis and modelling of a myriad of different information sources including credit databases, information flow on the Internet, and genetic histories for such purposes as demographic monitoring, enhanced surveillance of workplace activities, and insurance eligibility (Egghe & Rousseau, 1995). Abraham develops the field of what he terms 'Webometry' whereby he aims to sort the complexity of the World Wide Web by creating a chronotopography (1996, 1997). And Almind and Ingwersen (1997) use infometric methods for webometric analyses. Elsewhere, Ingwersen (1998) offers a means of calculating Web Impact Factors by adopting infometric methods to test national, sector and institutional impact factors.

Other important data sources than that infometrically obtained are relevant here. In particular, the cybermetric approaches of Korenman & Wyatts' (1996) analysis of group dynamics within email lists, Hernandez-Borges' (1997) comparative study of Pediatric mailing lists on the Internet, and Matzat's (1998) analysis of informal academic communication via Internet mailing lists. These approaches all use email communications as the hermeneutic unit of analysis in a similar way that scientometric analyses employ scientific publications. Finally, some notable work has been done recently with respect to mapping the networked dimensions of online web debates (Rogers & Zelman, 2002; Rogers & Marres, 2000), Triple Helix relations on the web (Leydesdorff, 2001, Boudourides & Sigrist, 1999), and with respect to purely quantitative approaches such as Kugiumtzis & Boudourides' analysis of Internet ping data (1998).

These approaches have each addressed either the print medium (predominantly in the case of bibliometrics and scientometrics), or the electronic medium (in the case of cybermetrics). However, the approaches lack sufficient comparison of media forms with each other. One would expect that analysis of media impact on processes of knowledge production would be concerned with the nature of the medium itself in biasing these processes. In this study a number of metrically oriented approaches have been combined and employed to discern notable differences between the print medium and the electronic. In this way this analysis aims to contribute a new perspective to this discourse. Further, while representative of an extremely interesting and burgeoning field, the literature outlined above lacks sufficient theoretical underpinnings to make the studies relevant to larger audiences. In part this study is motivated by this lack, and thereby weaves together distinct theoretical perspectives with empirical analyses to provide a more holistic account of the changing science system.

The Challenge

Two central perspectives are juxtaposed in this analysis: those that concern processes of symbolic exchange and those that model these architectural, network and systemic relationships (and thereby also processes of symbolic exchange). Information as a 'stock' concept can be understood here as a reservoir of symbolic meaning, and communication 'flow' as the process through which meaning is achieved and knowledge produced. Media use can be perceived to entail at least three distinct components: a communicating party, a communicated substance, and a communications channel. A wide range of theories from *Communication Studies* and *Science & Technology Studies* are employed to provide a backdrop on which to describe the symbolic dimension of communicative processes evident in collective research endeavours, and to provide context to the modelling approaches from *Science & Technology Studies* used to compare these processes in their architectural, network and systemic capacities.

It is critical that the present study be understood as an *exploration* of several distinct metric techniques in juxtaposition to a theoretical framework through which *architectural*, *network*, and *systemic* features of mediated knowledge production are identified and categorized. The problematic presented by the centrality of media to processes of knowledge production can be addressed by integrating these different features of academic communication. We can understand all social communication to entail architectural features inasmuch as they are treated as events which share certain qualities; for example, communications generally have an advent, a termination, a dynamic interplay between actants, and a delineated communications system. Medium Theory is used to ground this perspective and will be described in detail in the next chapter.

The network features of the SOEIS communication system can be understood to highlight the dynamic interplay of symbolic exchange over the time dimension outlined by the architectural parameters. By examining the network features of the SOEIS research project we gain an understanding of how networked communication has changed over the time period of the project, and how this is a collective result of individual actions. Actor Network Theory is used to ground the network analyses. Finally, the examination for systemic features aims to capture that element of the communication system which remains above and beyond the control of individual actors. That is, the collective research endeavour is understood to operate on a macro level which remains above and beyond the full comprehension of any individual in the group. The systemic features of the SOEIS provide a unique frame of reference not obtainable through architectural and network analyses. Actor Network Theory and Systems Theory are also addressed in more detail in the following chapter. This combination of metric techniques and grounded theorizing will provide a unique means of mapping and understanding mediated processes of intellectual development.

Thus, the goal of this research is to explore the significance of symbolic exchange, the centrality of media in this process, and to represent the *architectural, network,* and *systemic* differences between print and electronic media used to communicate similar, but differently coded information. The challenge then is whether symbolic and modelling approaches can be fruitfully combined to enhance our understanding of the

roles and biases of particular media in processes of knowledge production. The following analysis is therefore best understood by the reader as an exploratory approach whereby a number of overlapping but significant communicative domains of the SOEIS project are compared to expand our understanding of the processes of mediated knowledge production. Through exploring and comparing these processes a methodological foundation is established, upon which further analyses can be pursued. A central aim is therefore to contribute to both *Communication Studies* and *Science & Technology Studies* through this interrelation.

Dissertation Structure

The dissertation is organized into three main sections: *Context, Analysis,* and *Reflection*. The concepts of *mediated communication* and *knowledge production* have been introduced in this introductory chapter – both assist in describing the extent of the current problematic concerning the changes in the nature of mediated communication and the subsequent changes in knowledge production that this implies. Similar analyses that examine this phenomenon have also been reviewed and challenged. Importantly, this chapter has placed this analysis into an existing discourse whereby social communication can increasingly be mapped using metric approaches. This introductory chapter traced the *metric* approach from early bibliometric concordance techniques from the scribal and hermeneutic traditions, through modern textual analysis and visualization techniques, as well as scientometric techniques, and new emergent cybermetric forms of analysis. In this way the theoretical and metric priorities outlined in the following chapters were introduced and contextualized.

In *Chapter II: Theoretical Grounding* we will explore a range of theoretical positions from both *Communication Studies* and *Science & Technology Studies* inasmuch as they concern the two central concepts of *mediated communication* and *knowledge production*. The chapter outlines Medium Theory as the conceptual foundation upon which the theoretical rationale rests; this provides an architectural metaphor to aid in conceptualizing processes of knowledge production. From *Communication Studies*, Stucturalist, Poststructuralist, and Structurational theories of meaning and networked relationships are interpreted in light of their descriptions of the 'locus' of meaning. From *Science & Technology Studies*, Actor Network Theory and Systems Theory approaches to mapping network and systemic relations are explored and then explained to contextualize the metric analyses. These claims are compiled into a general model: the theoretic triad of *Architecture – Network – System*, through which the subsequent empirical analyses are performed and interpreted.

In *Chapter III: Materials & Methodologies*, the Self-Organization of the European Information Society (SOEIS) research project will be introduced as the case study selected for this analysis. Importantly, this third chapter conceptually binds the theoretical priorities of the analysis with the empirical materials and metric approaches to be used in the analysis. Here the metric approaches are described with particular attention paid to the role of the architectural, network, and systemic concepts exhibited by each approach.

The *Analysis* section of the dissertation consists of four chapters. Each chapter has as its focus an empirical analysis of one of four isolated communicative domains of the SOEIS research project: print communication, electronic communication, journal publication, and mailing list environment, respectively. *Chapter IV: Textual Analysis of Print Communication* examines the dynamics of print exchange in the context of the SOIES project and reveals patterns of codification of scientific information, networks of cognitive orientation, and the systemic dimensions of print word distribution. Similarly, *Chapter V: Textual Analysis of Electronic Communication* examines the dynamics of electronic writing as exhibited by the SOEIS community – here the results are compared with the results of the print analysis and are shown to exhibit different modes scientific information codification, different networks of cognitive bias, and different overall word distributions.

In *Chapter VI: Analysis of Journal Publication* examines the changes in the publication patterns of the SOEIS community on both the project level (article generation) and field level (the journal environment) and reveals both similarities and differences in the collective cognitive orientation of both the cited dimension (comprised of publications by the SOEIS community) and the citing dimension (those that cite SOEIS relevant materials) over the five year scope of analysis. Finally, in *Chapter VII: Analysis of Mailing List Environment* the network dynamics of eleven *Science & Technology Studies* and *Self-Organization Theory* oriented mailing lists are compared in terms of their individual threaded messaging behaviour to reveal that the SOEIS related project mailing lists function like field level lists, despite exhibiting project level dynamics.

The final section of the dissertation: *Reflection* is comprised of two chapters. *Chapter VIII: Integration & Conclusions* will seek commensurability between the theoretic lens and empirical methods employed herein, and will reflect upon the original research questions and expectations. Finally, *Chapter IX: Discussion & Relevance* will describe challenges associated with integrating symbolic and modelling approaches and will provide both suggestions for future researchers in the field as well as suggest the design parameters of a modularized software program to aid in future analyses. We thereby readdress the central question of the Dissertation: *do print and electronic media foster unique types of media environment, and are different modes of knowledge production and meaningful exchange thereby implied with each medium and its use?*

A common thread through the chapters is the triad of *architectural, network,* and *systemic* features of mediated knowledge production. In this way the challenges associated with comparing symbolic and modelling approaches to understanding communication are addressed and the critical differences between Mode I and Mode II knowledge production identified.

Chapter II: Theoretical Grounding

Introduction:

Three theoretical bodies are central here and a number of periphery works are addressed. Briefly stated, Medium Theory comprises the theoretical backbone for the analysis through the concept of the *History of Mediation*,[1] Actor Network Theory provides both a network metaphor and a background in mapping scientific research by means of textual analysis, and Systems Theory provides a dynamic network perspective that enables a macro view of co-ordinated actions and actors. These theoretical traditions each focus on the problematic of modelling aspects of mediated communication in contrast to symbolic approaches. The concepts introduced herein are each relevant to the analysis as they address the centrality of media in processes of knowledge production.

In addition to this core theoretical triad, the framework is enriched with Structuralist, Poststructuralist and Structurational theories of meaning, and by extension their theories concerning networked social relations. These latter traditions provide this thesis with a range of discourses which problematize the notion of mediated communication in terms of its symbolic dimensions, rather than modelling. The general theoretical lens is thus comprised of a significant range of theoretical positions which each address mediated communication (in its myriad forms) as central to processes of knowledge production.

Each of these theoretical positions is relevant as a perspective that addresses the nature of human interaction, and each employs network metaphors to describe patterns of social relation. They are collectively employed for this analysis as they help frame the types of questions we can ask about processes of mediated communication. Individually they offer original insight into the dynamic nature of networked communication, and together they provide a cohesive framework for this analysis.

Two important concepts will aid the reader through theoretical arguments below. The first is the *History of Mediation*. Medium Theory argues that media use is both an epochal phenomenon (oral, print, electronic stages through history) and a transformative phenomenon, in that each new predominant medium must contend with the impact of the former. This theoretic claim was challenged and expanded in *The History of Mediation: Mapping the Dialectic between Surface Interaction and Deep Structure*. (Zelman 1997). There it was argued that the history of media usage be viewed heuristically as having *two* distinct historical trajectories: a history of social relations (interactions) and a history of symbolic development (or knowledge production). Here this distinction is used to demarcate communicative processes

[1] The theoretical lens described in this chapter is a synthesis of a larger theoretical project developed in Zelman, A *The History of Mediation: Mapping the Dialectic between Surface Interaction and Deep Structure*, Masters Thesis, University of Calgary, Alberta, Canada, 1997.

(*flow*) from what is ultimately communicated (*stock*), because each can be viewed as an aspect of mediated communication that is individually significant.

Communicative processes demand both a reference system and a participating party, and these each have unique historical reference points. The History of Mediation, understood this way, enables a means of assessing the differences between modes of mediated communication by enabling juxtaposition between actual and expected communications. For the purposes of this study a theoretic triad of *Architecture – Network – System* is established as a heuristic or model to understand the dynamics of the SOEIS communication system, and it is through this *History of Mediation* lens that the following theoretical bodies are explored to better situate the empirical analyses, and their interrelation.

The second important concept of relevance here concerns the *'locus' of meaning*. Stated more precisely: is *meaning* a situated process, and is it a mediated process? What is knowledge production? Is the production of knowledge even possible without mediation, or the notion of *meaning*? All of these questions are intertwined, and it remains a matter of definition as to how one locates *meaning*. To this end, Structuralist, Poststructuralist, and Structurational theories of meaning will be examined and placed within the context of the *History of Mediation*. Thus, the modelling approaches of Medium Theory, Actor Network Theory and Systems Theory are combined with theories of meaning and knowledge production in order to provide a well rounded approach to understanding the dynamics of mediated knowledge production, and to enrich the interpretation of the results of each of the respective analyses performed in *Part II – Analysis*.

In what follows several key theoretical positions are explored, as argued by their central proponents. An overview of Medium Theory, as presented in the work of Innis, McLuhan, Ong and Meyrowitz, will provide the central framework around which the other theoretical traditions will be discussed. Central arguments concerning the locus of meaning are then addressed, as argued by Saussure, Lévi-Strauss and Ricoeur from the Structuralist tradition, Derrida from the Poststructuralist tradition, and Giddens from Sociology. In so doing we provide a theoretic stance from which to understand the notion of knowledge production as a networked *process*. Actor Network Theory as argued through the work of Callon, Latour, and Wise will then be addressed; here we link theories of meaning with theories of networked phenomena. Finally, Self-Organization Theory is reviewed, as presented by Luhmann and Leydesdorff. By providing an overview of each of these positions in detail, a language is provided to contextualize the following analysis of mediated communicative processes, their implied information networks, and the recursivity involved with said communication.

Medium Theory

As indicated, Medium Theory provides two basic concepts: historically contingent epochs in which there was a predominant *medium* (Oral, Literate, Electronic stages of mediation) and the notion of *transformation* between these epochs. Importantly transformation indicates change, and in that respect, the history of mediation is best

understood as a history of media *use*. Understood historically, media use is a dynamic process whereby individuals have collectively communicated using a myriad of different media and created networks of interaction.

This process can be understood as the History of Mediation: a heuristic that encompasses architectural, network and systemic properties along distinct historical trajectories. Along this historical axis at least two trajectories are observable. Processes of mediated communication have both a participating party and a collective reference system that defines them; communicators are always contextually situated and thereby defined by a myriad of factors. This collective reference system is not context bound, and has its own unique history of use (or more accurately, of being used). Therefore, that which is referred to in processes of communication, such as concepts, stories, grammatical rules of language or codes of behaviour (between scientists, siblings, monks) have unique histories that are always contingent upon social processes.

Similarly, social processes are contingent upon the development, maintenance and exchange of these concepts, language norms, and behavioural codes. In processes of mediated communication we reference a collective or shared cultural memory. Yet this sum total of our collective deep structure remains inaccessible to any individual in full; each of us only understands a fragment of its totality. All processes of communication are comprised of a myriad of different factors, and all are contingent upon the process of *mediation*.

In what follows, we review Medium Theory as an academic tradition, and expand upon the concept of the *History of Mediation* as a useful heuristic in understanding the biases of dominant media and their impact on processes of knowledge production. Medium Theory thereby provides this analysis with both a language to address media impact, and a historical framework with which to contextualize this impact.

Joshua Meyrowitz, a central proponent of the academic tradition of Medium Theory, argues that Medium Theory is best conceptualized as having two distinct generations (1994). He introduces a distinction between first and second generation Medium Theory. First generation concerns the formation of deep, unconscious frameworks that influence human perception and interaction. By contrast, second generation concerns the role of human agency in the production of meaning. Simply stated, first generation Medium Theory presents the history of media as technologically deterministic and in so doing negates the essential element of human agency in mediation as a process. Second generation Medium Theory avoids this deterministic bias and thereby achieves a more dynamic notion of the History of Mediation. We examine the implications of each, below. Importantly, this latter position highlights the socially networked dimensions of mediated communication. Second generation Medium Theory offers a means of conceptualizing how the production and exchange of knowledge is contingent upon the various media employed for communication, over time.

First Generation

First generation Medium Theory can be generalized by a central tenet: *Media are the means of communication, and when media usage is viewed macro-historically, the overlap between media forms reveal deep structural patterns*.

Innis

In *Empire and Communication* (1950) and *The Bias of Communication* (1951) Harold Innis developed a theory of economic sustainability suggesting that an empire's ability to maintain stability depended upon its capacity to balance the internal biases of its dominant media. The nature of these biases can be exemplified with a simple example: stone tablets as means of communicating text are more biased to time than space, given its weight and durability, whereas paper or papyrus is more biased to space since it can be moved far distances but hasn't the durability to sustain it in the time dimension. An empire that employs a medium is subject to its possibilities and limitations. The view that dominant media have inherent properties is decidedly technologically deterministic.

Innis also perceived history as a series of epochs that are separated by discontinuity. He believed that each epoch relies upon dominant forms of media to transform information into systems of knowledge. The consequent "interaction between media form and social reality create biases, which strongly affect the society's cultural orientation and values" (Crowley & Mitchell, 1994:xvi). Systems of knowledge were perceived as intricately bound within the network of media relations that exist within any given epoch, and this suggests that media are not mutually exclusive but are inter-dependant and form patterns of relation.

McLuhan

Extending the work of his predecessor, Marshall McLuhan argued that media determine the structural possibilities and limitations of social development, and expanded the concept to include the effect that media have upon the interplay of our perceptual and cognitive processes. For McLuhan the history of mediation was best perceived as a multi-epoch process of symbolic and technological expansion. He argues in the case of writing, for example, that the print medium permitted a distanciation between space and time in the sense that an *inscribed* text becomes disembedded from its particular space and time and is able to extend itself in either direction. For McLuhan, media were not just extensions of the body (binoculars extend the eye) but also of the mind (in the case of memory) – both are perceived as enabled via technological expansion.

Among the most interesting of McLuhan's arguments concerns the nature of mediated experience. For him, media bias is a fragmenting experience; they cause perceptual changes, and as extensions they demand certain reception habits. Media thereby cause a closure, or displacement of perception (1964:157). He argued further, that the development of the alphabet entailed a separation of the gesture, sight and sound associated with the spoken word (1964:147). The alphabet thereby permitted the use of the unconscious via internalization, which served to fragment and distanciate experience, ultimately causing the splitting of percept and concept allowing us the capability of dialectic, logic, philosophy, and so on (1988:15). Mediated

communication thereby demands a numbing, a certain 'closure of the senses' that causes us to conform to the 'pattern of experience presented'.

Defense against the seduction of mediated experience was attainable through what he termed *Synaesthesia*: the action of sense re-combination (1964:275). *Synaesthesia* entails the (re)integration of sense and perceptual biases and provides a closure to the rift implied with the distanciating aspect of media. Thus the alphabet simultaneously separated the combination of gesture, sight and sound characteristic of oral cultures, yet allowed for an entirely new form of communication to arise.

This codification of experience (as evoked by such terms as *numbing*, *synaesthesia*, and media juxtaposition) implies that, for McLuhan, media form has long been an essential part of our ability to communicate with each other, and that each medium is unique in its biases. Moreover, McLuhan's arguments can be read to suggest that conceptual space itself is not a given phenomenon, but is a result of media usage.

Ong

Walter Ong provided a logical connection to McLuhan's notion of psychological transformation; together their work is known as Transformation Theory. Transformation Theory is a way of conceptualizing shifts between historical epochs. Ong's project reflects McLuhan's in the sense that both understood media usage as capable of profoundly altering our cognitive and perceptual processes, but Ong extended the argumentation to argue that changes in our thought processes via electronic media indicate a new form of orality. Ong is perhaps best perceived as a mature version of McLuhan, in that he clarifies and extends some of the more esoteric theoretical positions.

Ong's theory of Secondary Orality (1977, 1982) carries serious implications for all social institutions. In oral culture there is no such thing as an inscribed text, there is no external reference point, and knowledge is generally stored internally, or *psychically*, via memorization. Later, with the development of writing, we begin to have what is understood as a *physical* medium. Writing is perceived as a technology that signals a new type of internalization, or interiorization process (as with all technologies). Considered as technologies, oral memorization, writing, and print can be understood as a succession (or deep structure) of different media forms employed for communication which tend to bias certain senses and cognitions over the previous modes employed. Ong believed that the development of telephones, radios and televisions have signalled a new transformation in our psychic makeup – one that is largely reminiscent of oral cultures in their immediacy. In part we aim to assess this relationship between print and electronic forms of writing to determine particular biases.

Second Generation

Second generation Medium Theory can also be summed up with a central tenet: *The relations between media form deep structural patterns that influence the nature of social interaction; the process of social interaction, in turn, transforms deeper structural patterns*.

Meyrowitz

The distinction between first and second-generation Medium Theory stresses the importance of human actants with respect to media usage. First-generation is perceived as a theory of civilization stemming from the macro-historical, epochal approach isolated by Innis, developed by McLuhan, and solidified through the work of Ong and formalized through subsequent thinkers.[2] By contrast, second generation Medium Theory, as argued by Meyrowitz, concerns the socially networked aspects of mediated communication. For Meyrowitz, first-generation provides a framework of the deep structural pattern yielded through media usage, and of the physical and psychical transformations involved, but the approach lacks the hard quantitative data achieved through media content studies. (1994:51) The resolution lies in the application of Medium Theory to everyday social interaction: a second-generation Medium Theory. The current study engages this challenge and aims to link symbolic and modelling approaches to further our understanding of the dynamics of mediated communication.

Meyrowitz describes media as not only channels for conveying information, but also as shapers of new social environments. (1994:51) For Meyrowitz social reality is constituted through interactions among people. He thereby considers the physical setting of situated interaction less important than the informational worlds that are being exchanged. Communication may be context bound, but the nature of interaction between people, he argues, is more influenced by the patterns of information flow, than the physical setting. (ibid;36) Media use as the means of information transmission thereby implies a disconnectedness that shapes social reality. For Meyrowitz, media alter social behaviour, and he argues that this is an important focal point for Medium Theory because social roles are bound by communication media.

Importantly, Meyrowitz argues that "[s]ocial identity does not rest in people, but in a network of social relations" (1994:58). Social roles operate as *information networks*, and they cause a *disconnectedness* (in a McLuhanian sense) caused by the separation of social roles and interactions. In this way social roles can be understood as merely a question of access to social information networks. The patterns of access to social information, he contends, are linked to the patterns of access to social situations. (ibid:59) Thus, distinctions in behaviour, identity and status are created and maintained by segregating people into different informational worlds. "In general, *the more situations and participants are segregated, the greater differentiation in status and behaviour*. Conversely, *the more situations and participants overlap, the less social differentiation in status and behaviour*."[3] (ibid:59)

What is of distinct importance here is the notion that social situations should be perceived as information networks; it is the combination of factors that contributes to the general constitution of a given situation. Situations are determined by patterns of information flow and social identity is similarly determined, but more crucial to Meyrowitz's project is how we perceive situated interaction. For Meyrowitz, situations should be seen as information-networks, or informational systems. (ibid:59)

[2] Havelock (1963), Goody & Watt (1963), Luria (1976), and Eisenstein (1979, 1983).
[3] *Italics* in original.

Meyrowitz uses the epochal framework of first-generation Medium Theory and applies the role theorem of sociological analysis; together they frame the arguments for a second-generation Medium Theory. He places his role triad: *group identity, socialization* and *hierarchy* in juxtaposition to the oral, literate, and electronic stages of mediation (1986, 1994). The roles in the triad are best understood here as universally shared norms. The first can be represented by the fact that we are all either male or female; we therefore experience a group identity. Socialization can be understood in terms of the transition from childhood to adulthood; we all experience this process. Hierarchy is described as a relationship to political power; we are all either political leaders or average citizens. Meyrowitz describes social reality in terms of information systems, and clearly these roles define social behaviour with respect to information access. The behavioural role triad is best understood as a heuristic aid that outlines the parameters of networked social interaction. In the context of this study, we are most interested in the notion of an information network that has extended over time and therefore contains elements of its earlier conditions.

Thus, Meyrowitz's role triad provides a link to theories established in the work of Innis, McLuhan, and Ong. He provides a heuristic device that can be used to conceptualize the dynamics of mediated social interaction with respect to the individual and collective psychic transformations that occur as a result of mediated communication, and the accompanying social changes. McLuhan and Ong were most concerned with individual psychic changes as a result of media usage; Meyrowitz is most concerned with the changes of networked social dynamics throughout the history of mediation. In this project we are not as concerned with possible psychic changes than with the evident differences between patterns of media use as exhibited by the traces produced by using print and electronic media. While this analysis of print and electronic communications is not chronologically placed within an epochal framework, we can understand that there is evidence of each in our current age, and the differences between them may prove to be significant.

Medium Theory thereby provides this thesis with a theoretic backbone from which other theories concerning the nature of mediated communication can be addressed. In particular, Medium Theory enables one to position various media and their impacts using an historical framework of increasingly complex interrelations. With respect to the SOEIS project in which print and electronic media operate in tandem, the notions of the *History of Mediation* and of *Information Network* provide a means through which we can assess and compare the similarities and differences between the mediated communications of the research project.

The Structural Tradition

Structuralist, Poststructuralist, and Structurational theories of meaning are relevant here because they provide a conceptual link between Meyrowitz's information network and theories concerning the location of meaning and its exchange, and by extension, theories of networked social relations. This review of primarily symbolic approaches also provides a useful juxtaposition to the modelling approaches of Medium Theory, Actor Network Theory, and Systems Theory. Importantly, while the approaches covered here in the Structural Tradition are symbolically oriented, each

provides a unique conceptualization of knowledge and its 'location' and thereby provides this thesis with a range of different ways of conceptualizing knowledge production.

Here, central arguments concerning the locus of meaning are reviewed to describe the network connectivity implied with word use. Saussure, Lévi-Strauss and Ricoeur from the Structuralist tradition, Derrida from the Poststructuralist tradition, and Giddens from Sociology are addressed. In so doing a theoretical stance is provided from which knowledge production can be understood to be a mediated process; it is an achievement of meaning by communicating information. The example of the information network is an integral feature of the History of Mediation as it will be used to highlight the parameters of each mediated communication under analysis.

Structuralism

Saussure

In the early Twentieth Century, Saussure (1909) developed a framework of linguistic analysis through which he conceptualized language and meaning to be located within a network of relations. This approach was subsequently imported into Anthropology by Lévi-Strauss, and thus helped formalize 'Structuralism'. These two theorists articulated the basic building blocks upon which all further Structuralist analyses followed.

A brief outline of Saussure's concept of *difference* will help explain the fundamental ideas of Structuralism. In a word, *difference* suggests that the meaning of words is contingent upon their relationship with other words. He delineates *langue* as the language object, and *parole* as its use, and in so doing unwittingly postulates a transcendental realm of meaning that proves devoid of any reference to context. *Langue* assumes a universal meaning: difference indicates that words refer to a transcendental signified, not to everyday social context. The key point is that meaning is understood to be located in the network of relationships between words. The sign is perceived as a duality, it consists of both a signifier and a signified. The signifier is best described as a sound, a written pattern, a gesture or any medium that connotes a message. The signified, by contrast, describes the sign in terms of its differential value in the lexical system. This presumes a static and unchanging network of relations, as it remains transcendent and free of any local influence. The metaphor of the network, used here, suggests an inter-linking between all words and concepts in all languages, and moreover, that these relations share a common ground. The reader should note that Saussure never characterized this realm of transcendental meaning as a network, per se, nor did he use the terms system or structure in the way that they are currently employed. Nevertheless his ideas were central to the historical development of these terms.

Importantly, structural linguistics shifted general linguistics from the study of *conscious,* observable linguistic phenomena to the study of the *unconscious* infrastructure of language. It does not treat words as independent entities, rather, the concern lies in the *relations* between words – and this implies systemic properties. The linguistic model isolated by the theory of difference introduced something

entirely new to the humanities: the possibility of a system of operations that functions entirely outside of social context. *Difference* thereby suggests a deeper structure than we are normally aware of in everyday social interaction. This formulation is simply inadequate because both human beings and social context are integral to how meaning is generated in processes of communication.

Cilliers (1998) argues that Saussure's argument is that language, artificial or otherwise, cannot be controlled whilst in circulation – once used by a community it will adapt and change. Importantly, then, "the sign is a node in a network of relationships. The relationships are not determined by the sign; rather, the sign is the *result* of interacting relationships." (1998:39). The network metaphor, as it is used here, represents a way of thinking about the organization of large information structures or systems of knowledge. Indeed, Cilliers argues that through the lens of general theory of complex systems, "one would say that these dynamics of the system of language are a result of the way in which a system self organises in order to meet the needs of the community." (1998:40) Still, it is important to appreciate the closed nature of the network as implied by Saussure's concept of *difference* – this is important as it provided the catalyst for a Structural Anthropology.

Lévi-Strauss

Lévi-Strauss' *Structural Anthropology* (1963, 1976) is significant as it extends Saussure's Structural Linguistic framework into a general paradigm for the social sciences. His central point in this respect is that kinship systems entail a similar 'language' as linguistic systems. Structural anthropology is best perceived as an effort to uncover the general laws or universal features of the social stratum. Like Saussure who identified the word as the key unit of analysis for linguistics, Lévi-Strauss' key unit of analysis is the kinship group – it is perceived as a fundamental building block of more complex systems (1963:48). Lévi-Strauss' application of the structural method to Anthropology revealed for him that any culture may be viewed as an ensemble of conscious and unconscious symbolic systems – language, marriage, law, art, science, and religion.

For Lévi-Strauss social phenomena could be studied on the same terms as linguistic phenomena – both are influenced by unconscious, underlying patterns. He argued that the structural method employed in linguistics, when used for the study of all social phenomena, could reveal certain relationships between these 'languages' and could therefore enhance our understanding of society. Thus the fundamental distinction between the structural approach to linguistics and the structural approach to anthropology is that the latter served to isolate the relations between systems such as language or kinship groups; whereas the linguistic project merely analyzed relations within the internally referential system of language itself. These two views differ in the respect that structural linguistics described a closed, internally referential system, whereas structural anthropology sought to reveal the patterns of association between systems. In both cases the problematic is the same – how does one isolate the deep unconscious structural codes that influence meaning and behaviour?

Here it appears that the network concept is used slightly differently, and it is accompanied by a different set of assumptions. For Structural Linguistics the network remains an internally referential system. For Structural Anthropology the network

implies a relationship between systems – it is therefore a more open conceptualization of a network. This is an important distinction because it provides a conceptualization of a network that is contingent upon local factors. These two characterizations are best perceived as 'static' versus 'dynamic' perceptions of network qualities.

Saussure's original application of the structural framework isolated language as a virtual system of differences existing outside of social context, and this approach was shown to be a unique yet inadequate theory of meaning as it negated social context. Lévi-Strauss' application of the structural model to social phenomena such as phonemic and kinship systems expanded the original framework by introducing an aspect of structural analysis lacking in Saussure's linguistics: namely the interaction between systems, as opposed to a single internally referential system. Nevertheless, Lévi-Strauss' adaptation of the structural method to the study of social relations similarly lacks an adequate account of human agency as an integral aspect of social change. Finally, we look to Ricoeur's structural hermeneutics as a refinement of the structural framework.

Ricoeur

Ricoeur's adoption of the structural framework is significant because it addresses language as *used*. Earlier structural approaches emphasized a deep unconscious structure but negated how this structure enables and constrains human social interaction. Ricoeur's project in general can be categorized under the general rubric of Interpretation Theory. Briefly, Interpretation Theory isolates the moment of *discourse* as the point in which we employ the 'systems' of language, to communicate 'structured' meaning. This approach acknowledges human beings as an integral aspect of the process of knowledge production. Two key texts will be addressed here: Ricoeur's 1974 text: *The Conflict of Interpretations; Essays in Hermeneutics*, and 1976 text: *Interpretation Theory; Discourse and the Surplus of Meaning*.

Ricoeur begins his interpretation of the structuralist approach by invoking Saussure's science of signs. The reader will recall that the sign is perceived as a duality, it consists of both a signifier and a signified. This science of signs is important for Ricoeur because the distinction between signifier and signified allow for two different kinds of analysis: phonological and semantical. He argues that this definition reduces language to a self-sufficient system of inner relationships. (1976:6) Through this view, language as discourse has disappeared. For Ricoeur, Saussure's science of signs excludes the primary intention of language, which is to say something about something; as he states: 'speaker and hearer understand this intention immediately'. (1974:84)

For Ricoeur the study of language should determine both a science of states of system – a synchronic linguistics, and a science of changes – a diachronic linguistics.[4] Saussure applies just the synchronic analysis, and hence, Ricoeur argues, change remains unintelligible to his project. (1974:81) Saussure's collection of signs

[4] *Chapter IV: Analysis of Print Communication* and *Chapter V: Analysis of Electronic Communication* address precisely this aspect of linguistic analysis through an examination of the 'state' of each system and of the significant changes in patterns of word use in each medium over the two year time period of the SOEIS project.

(difference) must remain a closed system in order to be analyzed, because change is not a part of this structural equation. (ibid:82) The essential point here is the closed state of the linguistic universe. For Ricoeur the "units of meaning elicited by structural analysis signify nothing; there are only combinatory possibilities. They say nothing; they conjoin and disjoin" (ibid:77). The structural linguistic approach as a theory of meaning is thus handicapped by its lack of diachronic analysis, and its inability to account for changes in the meaning system itself render it inadequate.[5]

Ricoeur's project sought to establish a theory of language that could account for changes in the structure of meaning. For Ricoeur a message is a temporal event, while the code is atemporal (as a synchronic system). Thus, a message is intentional because it is *meant* by someone, whereas the code itself is anonymous and not intended. In this sense Saussure's *langue* is an unconscious structure which can only be understood synchronically, in juxtaposition to *parole*, which is the intentional aspect of language and can only be understood temporally, and in terms of context.

Ricoeur also critiques Lévi-Strauss' structural anthropology. The reader will recall that Saussure's analysis lacked a diachronic dimension whereas Lévi-Strauss' addressed the notion of change over time. Ricoeur wants to appropriate this objectivity of structural anthropology for hermeneutic insight. Lévi-Strauss' anthropology provides Ricoeur with a dimension of analysis that Saussure's approach overlooks, namely diachrony. Lévi-Strauss' analysis was diachronic in the sense that he perceived kinship and phonemic systems as the primary building blocks laying the foundation for the development of more complex systems. In this sense, these systems reveal an opening of the objective, synchronic language system isolated by Saussure into a paradigm of social analysis that must contend with the temporal dimension as a *layering* of systems. Thus, Lévi-Strauss is important for Ricoeur's project because he outlined the relations between systems, not merely the interactions within a single system.

Ricoeur develops a new unit of analysis that contends with the fact that language is not only structural or systematic, it is *used*. Ricoeur substitutes Saussure's *parole* with the word *discourse*. *Parole*, he argues, can only be understood as residual effect of *langue*. The word *discourse* is intended to emphasize the importance of the fact that language is used in everyday contexts – that it is not an *effect* of the language system outlined by Saussure. Ricoeur makes this distinction to illustrate two points. First, although language may contain structural imperatives, mediated communication is not an effect of these structures, it is an action. Second, one must distinguish between semiology and semantics: between the sign and the sentence. (1976:7) The difference is this: the sign, as the object of semiotics, is merely *virtual*. The sentence, on the other hand, is *actual,* as the very event of speaking. Herein lies the importance of Ricoeur's distinction that discourse is an action that occurs as an event. For Ricoeur, "events vanish but systems remain" (ibid:9). Thus the act of discourse is not merely transitory and vanishing, "it may be identified and re-identified as *the same* so that we may say it again or in other words" (ibid:9). Discourse can thus be viewed as the act of repeatedly using the same systems in order to communicate, and it is in this sense

[5] See: Hjelmslev's *Prolegomena to a Theory of Language* (1943).

that it is eventful. Every message, for Ricoeur, has as the ground of its communicability the structure of its meaning.

Ricoeur's root concept in his reformation of parole as discourse is the word. The word is the atom of discourse. The word is important for Ricoeur because it occurs via discourse. It represents the *use* of language as a *system*, yet it simultaneously represents the conformity to an underlying *structure*. The sign system remains virtual, but the sentence occurs as an event. He explains: "[w]ords are signs in speech position. Words are the point of articulation between semiology and semantics, in every speech event. Thus the word is, as it were, a trader between the system and the act, between the structure and the event" (1974:92). With this reformulation of parole as discourse, Ricoeur has achieved a method of applying the structural model to language in a way that contends with the time dimension. The word for Ricoeur is at the "intersection of language and speech, of synchrony and diachrony, of system and process" (1974:95).

Ricoeur's Interpretation Theory entails several other key features. His theory of discourse goes further into an analysis of polysemy: multiple meanings. He argues that the word is a "cumulative entity, capable of acquiring new dimensions of meaning without losing the old ones" (1974:93). This implies that words are not only bound within the meaning system of language itself, but that their usage over time projects the system onwards. Thus, Ricoeur's concept of the word as the atom of discourse (parole), represents a unique application of the structural method. Ricoeur's theory of discourse describes meaning as an event; every message is determined by the 'structure of its meaning', and every message is communicated through the system of language. The act of discourse is thus perceived as the intersection between system and structure. That is, speech necessarily *uses* the language system in order to say something about something, and this suggests an action or human agency. In sum, Ricoeur's structural hermeneutics marks a shift from the two earlier structural approaches in the sense that it isolates the moment of social interaction as the locus of meaning. Ricoeur pinpoints the nexus: the moment we use words in discourse, but does little to explain the phenomenon of meaningful interaction itself.

Saussure provided an understanding of language as a system that exists regardless of context – knowledge and therefore meaning were perceived as both unchanging and transcendent. Lévi-Strauss' similarly conceptualized systems of meaning devoid of situated context, yet he did argue that one could address the interaction between systems, thereby suggesting a different notion of meaning – one that breaks down the notion of a singular internally referential system, thereby introducing a different notion of meaning systems. In this light, the comparison between the print and electronically generated information that is compared in this thesis can be understood similarly as overlapping communication systems. However, unlike Lévi-Strauss' approach, here we acknowledge no notion of transcendent meaning, but rather one that is contingent upon situated processes of knowledge production. Ricoeur provides yet another position whereby the notion of transcendent meaning is abandoned. For Ricoeur meaning is something that 'happens' via discourse (spoken or written), yet he falls short of making the poststructuralist argument for a meaning system entirely contingent upon the social. The notion that 'meaning' is something achieved via mediated communication is important here, as the empirical analyses to follow

assume this stance. That is, meaning is not assumed to exist *anywhere*, rather it is assumed to be an achievement obtained through the process of mediated communication itself. A central assumption in this analysis is that the traces left by communication can be examined to reveal the properties of particular processes of mediated knowledge production.

Poststructuralism

The distinction between Structuralism and Poststructuralism is similar to that between first-generation Medium Theory and second. In both cases the shift represents a rejection of the technologically deterministic bias in favour of an approach that addresses the centrality of human agency in processes of communication. By extension, both rely upon the deterministic framework of their predecessors. Structuralism and first-generation Medium Theory privilege structure whereas Second-generation Medium Theory and Poststructuralism abandon the notion of a transcendental deep structure, and address the *medium* as *used*. Generally, the shift in both cases represents a rejection of a purely structured approach for a contextualized approach contingent upon social interaction.

Derrida

This section will survey Poststructuralism as a tradition of thought with respect to its appropriation of the structural method, and the acknowledgment of the *subjective use* of language. Central here are the poststructural linguistics of Derrida. His work will be employed here for his notion of *différance*, as distinct from Saussure's difference. This reformation resembles Ricoeur's structural hermeneutics in the sense that it contends with the temporal dimension, and that it reworks Saussure's difference to address language as *used*. Derrida's deconstructive project provides a useful segue in this brief overview of the structural tradition, as his work critiques linguistics, anthropology, and hermeneutics alike. His project will be used here to the extent that it deconstructs the foundations of the structural method.

The reader will recall that Saussure's distinction between *langue* and *parole* divorced the system of language from the environment in which it is used. Language is perceived as a differential system of signs, in which each sign exists as both signifier and signified. Every sign signifies something: it refers to the thing that it represents, and it refers to a signified, to its differential value in the lexical system. It was argued that Saussure's signified refers to a transcendental realm – Derrida also argues that Saussure refers to an ideal meaning – we can understand Saussure's sign, signifier and signified as a meaning system which exists outside of situational context. Derrida reworks Saussure's system of signification to address the signified as an infinite play of meaning which does not refer to a transcendental signified. The reformation is such that the sign is composed of a signifier and signified, but in this case the signified represents the differential play of meaning in the time dimension, not an ideal, transcendental realm.

The work of Ricoeur and Derrida is similar in the respect that both theorists adopt Saussure's original method and integrate time into the equation. Ricoeur reworked parole to account for the fact that language is used; Derrida reworks langue to

reinstate time and social context as integral aspects of the meaningful process. In order to explain Derrida's *différance* as an extension of the structural method, I will review the three key theorists upon whom Derrida relies for this reformation. Saussure will again be critiqued for his negation of human agency, Rousseau isolates an important aspect of language; namely that the written word be perceived as a supplement of the *real* world, and Freud is reviewed for the concepts of libidinal deferral and the trace. These three theorists, as we shall see, provide Derrida with a conception of the language system that surpasses the original concept of difference.

Derrida clearly biases the medium of text. Structuralism biased text over speech in the sense that it physically contains the code of the language system, and thus provided a concrete object of study. But for Derrida, writing is particularly important for language analysis because it not only exists as a physically inscribed text but as a psychical medium as well. Derrida downplays speech; he views writing (as mental inscription) as older than the medium of speech itself. For Derrida all text is necessarily involved with larger inter-textual systems of meaning. Thus, all writing, whether physical or psychical, is interrelated. Meaningful relations are therefore inter-textual, signs *mean* in juxtaposition to each other and not through reference to an ideal form. Derrida's *différance* is self described as neither a word, nor a concept in the literal sense; *différance* refers to the overall system of intertextuality. (1982:3)

Derrida reworks Saussure's difference because it lacks an adequate account of how the subject's identity relates to language. For Derrida, Saussure's analysis suggests that: "language (which only consists of differences) is not a function of the speaking subject. This implies that the subject (in its identity with itself or eventually in its consciousness of its identity with itself, its self consciousness) is inscribed within language, is a 'function' of language, becomes a *speaking* subject only by making its speech conform to the system of the rules of language as a system of differences."(ibid:15) Thus, for Derrida, Saussure's formulation denies subjects of conscious agency; supposedly, they must conform to the rules of language in order to structure intelligible meaning.

Derrida turns to Rousseau for his concept of the supplement and to Freud for the concept of deferral; together these theorists provide him with the means with which to reformulate difference as *différance*. For Rousseau writing is a disease of speech, it destroys presence. The word or sign is perceived as a 'supplement' of the natural world. (1974:142) Derrida appropriates this concept and argues that as a supplement, the sign can be viewed as performing two functions. First, as a supplement, signs cumulate and accumulate presence; they represent something in their absence – the sign is a present absence. (ibid:144) But the supplement also supplements, 'it adds only to replace', it insinuates itself 'in-the-place-of' something else. The sign is also an absent-presence, it is a supplement of the thing itself. (ibid:145) The supplement is both the missing piece and the extra piece. This can be likened to the example of the space-time distanciation characteristic of text described above in the context of Medium Theory; the word (text) stands in place of something else, it represents stored information. From Freud's concept of deferral we can understand the supplement as a deferral of presence. Importantly, Freud employs the concept in terms of the trace – the mind is perceived as a network of unconscious traces, of deferred libidinal urges. This implies a continual deferral of the present.

For Derrida, Freudian theory suggests that traces represent a spacing and a temporization – a spacing in the sense that the sign system exists as a differential network of unconscious psychical traces, and a temporization in the sense that these traces represent a deferral of present instances. Freud's concept of the trace as a deferral, combined with Rousseau's concept of the supplement provides Derrida with the means to create a new approach to the study of the language system. The word *différance* for Derrida entails Saussure's difference, Rousseau's supplement and Freud's deferral. *Différance* is simultaneously a differing and a deferring; together these concepts indicate a system of difference that exists not only synchronically, but diachronically as well. Thus, *Différance* represents the breakdown of Saussure's distinction between the signifier and signified. For Derrida, *différance* erases this distinction so that the signified no longer refers to a transcendental meaning, it now refers to the system of unconscious differences as deferred signification. The borderline between the signifier and signified is erased.

Derrida's project can be understood to surpass a mere reworking of the structural paradigm. The differential marks of presence and absence that he isolated from Freud's work represent chains of words in written text, but they also represent chains of inscription upon the mind. In this view, whether writing is physical or psychical it still implies a deferred meaning – the use of the word invokes its temporal aspects; meaning is not a reference to a transcendental signified, it is bound within the network of physical and psychical inscriptions which refer to deferred meaning and deferred time. Thus, the present for Derrida is always supplemented; which is to say that the sign always entails the integration of a stored space-time envelope into the present.

Derrida's project provides a critique of signification as a whole; it is a critique of philosophy and its inherent constructivist project. In effect, Derrida's project is a critique of the metaphysics of presence. To clarify, *différance* is perceived as reworking not only the linguistic and anthropological structural paradigm, but it reveals the very nature of a sign's presence or absence as a supplement of the *natural*. By extension, the *use* of signs invokes this temporal aspect of the unconscious network of differences, and thus for Derrida we cannot be fully present when we signify. He argues that *différance* suggests that signs both differ (from each other) and defer (the present). The use of the sign thus defers the writer's present context, and the use of the sign supplements the subject's presence. For Derrida this means, in effect, that there is no such thing as a *pure* presence: experience is always deferred. Inasmuch as we can write 'I experience' means that we invoke the temporal dimensions of the words 'I' and 'experience', including all of the ways in which the words link with others, have been used before, and have accumulated meaning. The use of words therefore supplements a previously deferred presence in place of the 'present presence'.

It can be concluded therefore, that Saussure's difference indicates that the subject is created through conformity to the rules of language, and that Derrida's *différance* acknowledges that meaning exists through experience. Meaning therefore demands an experiencing subject. Moreover, *différance* suggests that subjectivity and inter-subjectivity 'happen' via signification. For Derrida there is no outside of intertextuality – all signification is bound within the same network of differential relations, including identity. The concept that all signification is bound within the

same network of differential relations resembles Meyrowitz's contention that social reality can only be understood in juxtaposition to society's information networks. Hence, for both Derrida and Meyrowitz all signification including social identity is bound within the meaning system.

Derrida argues that self awareness is bound within the realm of signification, and in this sense strongly resembles the totalizing view of mediation that first generation Medium Theory portrays – that there is no memory or form of communication that is not at the same time within mediated experience. Derrida's argument seems to be that all memory and communications entail media: he believes that all signification can be viewed as an ideal deep structural realm which, by its very usage, allows the basis for subjectivity and inter-subjectivity. *Différance* suggests that subjectivity exists in the interval between spacing and temporization – the subject is therefore realized through discourse. Meaning, in this view, is constantly deferred.

Derrida's attempt to transcend the Western philosophical project suggests that there is no experience of experience outside of writing – no experience outside of an inscribed medium that predates the use of speech. We can understand Derrida's reworking of the structural approach as an extension of difference to incorporate aspects of subjectivity in the sense that text is viewed as a mentally inscribed medium. To be sure, we reflect upon individual memory that arguably has a textual dimension, and in this sense Derrida has returned parole into the structural equation. But he argues, in effect, that parole is intricately bound within the language system. That is, in everyday social interaction we reference a deep structure of signification in order to communicate, but Derrida's *différance* indicates that the present moment of interaction is never a truly 'pure' present, because through speaking, reading, and writing we invoke the deferred presence of the sign. To state this another way, Derrida suggests that parole (the use of media) is inscribed within langue (deep structure); or yet another way, meaning is determined not only through the actual situation, but through the weave of intertextual relations that exist both psychically and physically. Derrida's deconstructive project is to introduce a science of language that contends with the phenomenon of a de-centred, supplemented present that is laden with historicity.

Generally speaking, Derrida offers another symbolically oriented approach that provides us with another metaphor for knowledge or meaning systems. For Derrida, unlike his Structuralist counterparts, meaning does not exist transcendentally, nor is it an entirely socially dependent phenomenon. Rather, meaning is perceived as an open construction that exists not *just* in the moment of discourse (as Ricoeur would have it), but that is an achievement of the co-ordination of a range of different intertextual relations that exist *psychically* in the minds of those communicating and in the shared cognitive realm of those communicating, and *physically* in books, videotapes, Compact Discs, etceteras. The notion of meaning as presented here through the work of Derrida brings us closer to a notion of meaning and knowledge that is contingent not only upon media for communication, but upon participating parties to 'achieve' meaning; it is therefore a more superior stance from which to position this work, but one that was only possible through the insights gained from Saussure, Lévi-Strauss and Ricoeur.

Structuration Theory

Giddens

The social theory of Anthony Giddens provides a unique approach to understanding the dynamics of mediated communication. Spanning some twenty years, Giddens' project can be understood in part as an endeavour to reveal the importance of media to processes of human social interaction. The relevance of Giddens' project to this study cannot be understated, as it provides an extension of Medium Theory, a rejection of the Structuralist conception of an unchanging deep structure, and a critique of Poststructuralism with respect to the subjective and phenomenological aspects of social interaction. This section will review Giddens' contribution through an analysis of his extension of the space-time distinction into a general theory of space-time distanciation, and will then address Structuration Theory as a critique of Structuralist and Poststructuralist assumptions through a description of his concept of the *duality of structure*.

Medium Theory, and the time-space geography of Hägerstrand (1976) and Pred (1981) among others, provided Giddens' with the general concept of space-time distanciation. As argued above in the Medium Theory section, the distanciation between space and time is a result of media usage, and this phenomenon has a long history of affecting human social interaction. For Giddens, this concept is integral to understanding the operation of the social system. Giddens argues that virtually all experience is mediated, and most particularly through language (1991:250). He states that language is an evolutionary universal, and that all media are central to social interactions (1984:264). Taking this concept as a core element of human social interaction, Giddens reveals the role of the information medium in the continuity of day-to-day social practices:

> The storage of authoritative and allocative resources may be understood as involving the retention and control of information or knowledge whereby social relations are perpetuated across time-space. Storage presumes *media* of information representation, modes of information *retrieval* or recall and, as with all power resources, modes of its dissemination. Notches on wood, written lists, books, files, films, tapes – all of these are media of information storage of widely varying capacity and detail. (...) Information storage, I wish to claim, is a fundamental phenomenon permitting time-space distanciation and a thread that ties together the various sorts of allocative and authoritative resources in reproduced structures of domination. (1984:261-2)

Giddens argues that human beings have long employed media for information storage, and that this usage has influenced the very nature of social organization. He argues that this phenomenon has existed since the pre-modern, oral stage of humanity, in which memory was virtually the sole repository. Like Innis and McLuhan, he believes that to this day media continue to be the conduits for structures of domination. (ibid) Viewed historically, Giddens contends, media (used for information storage) distanciate space and time, and yet simultaneously bind distanciated space-time.

The distinction between structure and system introduced in the Structuralism section above suggested that the use of systems throughout time (such as kinship or

language), when analyzed, reveal deep structural patterns. This notion was extended through Postructuralist conceptions of agency and meaning via Derrida's linguistic project. Similarly, Giddens addresses the concepts of system and structure but develops the distinction into a far more dynamic conception of their interrelation. For Giddens, structure is a 'virtual order' of rules and resources which *enable* and *constrain* human social interaction.

> Structure thus refers, in social analysis, to the structuring properties allowing the binding of time-space in social systems, the properties which make it possible for discernibly similar social practices to exist across varying spans of time and space and which lend them 'systemic' form. To say that structure is a 'virtual order' of transformative relations means that social systems as reproduced social practices, do not have 'structures' but rather exhibit 'structural properties' and that structure exists, as time-space presence, only in its instantiations in such practices and as memory traces orienting the conduct of knowledgeable human agents. (1984:17)

The distinction between system and structure previously outlined is thus improved through Giddens' formulation, precisely because structure is not viewed as a stable entity which stands apart from, and yet determines, the social system. Rather, structure is perceived as a set of rules and resources which are organized as properties of social systems, while systems are perceived as the *reproduced* relations between individuals or groups which are organized as regulated social practices or routines. Structures, for Giddens, are the rules and resources we access through media, they are the deep structure that we draw upon for social system reproduction. For Giddens, the structural properties of the social system are both dynamic and transformative. Note that structure here refers not to external, physical structures, but rather to instantiated social practices and to psychical memory traces in the individual.[6]

This reformulated distinction between system and structure lies at the heart of Giddens' theory of Structuration. The relationship between structures as rules and resources, and systems as regularized social practices structurally enabled and constrained by said rules and resources, is perceived as a reciprocal process of transformation. The word that Giddens uses to describe this reciprocity is structuration; literally – structure and action. Structuration reveals the conditions governing the continuity and transmutation of structures, and the reproduction of social systems (1984:25). Mediated human social interaction is thus perceived to be both enabled and constrained through the structural properties of social systems, and this interaction simultaneously transforms both the structural properties and the operation of the social system. The key issue is how society is integrated: social interaction is perceived to operate as a primary level of 'building blocks' whereby the institutional structure of social systems is articulated (1984:89). Giddens refers to this as the *duality of structure*. In what follows we address Giddens' concepts of social and system integration as a metaphor for the duality of structure.

The duality of structure is best contextualized with the concepts: *social integration* and *system integration*. The differentiation between social and system integration is

[6] 'Structure' for Giddens, is used in a Durkheimian sense: it is considered more internal than external. (1984;25) This approach is similar to the Medium Theory of McLuhan, Ong and Meyrowitz. Media are considered physical as well as psychical (mental inscription). The notion of an internal structure is also addressed in Derrida's work as an unconscious network of differential relations of signification.

essential to understanding the relevance of Giddens' project to this study. Social integration can be perceived as the micro aspect of the duality of structure as it presumes reciprocity between co-present actors. By contrast, the macro aspect: system integration, indicates reciprocity between actors or collectivities across extended space-time. An important feature of the macro aspect of the duality of structure is the view that rules and resources are recursively involved in the reproduction of social relations and institutions. Institutions, by definition, are the most enduring aspects of social life (1984:24).

System integration relies upon societal integration via situated human agency. The question that this position evokes is how do social and system integration overlap and relate to one another? Giddens' perspective on this problematic is clear:

> The 'problem of order' in the theory of structuration is the problem of how it comes about that social systems 'bind' time and space, incorporating and integrating presence and absence. This is closely bound up with the problematic of space-time distanciation: the 'stretching' of social systems across time and space. Structural principles can thus be understood as the principles of organization which allow recognizably consistent forms of time-space distanciation on the basis of definite mechanisms of societal integration. (1984:181)

Via space-time distanciation the media of societal and system integration become quite distinct forms of integration. With the immediacy of speech and gesture both the social and system aspects of existence maintained continuity. With the increasing predominance of physical, external forms of media for information storage, the media that integrate the social (gesture, speech) are divorced from the media which integrate the system (text, institutions, internet). Giddens describes this process as an increasing differentiation between social and system integration.

Giddens is explicit about social and system differentiation as a three stage process. He describes tribal society (oral cultures) as characterized by a fusion of social and system integration, class divided society as a differentiation of social and system integration with respect to the rise of the state (via the distanciation of space and time associated with text), and class society as a differentiation of social and system integration with respect to the centrality of the state in modern culture. (1984:181-2) It is important to note, however, that Giddens does not describe this threefold classification as an evolutionary scheme whereby oral cultures are characterized as 'not yet' having disentangled social and system integration. Rather, the differentiation between social and system forms of integration is a causal result of the development of physical media, and of the distanciation between space and time.

For Giddens, modernity is a result of the distanciation between space and time fostered by physical media. The separation of the media of social and system integration is due first and foremost to the technology of writing. Giddens' concern in highlighting this distinction is to articulate the necessity of realizing that our current situation of globalized social relations via electronic media reveals not a stage beyond the modern, but rather a mature, or late modernity through which social relations and institutional form become stretched across the planet. Giddens' discourse on Radical

Modernity[7] is particularly geared towards uncovering the implications of space-time distanciation. This discourse is distinct from his theory of Structuration. Giddens' concepts of disembedding and reembedding concern the means through which the development of modern institutions is due to a flux between mechanisms of dispersal and integration across space and time.

Structuration, as indicated, provides the concepts of the duality of structure and the differentiation between the media of social and system integration. The concepts of disembedding and reembedding as the key features of Giddens' Radical Modernity, however, can enhance an understanding of these phenomena with respect to media and distanciation. The reader should be clear that these discourses are distinct, and are intended to highlight quite different aspects of Giddens' overall project. What follows is a discussion of disembedding and reembedding in order to bridge Giddens' theories which pertain to mediation, with those which directly critique the structuralist and poststructuralist assumptions regarding the symbolic aspects of mediated communication. Briefly stated, disembedding can be understood as the extraction of social relations from immediate space-time locales due to an increased distanciation of space and time through physical media. Reembedding is best understood as the reinsertion of displaced social relations back into specific space-time locales. Both components are integral to processes of social communication.

For Giddens the two key elements of social communication are *talk* and *cultural objects*. Everyday interaction between people involves face-to-face communication, and *talk* is the term Giddens' uses to describe such processes. C*ultural objects*, by contrast, can be considered as something that facilitates communication. Both talk and cultural objects reference deep structure; the contextuality of action is thus determined by both talk and cultural objects, and also by *what* is referred to in the course of interacting: deep structures of signification. Recall that Saussure's *langue* was interpreted as a deep structure; *parole*, by contrast, is the action or use of language. Cultural objects and talk are both aspects of parole, but the difference is that talk refers to everyday communication whereby speech is employed in the course of exchange (this also includes a whole range of non-verbal modes of expression), and that it is always context bound. By contrast, cultural objects act as extended forms of signification across space and time, and are not bound to specific space-time locales. He describes cultural objects as extended forms of signification; they are distinct from objects in general because they carry embedded meanings. (ibid:215).

Cultural objects are defined by three key characteristics. They require a durable medium of transmission, such as text, video or even memory. They require a means of storage as an encoding of information, and they require a subsequent means of retrieval or decoding of stored information. (ibid:216) Using the example of human memory as a durable medium of transmission, the encoding and decoding features would be equivalent to the ability to store and recall the memory using language.

[7] Giddens' (1991) discourse on Radical Modernity is a direct critique of Postmodern theorizing – particularly Lyotard's notion of the disintegrating grand narrative of history. Giddens' criticism is that although we have certainly gone beyond what we consider to be a modern era, we are mistaken if we assume that we are in an era of *post*modernity because the institutions upon which modern culture is grounded still persist.

What is key to understanding this framework is realizing that talk and cultural objects are not mutually exclusive, indeed, cultural objects can only be understood in relation to talk. "The significance of cultural or informational objects is that they introduce new mediations between culture, language and communication. In talk the agent and the setting are the means whereby culture is linked to communication (ibid:217). Thus, the contextuality of action defined as the moment in which talk or cultural objects reference deep structure in the course of day-to-day action, and within this setting participants, or agents, continually monitor their own and each other's actions.

In addition to the mutual monitoring involved in contexts of co-presence, the cultural objects referenced through talk are themselves monitored. The interpretation of cultural objects occurs, however, without certain elements involved in co-presence. For example, turn-taking rules govern the context of interaction, allowing only one person to speak at a time in order to effectively communicate, talk is therefore inevitably serial. (1984:77) But, the interpretation of cultural objects is not restricted by the same constraints as talk. Cultural objects imply certain sets of reception habits, and they are insulated from turn-taking mechanisms. "Since language as 'carried' by cultural objects is no longer talk, it loses its saturation in the referential possibilities which language has in the contexts of day-to-day action. As a visible or recoverable trace, separated from the immediacy of contexts of talk, the signifier becomes of peculiar significance." (1987:217)

Thus, language which is encoded into cultural objects loses its self-reflexive characteristics, but it acts as a recoverable trace that becomes present with use. That is to say that when language is stored in cultural objects it loses the self-reflexive characteristic of language as used by human agents. Giddens' statement that the signifier is of peculiar significance therefore indicates that the consumer is more important than the producer of cultural objects in the achievement of meaning (1987:216). Cultural objects act as recoverable traces of disembedded space-time contexts, which become present (reembedded) through talk, and this process is a disruption to the flow of action.

Giddens' appropriation and reworking of the concepts langue and parole marks a significant shift from the structural approach that tended to bias the code (deep structure) in the search to 'locate' meaning. The reworking is significant because it rejects Saussure's original negation of context in favour of an approach that places the context of interaction at the center of analysis. Giddens describes talk as the moment in which reference and meaning interlace (1987:211). To clarify: talk is the moment in which reference and meaning overlap as it references both the everyday situation and cultural objects. Meaning therefore exists in the moment background structures of signification are referenced through talk or cultural objects in the context of the situation.

Talk entails an ongoing monitoring process in which space and time are disembedded through reference to cultural objects, and this indicates that as an aspect of social interaction, cultural objects contain a different space-time than the current context of interaction. Talk is therefore of key importance when considering 'meaning'. Meaning is always dependent upon the recursivity of talk, and upon discursive

consciousness as the ability to talk about; meaning is always dependent upon the contextuality of action.

The implications of this reworking of the structuralist approach to meaning has far reaching implications for social theory. Giddens' negation of Saussure's langue bias in favour of a context-based approach indicates the importance of day-to-day interaction in the determination of meaning. Social interaction alters the organization of, and reference to, deep structure. Meaning is no longer assumed to exist entirely in the deep structure (as Saussure argued), nor does it exist just in day-to-day interaction; rather, meaning is a product of the combination of talk and cultural objects as references to deep structures of signification (rules and resources), and of monitoring and reembedding. This is a central point which grounds the following analyses of the SOEIS media environment – as argued by Derrida, the traces left by said communication contain evidence as to the biases of the respective media used to exchange information.

Giddens states that all social interaction is characterized by both intended and unintended consequences of action and these operate in a feedback fashion (1984:27). Each action is performed in the face of unacknowledged conditions, and each action yields unintended consequences. This represents an effort to map the dynamics of social interaction at the level of the individual. The deep structural aspects of mediated communication is represented by the unacknowledged conditions of action, and the unintended consequences of said (inter)action. The SOIES communications can be understood to have operated in a feedback fashion whereby new information was obtained and contributed thereby creating a new information environment in which the SOEIS members operated. But what must be accounted for is *that* element of the communication whereby communications are misinterpreted, or have different consequences than intended. The situation in which the SOEIS communications operated can be understood as a unified information flow with variations in its composition. Elements such as time (two years) and structure (project plan, milestones, reports) influence the ways through which information is communicated; likewise, variations in intent and variation between print and electronic media biases each played a role in the creation and maintenance of this complex system.

The networked aspects of mediated communication, when viewed through the lens of Structuration Theory, indicate more dynamic and transformative relationships than those perceived through the lens of Structuralism and Poststructuralism. The agent, as the counter-concept to the limited notion of the subject articulated in the poststructuralist analyses, indicates a more operative theoretical position with respect to the nature of mediated communication itself. Relevant to this analysis is the difference between social and system integration. Interpreted literally we can understand SOEIS communications to fulfill both integrative modes. The communications of the group served to coordinate individuals and unify efforts to produce a worthy final product, but in the very act of doing so the larger science system is supported, legitimized and maintained as well.

However, where Structuration Theory gains in its weaving together structure, action, time and media, it fails in providing a useful model whereby said communications can be analyzed and compared. The present study requires theoretical bodies that engage

the network metaphor in a way that suits the study of differences in mediated communication – specifically approaches that contend with modelling mediated processes, rather than symbolically oriented approaches. Actor Network Theory provides such a theoretical position that contextualizes the interrelation between actors and, arguably, the disembedding and reembedding processes evident in SOEIS project communications.

Actor Network Theory

Actor Network Theory (ANT) provides this analysis a perspective similar to that of Medium Theory and the Structural positions outlined above in that the theoretical bodies share a common emphasis on outlining networked relationships. What differs here is that ANT is less focused on the symbolic aspects of mediated communication, in favour of modelling its properties. Moreover, ANT has been used in the past to theoretically ground textual analyses of contingent and emergent networks of scientific discourse (Callon 1986, Latour 1992, Wise 1997). In this respect, ANT presents a way to conceptually link the results of print and electronic keyword analyses, and indeed, the publication and mailing list analyses as well.[8]

ANT is perhaps best understood by introducing the major theoretical flaws it tries to avoid. Two schools of thought are relevant here: Medium Theory and the Social Construction of Technology (SCOT).[9] The primary criticism of Medium Theory is that it is technologically deterministic. Medium Theory has a tendency to downplay social aspects of technology in favour of the technological. By contrast, the primary criticism of the SCOT is that it is socially deterministic, favouring social aspects over the technological. The ANT attempts to bypass both of these 'determinisms' by treating human actors, natural phenomena, and technology on the same level of analysis. This is achieved by reducing all elements into the same analytical vocabulary and then positioning them into a network of relations. In a word, an actor network is a means of positioning all of the factors relevant to the study of a particular social-technological relationship, by reducing them down to relatable elements – as actants.

Callon

For Callon (1987), the ANT operates on the principle of two mechanisms: *simplification* and *juxtaposition*. *Simplification* implies the reduction of all factors into relatable elements, and *juxtaposition* (like Saussure's difference) implies a network of associations. He argues that it is possible to outline the network by using sequences of points and lines, through which we view each point as a network that in turn is a series of points held in place by their relationships. The point is not, as in sociology, to emphasize a particular type of element, rather it is to *discover* the pattern of forces as these are revealed in relationships between different types of elements. The ANT,

[8] Importantly, the print and electronic communications of the SOEIS project are intended for different audiences; respectively: the European policy environment, and SOEIS members. ANT assists us in not only bridging this gap, but by drawing connections between the other communicative dimensions of the research project.

[9] For an introduction into the central tenets of SCOT, see: Pinch & Bijker (1987).

therefore, is a method that seeks to deal with the social, economic, technical, natural and scientific aspects of technological development by using the same vocabulary.

Importantly, Actor Network approaches are often used to describe network features of text; as Callon, Courtial & Laville (1986) argue, word and co-word analyses can be framed conceptually with actor-network approaches. They state that "by having recourse to the quantitative, it thus becomes possible to map the degree to which the efforts of actors to build their worlds are met with success. The maps present a pattern of translations that arises from the interaction between the efforts of many actors."(1986: 225) The suggestion here is that it is not the content that 'makes' the relationship but rather the nature of the interrelationships themselves that determine the outcome of the communication. ANT thereby provides this study with a metaphor to aid the weaving together of the four SOEIS communicative domains, and in understanding the network architectures evident therein. ANT enables us to conceptualize the complex of networked relationships implied with research projects – the network concept provides a means of understanding the role of media in integrating people via texts and emails, thereby forming networks and enabling continued patterns of relation.

Latour

Latour's principle of symmetry provides us with another rich example of an Actor Network Theory. He argues that: "networks of associations replace both the content of science and society. The growth of networks through translations replaces differences of scale between micro- meso-, and macrolevels." (1992: 275) The notion of translation is important in conceptualizing networks as an emergent phenomenon – they are always in the process of being constructed, they are always in transition, always becoming. From a macro perspective, Latour's actor-network description aims to harness that aspect of pan semiotic communication that exists above and beyond individual action (Hagendijk, 1999). In a local sense, networks of words and symbols are given factors in social interaction. From a mapping perspective it is the similarities and differences between these networks that are of interest. Latour's position that actors contribute different things in different contexts and at different times is relevant to our analysis. Accordingly, the SOEIS communications are mapped as networks of translations that are expected to be similar due to the commonality of the discourse exchanged through each medium, and to differ given the biases of each medium employed for the communication.

Wise

Wise argues that the ANT perspective "stresses both the *contingency* of networks (i.e., they are not determined, permanent or universal) and their *emergent* qualities" and that the approach focuses on "real-time analyses, seeing how the network unfolds and transforms from the perspective of one of its actors." (1997:32) The analysis of the SOEIS communications is performed in a similar fashion, but importantly, the perspective taken here is that the unfolding or emergence of the network is seen through the lens of the *medium* as an integral *actor* in these processes of communication. Wise criticizes the ANT theorists for an inability to deconstruct the ways that capitalism and imperialism continue to dominate, and suggests that we are given a methodology for tracing the multiplicity of actors that constitute networks, but no sense of what to do with them. That perspective motivates this analysis to engage

ANT using the strategies they employ to map social processes, but to do so in a way that focuses on the nature of inter-human communication as necessarily mediated.

The overview of Saussure's Structural Linguistics revealed that the network was perceived as a closed set of relations in which each element has meaning with respect to how they differ. By extension, the ANT notion of juxtaposition suggests a similar interpretation – elements only 'mean' in terms of how they differ from (or arguably, relate to) others as processes of translation. Recall that the overview of Lévi-Strauss' Structural Anthropology identified a qualitatively different network metaphor – many networks that can be compared for their shared, inherent structural features. In this sense the ANT resounds more with Strauss' structuralism. But importantly the ANT views the network as contingent and as emergent, not static nor transcendental. Thus, the linguistic and anthropological approaches sought to uncover what they considered an unconscious structure of difference (which by definition can never be fully observed). The network metaphor conceived within ANT is neither transcendent nor non-observable, it is concretized and observable. By contrast, the network metaphor employed by Systems Theory, as described below, suggests a way of theorizing both observable and non-observable networks.

Self-Organization Theory

Like Medium Theory, Systems Theory is best understood as having two distinct generations. First order Systems Theory can be traced back to the work of von Bertalanffy (1968), Wiener (1948, 1954), Shannon (1948), and Parsons (1951, 1971). While each approach is unique, they share a static notion of network that is comparable to the Linguistic and Anthropological use of the metaphor. The shift from first to second-order is best characterized in terms of differing notions of the network metaphor. In the case of the latter, the network is more similar to the ANT notion of contingent and emergent networks. Second order Systems Theory introduces a dynamic network metaphor. Theoretically it is based on Luhmann's reworking of Parsons' Social system (1982, 1986, 1990) using the evolutionary metaphor from the theory of autopoiesis (Maturana, 1980; Maturana & Varela, 1987). Luhmann conceptualizes society as composed of interactions, or communications, not individual actions, roles, or persons as Parsonian first-order Systems Theory describes.

Luhmann

Luhmann (1982) introduces Maturana and Varela's concept of autopoiesis as a way to conceptualize the self-organizing properties of mediated communication. This method of black-boxing the social (the micro-action level of individuals) permits a higher-order analysis of the distribution of mediated communications. Luhmann's concern is to shift focus from the number of agents communicating to the complexity of communications among agents. He argues that the "system of society consists of communications. There are no other elements, no further substance but communications. The {*sic*} society is not built out of human bodies and minds. It is simply a network of communication." (1990:100) The theory suggests that society be understood as self-organizing. Systems are perceived as closed to their environment

and via self-reflection they change their operations for future rounds of communication.

Thus, for Self-Organization Theory individual actors are not of key concern – what we examine are the networks within which we operate. Luhmann (1990) describes social interaction as a recursive operation that systemically (re)organizes society, and in this way he essentially argues that one should not specify the people involved in a communications network, but rather the communications involved in systemic relations. This perspective is relevant for this analysis because it is the role of media, not people, that is understood here to be central to social interaction and more specifically, to the operation of the SOEIS project communications.

Luhmann's conceptualization is unique because it contends with both observable and non-observable phenomena. Collectively we act upon the world and in this sense there is an observable output to our actions, but for Luhmann the key is how these interactions operate recursively and therefore systemically. From a macro perspective individual actions or communications collectively make up the social world, and this is perceived as the very means whereby the social system recursively produces and reproduces itself. This reflexivity (as opposed to the agency described by Actor Network and Structurational approaches) is precisely what differentiates First from Second-Order Systems Theory. Internally, it is argued, the social system introduces new system / environment distinctions through the functional differentiation of its subsystems, which in turn permits an enhanced capacity for societal evolution through internal simplification. This can be likened to the ANT notion of simplification. However, the network implied with the recursive and virtual nature of Luhmann's evolutionary systems differs radically from the conceptions of relatively flat networks outlined above.

Luhmann argues that the system of society consists of a network of communication – all is reducible to communications. Thus, what is revealed by Luhmann's project is a virtual system like Saussure's transcendental realm of differentiation. Both suggest a virtual network of associations operating beyond any individual action. The primary difference being that the Saussurian, Lévi-Straussian and Derridean networks are based upon closed or fixed networks, whereas the dynamic networks described by Giddens, Actor Network theorists, and Luhmann are participatory and based on open and recursive networks.

Leydesdorff

For Leydesdorff (1996, 1997), the concern is to operationalize these virtual systems into transitional models – he engages Luhmann's theory by analyzing communication networks between scientists as self-organizing. The theory is operationalized by plotting actors and communications as row and column vectors in a matrix. The matrix is conceived as a three dimensional model in which time (dimension three) is just another dimension of the complex system. He argues that if one "represents communicating actors as the row vectors of a matrix, communication finds its origin in the co-occurrence of these vectors along the column dimension. (1996:4) Thus, "each action with reference to an actor can be considered as a communication with reference to the network. While the uncertainty is relational in terms of the actors involved, it has a position in the network. In other words, the network is spanned in

terms of relations, but it develops a specific architecture in which each action has also a position." (1996:2)

Print and electronic media can be understood in this context as two independent but overlapping communication technologies; the theory of self-organization will be employed to describe how these two media are mutually implicated as a single operation of the system of communication. Collectively these perspectives provide useful tools for conceptualizing the dimensions of the SOEIS project as a complex network of communications which have evolved over time via self-reference. Generally speaking, Self-Organization Theory is useful to our project as the phenomenon of project communications can be seen as operations through which knowledge is recursively produced via collective interaction. Like Medium Theory, the Structural Tradition, and ANT, Self-Organization Theory helps to frame the network dimensions between mediated communications (i.e.: words, publications, threads) as our key units of analysis. More importantly, Self Organization theory provides a means of conceptualizing the largely unobservable (by definition) system of communication by observing patterns in the observable phenomena.

Self-Organization Theory is used to contextualize and describe the systemic properties of SOEIS print and electronic communication. The analytical procedure is informed by theoretical consideration, in the sense that individual actions or communications are understood to collectively behave in a systemic fashion, depending upon one's frame of reference. The statistical technique has been used to determine critical transitions in scientific communication (Leydesdorff, 1995), and in the evolutionary performance of selected transportation technologies (Frenken & Leydesdorff, 2000). Here we aim to identify systemic behaviour by observing the print and electronic datasets as a time series to determine if there have been significant shifts in the collective word use, journal publication behaviour, and mailing list dynamics of the SOEIS participants. With Self-Organization Theory we lift the notion of information network from local actors and actions to a next-order perspective that treats word and co-word patterns, journal publication, and thread size and frequency as fingerprints of the recursive operation of the SOEIS communications system.

The Theoretic Triad

Each of the theoretical perspectives reviewed here provide a window upon the dynamics of mediated communication. Each approach emphasizes a networked dimension; using this commonality they are best understood collectively as a cohesive framework on which the following analyses and interpretations were based. Clearly each helps frame the context of the analysis of the four dimensions of the SOEIS research project under analysis, and each lends a perspective that permits a more detailed description of the distinction between Mode I and Mode II knowledge production. Together, these theoretical bodies frame this analysis in the sense that the node through which they intersect is the notion of mediated communication: the observation of SOEIS Communications achieves a different meaning with each perspective.

Medium Theory sets the parameters of the various media under study and establishes a means of comparison between the content of the project communications (in each medium) over the course of the SOEIS research project. The Structural Tradition provides us with network and meaning metaphors with which to conceptualize meaningful exchange between SOEIS members. Actor Network Theory grounds the analyses – the distribution of actions (words used, publications, threads) in the datasets. Finally, Self-Organization Theory provides the evolutionary conceptualization through which we examine the relationships between time segments to identify critical transitions in system operations, as well as measure differences between the print and electronic word transmission and occurrence distributions.

In general, the group participation of the SOEIS members can be viewed as a historical phenomenon comprised of a complex of communicative events. These interrelationships can be conceptually organized using the *Architecture – Network – System* triad. This complex network is understood to consist of individual actions or traces which by definition achieve network formations which may behave collectively in a systemic fashion. These theoretic approaches frame the analyses and should be considered as central to the definition of *dynamic network* as described here. The *architectural* dimensions suggested by the Medium Theory notion of the information network, the contingent and emergent *network* metaphor from ANT, and the notion of a *system* of observable and unobservable phenomena from Systems Theory offer this dissertation a unique combination of perspectives. This theoretic lens thereby provides a central position from which to engage the subsequent analyses. The respective analyses of print communications, electronic communications, journal publication and the mailing list environment are carried out and interpreted using the model: the *Architecture – Network – System* theoretic triad.

Finally, the metric approaches described in *Chapter I: Introduction – Key Concepts*, and elaborated upon in *Chapter III: Materials & Methods* are performed and interpreted in *Part II – Analyses*. Using the theoretic triad as the dissertation heuristic, the various dynamic network conceptions contained herein provide a rich backdrop onto which SOEIS project communications can be analyzed and understood. Each analysis takes as its focus the architectural parameters of the communication under study, the apparent network of interrelationships, and its subsequent systemic dimensions. In this way we aim to reveal virtual networks of interconnectivity beyond the comprehension of any individual actor. The triad frames this analysis by enabling a comparison of features across different datasets of different communications. While the theoretic claims may appear incommensurable, it is in their interrelation that the value of an interdisciplinary framework becomes clear. This combination of *Architecture – Network – System* into a triadic lens enables a means of using both symbolic and modelling approaches to understand the dynamics of mediated communication.

Chapter III: Materials & Methodology

Introduction:

This chapter describes the research project selected for the analysis: the Self Organization of the European Information Society (SOEIS). The Fourth Framework Programme of the Targeted Socio Economic Research (TSER) Research Programme of the European Commission is first outlined and then the communicative features of the SOEIS research project are specified. The chapter will also provide an overview of the methodological approaches employed in this study; the project communications elected to be analysed are described in juxtaposition to the specific metric approaches used for each analysis. The theoretical relevance behind each distinct metric analysis is then outlined. Finally, expectations concerning the impact of ICT on processes of knowledge production are formulated and formalized into an overarching research question. In principle the techniques developed here could be used for understanding similar processes of knowledge production in other academic, government, or industrial contexts.

During the period 1994-1998 the 4th Framework Programme covered all the research and technological development activities funded by the European Commission. In all, 13,215 million Euro were contributed to the achievement of several primary goals. The explicit aims of the TSER framework were to facilitate the integration of technologies into society, and to anticipate future priorities, emphasizing three main areas of relevance.

The first was an effort to evaluate Science & Technology policy options with the aim of developing a workable science and technological development policy for the European Union (engaged via technology forecasting, assessment, and development). The second emphasis was research on education and training to improve these systems to ensure currency with technological progress for long-term economic and social development. TSER funded research thereby concerned the knowledge basis for new education and training technologies, the quality of education and training systems, and new forms of teacher-pupil interaction. A final emphasis was placed on research into social integration and social exclusion in Europe in order to develop knowledge and create instruments for combating social exclusion. Economic mechanisms (among others) related to social exclusion were analysed and compared with various integration policies pursued in Europe. This contribution was expected to enable the development of a shared knowledge base for the evaluation of science and technology policy options, to improve education systems and to develop an education oriented society, and thereby provide better and more comprehensive knowledge of the social impact of European integration. In part, this study aims to assess the dynamics of a TSER funded research project, but more generally it aims to reveal central issues concerning the role of media in this process.

The Case: SOEIS

As indicated, the research project selected for analysis was entitled: Self Organization of the European Information Society (SOEIS). The SOEIS research project was funded through the Fourth Framework of the TSER Research Programme of the European Union. It was selected because it operated as an international collaborative research effort that used both electronic and print media to communicate similar information and thereby exhibited features of both Mode I and Mode II types of knowledge production. Additionally, similar to the priorities of the present study, the SOEIS was theoretically oriented towards the problematic of analyzing and understanding the dynamics of the (European) Information Society. These features make the SOEIS an excellent and extremely relevant site to measure the differences between the relative impacts of print and electronic media on processes of knowledge production.

The SOEIS project should be understood to have entailed a reflexive analysis of the evolving Research, Technology and Development (RTD) research system. The present analysis of the project should therefore be understood as both infra-reflexive (with myself as a participant), and as a hyper-reflexive look at an evolving science system, as it addresses communication *about* these changes. Again, the SOEIS was selected because it provided an appropriate case to observe the *simultaneous* use of print and electronic media to communicate similar information within the workings of a trans-national research effort. The SOEIS research project appears on the edge between Mode I and Mode II types of knowledge production, and the trans-national flavour of the project made it a particularly useful case for this analysis. The analysis reflects not only upon the archived information communicated throughout the course of the SOEIS research project, but upon the (internal) *process* of knowledge production itself by treating the data as a time series. That is, information communicated during the course of the research project is considered as both a stock concept (as an archive to be analysed) and a flow concept, thereby understanding said information to have been created and exchanged. All print and electronic communications of the SOEIS group were archived, and thereby provided this analysis with an objective set of data for the analysis.

The communications of the SOEIS research project provided the resource data for the metric analyses described below. Four relevant domains of the project were selected for analysis. *Print Communication*, *Electronic Communication*, *Journal Publication*, and *Mailing List Environment*. Each reflects different aspects of the mediated environment of the SOIES and aims to harness the domain-specific communicative dynamics involved in that particular process of knowledge production and meaningful exchange.

The project was a single event with a defined time-line for completion[1], but for the purposes of this analysis several features of the communication network have been delineated for different forms of analysis. The analyses were expected to reveal a relationship between the changing nature of knowledge production and the

[1] The SOEIS project was approved by the European Union in late 1997, and the final report was submitted in 2000.

introduction of electronic media into academic environments. The reader should note that a delineation is drawn between communications contained within the context of the SOEIS project (the print and electronic communications), and the dynamics that are external to the SOEIS research project (journal publication and mailing list environment). Arguably, the latter contribute to the complex environment in which the SOEIS project operates, and should be understood as distinct from its internal workings.

Importantly, the SOEIS project was comprised of both core members and participating non-members; different groups of people are therefore involved with different elements of the communication systems. The print documents were created primarily by the 15 Core SOEIS members, while the electronic communications include the contributions of up to 74 people.[2] The Journal Publication Analysis and Mailing List Analysis were carried out using the names of all mailing list members. *Table 3.1: SOEIS Communicative Domains*, below, outlines the basic parameters of the four SOEIS domains selected for analysis.

Domain	Orientation	Chapter	Participants	Time Line	Unit of Analysis
Print	Internal	Chapter IV	15	01 / 97 – 5 / 00	Words (Printed)
Electronic	Internal	Chapter V	74	01 / 97 – 12 / 99	Words (Email)
Publication	External	Chapter VI	15 / 74	01 / 96 – 12 / 00	Journal Publication
Mailing List	External	Chapter VII	74	10 / 94 – 11 / 98	Threaded Emails

Table 3.1: *SOEIS Communicative Domains*

Several features of the SOEIS communication system should be noted. The first concerns limitations imposed by different languages operating in the dataset. One of the texts included in the SOEIS print communications was written in Italian; this has been observed in the dataset and is evident in the second time period of the print communications. This anomaly was not expected to skew results, but interesting observations were made concerning this period which will be discussed in *Chapter IV: Analysis of Print Communications.* In addition, several of the mailing lists included in the analysis of the mailing list environment were of Greek origin and one list of German origin. However, the content of the emails was not examined at this level – the respective thread dynamics were examined and these remained the same irrespective of language.

The second notable feature concerning the information used for the analysis is that I have personally read all of the texts included in the study and understand the semantic detail underlying each. The metric analyses undertaken in this examination should be understood, therefore, to supplement this understanding. The analyses do not determine the meaning of the communications systems, but rather provide us with an update to the understanding already achieved by participant observation in the SOEIS research project itself. In *Part II – Analysis* the four respective dimensions are analyzed discretely in four chapters. *Part III – Reflection* serves to integrate the

[2] There were 74 members of the SOEIS mailing list (EuroCon-Knowflow), including both core members and other participants. The total number of members fluctuated over the course of the 2 years of the project, but were taken as the baseline for the overall SOEIS group. The total number of actual participating parties in each domain is considerably less than 74. The member list can be viewed in *Appendix B.3*.

respective results of the four analyses by describing their interrelation and theoretical relevance. For future reference, each of the four analyses pursued here are accompanied by an Appendix located at the back of the book which contains supplemental information relevant to each study; they are: *Appendix A, Appendix B, Appendix C* and *Appendix D*, respectively.

Theories regarding the relationship between the social and the technological are by no means specific to Science & Technology Studies and Communication Studies, and in fact some theoretical bodies examined in *Chapter II: Theoretical Grounding* date back to the turn of the 20th Century. The principal motivation here is to operationalize the network metaphor using various types of metric analyses.

Bibliometrics is employed to conceptualize the relationship between source texts, Scientometrics to map relations between scientists (with an eye to changing disciplinary boundaries), and finally Cybermetrics to measure a range of mailing lists in the field of Science & Technology Studies and Self Organization Theory. Using these techniques may provide a means of understanding the impact of electronic writing upon the previously existing communication networks fostered by print. Despite the diversity between these approaches and the respective variety of objects of study, the metrics share the same basic feature: co-analysis. In what follows, the specific materials and methods employed in the analyses of the four respective communicative dimensions of the SOEIS research project are described. In this way we align them with the metric analyses introduced in *Chapter I: Introduction – Key Concepts*.

Materials & Methods

Four relevant communicative domains of the SOEIS were isolated: print writing, electronic writing, journal publication, and the mailing list environment. Arguably, oral modes of communication as exchanged during project meetings, telephone calls, conferences and the like could have been selected for analysis, and likewise, we could have chosen to look at any number of other combinations between the domains than the ones selected. However, of crucial interest to this project is the creation of a method through which one can compare the residual traces of project communications – hence written communications were biased. Those communicative dimensions that have left residual traces were selected specifically; oral communication (unless audio-taped or inscribed via 'participant observation') exists only as it is happening – it leaves no traces for further analysis. Print and electronic writing (as a noun not a verb) are precisely traces of previous communications and this renders writing an extremely important research site not only for understanding the symbolic dimensions of communication, but its networked aspects as well. By comparing residual traces left by communicating parties we can gain insight into the fundamental differences between media forms used. The priorities of our study include an assessment informed not only by theoretical positions concerning the symbolic dimensions involved in processes of knowledge production, but also about the tracing of a historical event using the output of several select media, and thereby produce a model to understand its architectural, networked and systemic dimensions.

Print and electronic communication were selected as the embodiment of the content of the intellectual exchange of SOEIS members. Since the nature of the information communicated along both channels of information flow are expected to be very similar, they were selected with precisely the intent to compare them for notable similarities and differences. Together the print and electronic communications contain all of the relevant information concerning the internal (not interpersonal) workings of the SOEIS research project.

The publications of SOEIS members and the mailing lists they use to communicate their findings comprise the external workings of the project selected for analysis. The publication patterns of this particular group of actors are examined over five years, accounting for the citing and cited Journal publication environments before, during and after the research project. The two SOEIS project mailing lists have been combined for another level of analysis; together they embody the electronic communications described above. Here the aim is to compare the thread dynamics of these mailing lists with a selection of others from the fields of *Science & Technology Studies* and *Self-Organization Theory*.

The networked relationships of the external workings of the SOEIS can be conceptualized in a similar way to the internally networked dimensions of the print and electronic communications described above. Overall, the concern is limited to the *Architectural – Network – Systemic* dynamics involved. The content of the information exchanged is addressed only secondarily; that is, for the purpose of interpretation. To be clear, we do not necessarily address how the content has changed – the primary concern is how the networked relations between people communicating can be shown to be changing. The theoretical bodies outlined in *Chapter II: Theoretical Grounding* largely reflect this approach, and they help frame the types of questions we can ask about the dynamics of knowledge production. Clearly there is no necessary relation between the theories and methodologies employed in the analysis; the methodologies are best perceived as operationalizations of specific modes of theorizing.

Print Communication

The print documents of the SOEIS research project were collected for the period between January 1997 and November 2000.[3] They include the initial TSER application and corresponding Annex, the project milestones, and the final report to the European Union. The documents themselves are not publicly available, but were obtainable through professional association.[4] The texts include all print data submitted internally to the group throughout the two-year project. Collectively these documents are considered to house the print component of the SOEIS, and by extension they are conceived to be the 'location' of the print knowledge produced in the project.[5] For a detailed outline of the texts used in this analysis see *Appendix A.2*.

[3] Note that two texts from the final report to the European Commission were received as late as November, 2000, despite the project's completion at the end of 1999; see Appendix A.

[4] The author would like to thank Peter van den Besselaar and Moses Boudourides for making the documents available.

[5] Importantly the print documents required no filtering beyond saving the documents as plain text files instead of Microsoft Word document files; this speaks to the nature of print communication itself. In the case of the electronic communications, several levels of filtering were employed, precisely because

The texts were collated into four groups of six month chunks and combined into distinct texts. An additional grouping was created of all time periods. Each text document was then filtered using the same stop list. Each of these filtered texts was then run through the *Wordsmith*[6] textual analysis program to isolate critical features of the text. These features can be understood to outline the architectural dimensions of print knowledge production.

The next analysis aimed to illustrate the networked patterns of relation between keywords in order to identify developments in the concepts being exchanged. The keyword-searches were performed for each time-period, and for the entire document set. Changes in the position of the keywords indicate if they are new, constant, increase or decrease in importance, or disappear altogether.

In the first of three keyword analyses the analysis of keyword distribution is restricted to the top 50 keywords. This data can be used to create networks of related scientific topics (Whittaker 1989, Callon & Rip 1986). The differing patterns of top keyword use are expected to reveal central topics being exchanged over the time periods. However, since the most commonly occurring words would include title words and other words significant to the research project itself, other analyses were pursued that emphasized strong relations and de-emphasized weak relations, thereby demarcating the central and non-central topics being discussed. By comparing the texts a perspective was gained on the relative importance of terminology. The second keyword analysis compared the text for each time period with the total document set in order to highlight the relationship between each time period and the whole project (stock concept). The final analysis compared each consecutive text; thus, the first is compared with the second, the second with the third and so on. In this way the *flow* of terminology is highlighted. Finally, in order to enhance our understanding of the networked relationships between those words isolated as key, a collocate analysis was performed on selected keywords to show the density of other keywords in proximity to the search term.

The systemic features of SOEIS print communication were examined by testing the respective time periods for points of critical transition indicative of a path dependency in the communication. The analysis will reveal whether or not particular ways of communicating information were integral for the development of the project's final output. The analysis includes an assessment of the *specificity* of the datasets (a measure of the degree to which some words occur differently across the dataset), and of *transmission* as a measure of the flow of mutual information across the dataset. *Chapter IV: Analysis Print Communication* examines the print exchange between members of the SOEIS research group using varied bibliometric techniques to determine the *architectural, networked,* and *systemic* patterns of word use.

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of the way the information is exchanged and categorized. Please see *Chapter V* for more detail.

[6] The *Wordsmith* program is the textual analysis program of the Oxford University Press; it was selected for its simplicity, ease of result exportation, and sophisticated indexing logics.

Electronic Communication

In October of 1996 the participants of the EuroCon-Knowflow mailing list used the forum for establishing relations between research groups to formulate a joint research project within the framework of the TSER program of the European Union. It facilitated the joint collaboration and creation of a research project that eventually became the SOEIS research project. The Self-Organization of the Information Society (SOIS) mailing list was added later to enhance the communication of the group within the larger scientific community. The SOIS was introduced midway through the SOEIS project to incorporate the larger framework of the global Information Society.[7] Both mailing lists served as the central bulletin boards for administrative messages, theoretical discussion, general inquiries, and the maintenance of the lists themselves during this time period. The term electronic communication, used here, refers to the communication amongst members using these two mailing lists. The EuroCon-Knowflow list participation died with the finalization of the project, and the SOIS list is currently being used to facilitate the organization and communications of another European Research Project.

The textual component from both mailing lists for the period between the beginning of the project in October 1997 and the end of the project at the end of 1999 was used. All relevant emails from both lists were collected and divided into four 6 month chunks in order to provide an initial basis for comparison. This initial process outlined the architectural dimensions of the SOEIS electronic communications. As with the print analysis, the texts themselves were collated into four groupings to be analyzed along a time axis to discern emergent network properties. The total number of individual emails included in electronic database (from both EuroCon-Kowflow and SOIS lists) was 1261. The emails were collected from respective archives of the two mailing lists.[8]

As with the print analysis the first keyword analyses was restricted to the top 50 keywords. The second keyword analysis compared the text for each period with the total document set, and the third compared each consecutive text, resulting in three keyword lists that highlighted the transmission of keywords between the time periods. A collocate analysis was also performed on a selection of important electronic keywords to reveal patterns of keyword association. The analysis of the electronic communications will identify the network relations between keywords, both at different time periods and between time periods. The difference between print and electronic writing will also be addressed: how often certain keywords occur in the body of the individual time periods, and how they compare with each other and the full document set reveals patterns that will enable us to discern properties or biases specific to each medium.

Relevant here is that keywords provide descriptors of the content of emails, and can be valuable indicators of the exchange of concepts within the group of active

[7] Interestingly, the attempt to enhance the communication resulted in an almost total participant shift to the new list. By contrast, when the EuroCon-Knowflow mailing list was divided into several distinct lists in an attempt to enhance the communications within each task, there was the opposite effect: communications became fragmented and the participants eventually organized themselves back around the original list.

[8] See: *Appendix D: Archive of Mailing List Analysis* for details of each list.

participants.[9] Importantly print communications are meant for publication and thus require a formalized method of communicating results, whereas electronic communications in the form of email tend to have a distinctive set of linguistic features. Most notably, the latter include an informal manner of writing, a particular situational context, and a triadic relation between the addressor, the addressee, and an assumed audience (Collot & Belmore, 1996). With respect to the SOEIS we must assume a common referent, which we identify here as an affinity of intellectual pursuits with a common aim. By definition, the common referent is the collective writing that constitutes the print database, as the SOEIS research project was necessarily aimed toward a final print report to the European Commission.

Finally, the third analysis examined the systemic features of the electronic communications by testing the respective time periods for points of critical transition, thereby indicating whether the information necessarily followed certain pathways to achieve the communication. This information will prove most useful when juxtaposed with the results of the systemic dimensions of the SOEIS print communications. It should be noted that the latter are collectively written documents (task / group specific) whereas the former are specific to individuals (irrespective of task / group). *Chapter V: Analysis of Electronic Communication* examines the communication between members using the EuroCon-Knowflow and Self-Organization of the Information Society (SOIS) mailing lists to determine their architectural, network and systemic communicative patterns.

Journal Publication

The names of the 74 individuals examined in this analysis were obtained from the participant list of the EuroCon-Knowflow mailing list. The publications of both the SOEIS members and the group are compared with those that cited the SOEIS material. The central journals from both groups will be compared – that is, the journals that the SOEIS members used to communicate their findings, and those that in turn are used to cite the SOEIS relevant material. The aim was both to describe the publishing relationships between these SOEIS members and associates, and to situate the SOEIS within the scientific community. The analysis highlights the architectural, network, and systemic features of the research project by emphasizing different features of the publication environment.

The scientific articles written by SOEIS members and participants for the years 1996, 1997, 1998, 1999, and 2000 were collected from the *Science Citation Index* (SCI), the *Social Science Citation Index* (SSCI), and the *Arts & Humanities Index* (AHI). A database containing all relevant information concerning authors, addresses, journals, and keywords was created. Secondarily the SOEIS relative articles were then used as search terms on the same databases for work that had cited them. In this way two distinct architectural dimensions of the SOEIS publication environment were defined and related. The frequency of cited and citing articles for each year of the analysis were compared, and then the most frequently citing and cited journals were compared. In this way the architectures of each dimension of the publication domain were delimited. In addition, the cited journals were compared by country, for both the SOEIS core and its associates, and for the density of co-authorship relations.

[9] By active participants I mean the percentage of the whole group which are active in the discussion.

The network analysis of the publication environment of the SOEIS collected and compared the referenced journals for both the cited and citing databases. By comparing the databases in a similar way to the architecture analysis above, the larger scientific domains of the cited and citing dimensions were compared for their most frequently occurring journals or indeed, disciplines. The citing and cited databases were compared for the frequency of referenced articles for 1996 through 2000, and the references cited by the core SOEIS members were delineated. Two journals arose as central to the research project and these are used in the subsequent system analysis.

The analysis of the systemic dimension explores the journal-journal relationships using the two most central journals of the SOEIS publication environment as the seed journals for the analysis, normalized over the *Social Science Citation Index* (SSCI). The citing and cited dimensions were compared, paying special attention to the interface between the two. Comparison at the journal level enabled an analysis of the field level of *Science, Technology & Innovation Studies*. The procedure examined journal-journal citations to further specify the field level. The approach thereby provides this study with a richer perspective of the role of the SOEIS project in the larger context of the science system. *Chapter VI: Analysis of Journal Publication* examines publication dynamics relevant to the SOEIS research group for the years prior, during and immediately following the research project to show its *architectural, network* and *systemic* communicative patterns.

Mailing List Environment

The mailing list environment refers to the use of mailing lists for enhancing academic research. Of particular interest is the EuroCon-Knowflow and Self Organization of the Information Society (SOIS) mailing lists which collectively housed the electronic communication of the Self-Organization of the European Information Society (SOEIS) research group. In addition to the Eurocon-knowflow list internal to the project, 10 other *Science & Technology Studies* and *Self-Organization Theory* oriented mailing lists were analyzed. *Chapter VII: Analysis of Mailing List Environment* illustrates the network distribution of these eleven STS & Self-Organization oriented mailing lists in terms of threaded messaging behaviour. Here a distinctly Mode II type of knowledge production is addressed.

As indicated, selected *Science & Technology Studies* and *Self-Organization Theory* oriented Internet mailing lists were selected as they reflected the theoretical priorities of this study. In addition, the lists used for this study were selected on the basis of whether the message archives were publicly available. Using this criteria, eleven mailing lists were selected for the analysis: *Autopoiesis, CyberUrbanity, Deukalion, ETK, EuroCon-Knowflow, Luhmann, Principia Cybernetica, Sci-Tech Studies, SimSoc, SOIS,* and *Xaos*.[10] Among these lists are project oriented lists, intermediate lists and field level lists.

The only list which functioned solely at the project level was the *EuroCon-Knowflow*. However, the *SOIS* list can also be considered as project level as it originated as an

[10] Please see *Appendix D: Archive of Mailing List Analysis* for the subscription data, list-server data, and archive location for each list employed in this analysis.

extension of the *EuroCon-Knowflow* list; the *Autopoiesis* and *SimSoc* lists similarly have their roots as project lists but have acquired the status of field level lists. The intermediary lists examined in the analysis are all of Greek origin; they include *CyberUrbanity, Deukalion, ETK,* and *Xaos*.[11] Finally, the field level lists include the *Luhmann* list, *Principia Cybernetica*, and *Sci-Tech Studies*. The eleven mailing lists were observed from their dates of inception up to and including November 6, 1998.[12] The general architectural features of the SOEIS mailing list environment were thereby identified.

The network dimensions of the eleven mailing lists were identified and isolated and described as levels of list participation and thread participation. The lists were then compared on the basis of whether they fall into one of three categories: project, intermediary (national), and field. The analysis then entailed a categorization of thread topics, thereby highlighting content biases. Importantly this level of the analysis reduced the amount of lists relevant for the subsequent systemic analysis. The measure for systemic properties entailed the application of tests for self-organized criticality, thereby indicating the importance of threaded messaging to processes of knowledge production.

Commensurablity

The theoretical lens outlined in *Chapter II: Theoretical Grounding* described a triadic framework upon which the empirical analyses would be contextualized, performed and interpreted. This section has served to integrate the empirical analyses and the theoretical lens through the shared interface of the *Architecture – Network – System* triad. The bibliometric, scientometric and cybermetric approaches outlined above each overlap in a number of unique ways. It is expected that the integration of theoretical approaches and metric methods can benefit both *Science & Technology Studies* and *Communications Studies*.

Here it is important to unpack the theoretical lens comprised of the *architectural*, *network* and *systemic* categorization. Media enable and constrain human communication; one can thereby assume certain biases specific to each medium. The Information Network metaphor borrowed from Medium Theory is salient here. It provides a metaphor for the architectural dimension of the SOEIS print or electronic communications as particular modes of information or *processes* of mediation. This is the key – the architectures revealed in the following analyses are best interpreted in light of the Medium Theory information network, which is by definition both synchronic and diachronic.

Actor Network Theory enables a complexification of this architecture by theorizing the medium as used, and mediation as a process. Observing word *use* is understood as integral to assessing modes of knowledge production. Importantly, the symbolic

[11] This research was performed in Patras, Greece, enabling access to a several Greek Science & Technology Studies and Self-Organization Theory oriented mailing lists.
[12] The Mailing List Analysis began on this date and served as the cut-off date for all lists under analysis.

aspects of mediated communication as theorized by Structuralist and Poststructuralist theorists and in Giddens' Structuration Theory provide metaphors to aid in understanding the meaning of fluctuations in patterns of keyword use. The hermeneutic units of the word and it's collocates, of journal publications, and of threaded messages are precisely where these theoretical bodies may intersect. Finally, Self-Organization Theory enables a macro view of the systemic properties of SOEIS communications.

Research Question & Expectations

Several key expectations can be identified, corresponding to the framework for the analysis as outlined above. The first expectation is that *Information and Communication Technologies (ICT) affect the ways that scientists communicate, perform their research, and contribute to the production of knowledge.* The reader is reminded that communication implies mediation. This position was argued by Poster (1990) with respect to changes in our dominant modes of communication, by Gibbons (*et al*.; 1994) as a shift from Mode I to Mode II knowledge production, and was emphasized by the OECD reports (1996, 1997) that suggested a causal relation between the changing nature of knowledge production and the advent of electronic media. This position was further established in *Chapter II: Theoretical Grounding*.

Bibliometric, scientometric and cybermetric analyses enable a means to assess the impact of electronic media by providing analyses that can compare print and electronic communications. A second expectation, then, is that *metric analyses and mapping techniques can enhance our understanding of the overlap, and distinction between, print and electronic communication technologies in academic environments, and therefore provide insight into the dynamic character of the evolving research practice*.

Finally, it is expected that *the theoretical orientation of the study can be used to contextualize and interpret the results of the metric analyses, despite the different phenomenological issues raised by the difference between modelling and symbolic approaches*. The theoretical lens comprised of Medium Theory, Structuralism, Poststructuralism, Structuration Theory, Actor Network Theory, and Self-Organization Theory provides a well rounded context to frame the entire analysis. It spans a large and unwieldy intellectual tradition, yet is able to simplify their interrelation by narrowing the field of reference to *mediated communication*, and *knowledge production*, and to the triadic relationship between the *architectural, network,* and *systemic* dimensions of knowledge production.

In the context of these expectations an overarching research question can be stated: *Given that mediated communication and processes of knowledge production are mutually implicated phenomena, and that the changing information environment in academic contexts can be theorized with respect to differences between print and electronic media, can the application of metric techniques to academic communications in tandem with applied theorizing show biases particular to each medium and thereby reveal the nature of said changes?*

The following section *Part II – Analyses* contains the four empirical chapters. In each of the following chapters: *Chapter IV: Analysis of Print Communication, Chapter V: Analysis of Electronic Communication, Chapter VI: Analysis of Journal Publication,* and *Chapter VII: Analysis of Mailing List Environment* three additional research questions are posed. The structure of each chapter follows the logic of the model: the *Architectural – Network – System* theoretic triad; for each additional research question posed there are corresponding expectations provided. This approach will help contain the diverse range of analyses herein, and should prove advantageous when the results are integrated in *Part III – Reflection*.

PART II – ANALYSIS

Chapter IV: Analysis of Print Communication

Introduction

The chapter describes the computer assisted textual analysis performed upon the print communications of the Self-Organization of the European Information Society (SOEIS) research group. Key features are identified to provide an initial architecture to the document set, networks of keyword and associate relation are then revealed, and finally the systemic properties are described – each of which reflect biases of the print medium. The question of how this mode of communication differs from that of electronic writing will be addressed in the next chapter where the results of the analysis of the electronic dimension of the SOEIS communications are compared with the results of this analysis. The different roles media play in relation to each other in processes of knowledge production are thereby identified.

The textual analyses were performed upon the print output of the participants of the SOEIS research project as outlined in *Chapter III: Materials & Methodologies*. Word usage in processes of communication can be shown to exhibit architectural (Ong, 1982), network (Callon, 1986) and systemic properties (Leysdesdorff, 1997) through different types of analyses. Here, the distribution of word use in the print documents is examined to determine the architectural parameters of the database, the relationships between keywords for each respective time period and over the whole project for the network analysis, and the overall pattern of word use as an indicator of the systemic properties of the whole of the SOEIS print communications. In this way we identify elements particular to this mode of knowledge production. Thus, the primary aim in this chapter is to identify the dominant features of SOEIS print communication, and the secondary aim is to locate those features that may be fruitfully compared with the results of the analysis of the SOEIS electronic communications in the next chapter.

Research Focus

Given the centrality of the print medium to the functioning of the SOEIS research project, the analysis aimed to determine if print provided a decidedly different mode of communication than electronic media, and if this difference had any measurable impact on the general make-up of SOEIS communications. The basic hypothesis in this chapter is that an analysis of the *architectural, network* and *systemic* features of print media will reveal biases particular to the print medium itself. Only when compared with the results of the analysis the electronic dataset in the next chapter can this hypothesis be confirmed.

Several significant elements should be considered when measuring features of print communication. Importantly, the objects of this study are texts written by individuals but written in communication as collective pieces. Note that this differs from the electronic communications database analyzed in the next chapter where the collated texts are individual emails; this difference slightly changes the priorities of the

electronic analysis. In both cases, knowledge is produced using a specific medium, and in this way, is codified into particular modes of communication. This study collates these communications into comparable aggregate sets (print *and* electronic), in order to compare them for significant similarities and differences.

The differences between SOEIS print and electronic communications will necessarily also be theorized in terms of function – where print served to integrate the SOEIS in terms of research output, electronic communications integrated the SOEIS group in a more individual and less formal way. In either case, our *a priori* assumptions are that these media differ in their modes of enabling communication, and that within the context of the SOEIS project each medium was designated a specific function. A perspective is gained whereby individual events compile to become collective actions, and the complex interrelation of these elements can be broken down into *architectural, network,* and *systemic* dimensions.

The use of the word in different contexts provides a focal point for questions concerning both individual and collective behaviour. Through analyzing word use as an event in the hermeneutic sense, keyword collocates and associates can be understood to integrate these events into sentences, articles, and indeed into larger social ramifications. By analysing how individuals use words in certain circumstances, one can theorize how the changes in word distribution over time may indicate fluctuations in processes of knowledge production that taken together may indicate a collective codification of knowledge.

The SOEIS print communications can be expected to be more codified than the electronic communications because of the inscribed nature of the output itself. Similar information has been exchanged over these two different information channels and differences between the respective databases are thereby expected to be significant in terms of revealing particular media bias. The print output is examined for its basic architectural features including the document size, word frequency and unique-word / word frequency (and their ratio), for network features such as rate of word-use change, and for systemic features such as phases of 'pathway dependence' or critical revisions in the dataset, and finally differences in overall word distribution. Relevant here are the differences in the consistency across each of the four print document sets representing the four 6 month time periods of the project. In the next chapter we compare the consistency of print and electronic communications and seek to reveal distinct biases of each medium in question. The analyses described herein should be understood in the context of the *Architecture – Network – System* theoretical triad outlined in *Chapter II: Theoretical Grounding*.

Research Questions & Expectations

There are three research questions, each stated with reference to a particular theoretical body as outlined by the theoretic triad of *Architecture – Network – System*. The research questions and expectations of each analysis are introduced in tandem, as each is theoretically informed using the a part of the triad. Each theoretic perspective enables additional questions to be posed and alternative, yet complimentary, frames of analysis to be employed.

First, *does the SOEIS print communication have a discernable architecture, and can particular qualities be identified with a decidedly print mode of communication?* This question will be addressed through an analysis and comparison of the ratio of unique words to overall word occurrence in each of the four six month time segments of the print database. This question is informed by the Medium Theory notion of the information network, and aims to characterize print word-use as central to the functioning of the SOEIS project, as distinct from electronic word-use which is expected to perform a more supplementary role in the SOEIS project. Changes in the percentage of unique words used over the 2 years of the project should indicate processes of information codification, thereby revealing the network architecture of the SOEIS print communications. The primary expectation here is that from this basic architecture, qualities particular to print communication in general can be identified. The print communications are suggestive of Mode I processes of knowledge production, whereas electronic communications appear more Mode II oriented, and this difference should be observable through a comparison of the results of the analysis of the print and electronic databases.

Second: *are network properties of SOEIS print communication discernable by comparing the fluctuation of keyword use over the four time periods in the analysis?* Here the primary concern is to isolate words which can be identified as 'key', and to examine their distribution over the four respective time periods to find evidence of changing emphases in the cognitive orientation of the research group. This procedure is accomplished by examining SOEIS print keyword distribution in a variety of different ways; notably, by comparing the top 50 keywords, and comparing keywords isolated by comparing the text of each time period with the full document set, and by comparing the text in each time period with each other. By identifying the increase, decrease or disappearance of keywords in each time period it is expected that changes in the cognitive orientation of the research group can be identified. The question is informed by Actor Network Theory and outlines the network features of print communication as a product of collective action. A key focus here is how individuals collectively contributed to produce texts and thereby formed information networks.

The primary expectation here is that a readily discernable pattern of keyword reoccurrence will be visible in the print dataset. A point of concern is the tracing of the transmission of keywords across the four time periods of the SOIES project to locate evidence of discourse codification. If certain words or word patterns occur in particular time periods, or only in either the print or the electronic datasets, then certain assumptions can be made about the biases of each medium and its attribute function. Thus, within the print dataset it is expected that some words will be distributed more or less evenly across the time periods, but certain words or word patterns will likely occur in only particular periods. By tracing which words occur when, it should be possible to discern shifting emphases and patterns of information codification in the print dataset.

The analysis of the network dimension of the SOEIS print communication therefore aims to reveal patterns of keyword distribution and thereby describe major developments in the concepts being exchanged – specifically by isolating patterns of relation between keywords. Importantly, keywords are positively or negatively

emphasized, and this designation can provide insight into the general overlap between the texts, as changes in the position of keywords should reveal constancy or a relative increase or decrease in emphasis or importance. Collective cognitive changes can be thereby be identified by observing fluctuations in keyword distribution. Unlike the electronic dataset, which is comprised of individual email communications, the print document set is an amalgamation of co-authored texts. Nevertheless, changes in the cognitive orientation of the SOEIS project itself can be identified by observing changes in keyword distribution at the aggregate level.

Word collocates are also important here. Collocates are defined as words which occur near other words, and they are normally distinguished between associate collocates and neighbourhood collocates. Associate collocates include words which would necessarily be cognitively connected; for example, the word car might have as its associate collocates words like gasoline, road, or driver. These associations are difficult to locate using textual analysis programs, and are more suited to manual analyses of individual texts or a small group of texts. Neighbourhood collocates, by contrast, are words which occur frequently near other words, and these are easy to locate over large document sets. More precisely, neighbourhood collocates are words that occur within a designated window of analysis; here only those words which occur within five words from the query word are used for the analysis.[1] Keyword collocate fluctuation across the time series may be interpreted as evidence of changing cognitive biases as exhibited by their respective differences. In this way we can appreciate the means through which individual communications aggregate and reflect collective orientation. This reinforces the Actor Network Theory contention that textual analyses can indeed be conceptualized using network approaches, and positions the analysis toward the systemic aspects of the aggregate data sets.

Finally, *can we identify path dependencies in the SOEIS print dataset, indicating systemically that critical transitions were necessary for the communication to develop in the way that it did?* Self-Organization Theory informs this approach; here the analysis aims to determine if the communicated information followed particular pathways over others, thereby indicating processes of critical revision. The analysis compares linear and non-linear associations between the time periods of the SOEIS Communications, by comparing the expected information content of each time period as compared to the previous state of the communication. With respect to this final research question it is expected that when examined for path dependency, points of critical transition will be observable, thereby indicating that each stage of the communication was necessary for the project's productivity. As argued above, fluctuations in keyword use may lead one to expect that certain words will likely appear in later time periods, and this is interesting for the network analysis. By contrast, the systems analysis measures the expected information content by comparing the overall information dataflow in each period with every other by comparing the linear associations (first period to the second, the second to the third, third to the fourth) with the non-linear (first to fourth, first to the third, second to the fourth). It is expected that the SOEIS print communications can be shown to have an

[1] The window of five words to the left and right of the query word was used in the collocate analysis as windows of less than five words often render too few collocates, and windows of more than five words deliver too wide a scope.

evolutionary component – precisely by observing the overall keyword distributions over the body of texts to determine if there have been crucial transitions in the ways that they are distributed over time.

Results

Architecture

All documents were collated into four individual document sets correlating with four major periods of the SOEIS in which print writing was generated[2], representing roughly four time periods of six months each. An adapted stop-list was used to filter most commonly repeated words useless for the analysis (e.g.: 'if', 'and', 'but'), after the basic information for each of the 6 month chunks was identified to provide an initial basis for comparison.[3] The collected and collated documents representing the four time periods were run through the *WordSmith* program. Each document set and the aggregated collection were examined for basic statistics including size, word count, unique-word count, their percentage of unique words and the standardized or mean ratio percentage of unique words.[4] The program also produced the word lists that are used in the subsequent analyses of network and systemic properties. *Table 4.1: Print Architecture* below provides the basic descriptive information; note that P1, P2, P3 and P4 represent the four respective six month time periods of the print communications of SOEIS research project.

Name	Size	Word Occurrences	Unique Words	Unique Words %	Mean Ratio %
P1.txt	488 KB	70638	2396	3.39	51.12
P2.txt	954 KB	145582	4467	3.07	50.64
P3.txt	228 KB	34560	1397	4.04	50.34
P4.txt	2271 KB	350524	6496	1.85	50.56
P-All.txt	3914 KB	601273	9142	1.52	50.56

Table 4.1: *Print Architecture*

From this distribution it is observed that the final time period has almost 60 % of the word occurrences, and over 40 % of the unique words. Perhaps more interesting is the unique word percent which illustrates a considerable increase of new word use in the third time period, and a marked reduction in the last. However, the standardized type / token ratio (mean ratio %) illustrated here remains consistent across the four time

[2] The four periods correspond with the project Application, Milestones, Reports and final Results.

[3] See *Appendix A.1* for the complete list of words included in the stop-list. The results presented below are all necessarily abstractions from the larger set of results located in *Appendix A*.

[4] Importantly, the unique word / word ratio percent varies widely in accordance with the length of the texts being analyzed. A 1,000 word article might have a type/token ratio of 40%; a shorter one might reach 70%; a million words will probably give a type/token ratio of about 2%, and so on. But arguably such type/token information is rather meaningless in most cases; *Wordsmith* uses a different strategy for this computation. The standardized or mean ratio percent is computed every 1,000 words as *Wordsmith* goes through each text file. Thus, the ratio is calculated for the first running words, and then calculated afresh for the next 1,000, and so on through the entire document set. A running average is computed which provides an average type/token ratio based on consecutive 1,000-word chunks of text. The standardized type/token ratio is interpreted here as an indicator of the *style of variation* between unique words and word occurrence over the entire print dataset.

periods. Both observations may indicate evidence of codification in the print document set, but for different reasons. The general rise in the unique-word percentage over the first three time periods, and then the marked reduction in the final time period, is suggestive of a 'cut and paste' environment wherein considerable segments of previous writings (project milestones, for example) were reused in later submissions.[5] The codification evident here is a matter of *process*; indeed the stabilized unique word percentage in the print document set could be due to the influence of a single author or group of authors.[6] By contrast, the mean ratio percent suggests an *a priori* codification, whereby the project is kept within certain structural boundaries as is the case with EU funded research projects which are characterized by time constraints, project deliverables, and precise expectations about the format of final results.

The four 6 month time chunks of the print communications were thereby grouped and analyzed as a time series to determine features of their collective architecture. The expectations of the first analysis were confirmed; indeed, the analysis not only identified evidence of information codification, but revealed two distinct forms of codification. The architectural statistics about the groupings of texts has thereby served to ground the analysis of print writing as a distinct medium of communication employed throughout the course of the SOEIS research project; one with evidence of both *a priori* and *processual* codification.

The analysis of the print communications of the SOEIS project entailed two distinct stages of analysis beyond the basic statistics described above; namely, the examination of the texts for network properties of collective co-word and collocate usage, and searching for evidence of systems transformation. The results of the network and system oriented analyses are described below.

Network

As outlined above, the expectations of this network analysis revolve around observed fluctuations in the distribution of keywords. Changes in the distribution of words are expected to reveal changes in the emphasis of the group over the 4 time periods, and thereby show changes in its cognitive orientation. Three keyword analyses are described below: the first isolates the top 50 keywords in the four texts, the second compares each text with the print dataset (P1 with P-All, P2 with P-All, and so on), and the last compares each text sequentially (P1 by P2, P2 by P3, and P3 by P4).

The first keyword isolation observed the most commonly occurring words in each time period. Ten salient examples from the top 50 keywords occurring in each time period are selected on the basis of their relevance to the SOEIS project in order to illustrate the range of topics found in its distribution; they are shown below in *Table 4.2: Top Print Keywords*.

[5] This cut and paste phenomenon is a normal procedure in EU funded research projects in general, as identified in Leydesdorff "*Scientometric Indicators and the Evaluation of Research"* (forthcoming, 2003).

[6] The final project reports were edited as one unified text prior to the publication of the final results. The codification of keyword use may therefore be related to the bias of an individual or group of individuals.

Word	P1	P2	P3	P4	Total
European	319	441	117	842	1718
Information	284	266	131	790	1471
Networks	428	191	82	737	1438
Analysis	180	333	163	695	1371
Systems	280	174	87	700	1241
Organization	142	134	126	497	899
Task	310	84	158	282	834
Data	189	167	108	347	811
Project	271	99	90	206	666
Firms	15	253	9	364	641

Table 4.2: *Top Print Keywords*

These examples have been selected to highlight the most relevant commonly occurring keywords and their different distributions across the time periods. For example the words *European, Information* and *Analysis* appear to occur proportionately with increasing frequency over the course of the project, with the slight exception that *Information* appears to occur slightly more often in the second period than one would expect, given the status of these words as project title words. Likewise, the word *Data* occurs more often than expected in the second time period but its use decreases by the end of the project.

The words *Networks, Systems, Task* and *Project* occur very often in the first time period, and have relatively high occurrence rates in the final time period. Indeed, in the context of the SOEIS project one would expect the words *Task* and *Project* to occur with a high frequency in the first period which included the text of the initial application to the EU. However, like the words *Networks* and *Systems* one might expect that they would occur with a higher frequency in the final period with closure of the project. It is also quite notable that the word *Firms* is included in the top 50 keywords of the print dataset, despite the unusually low rates of occurrence in both the first and third time periods.

The first of the keyword analyses conforms to our expectations that a general sense of the project's cognitive orientation can be gleaned by comparing the most frequently occurring words. Many examples can be found comparing the wordlists alone to understand the parameters the shared informational worlds comprising the SOEIS research project. However, it is arguable that the most commonly occurring words in any textual analysis reveal less about the exchange of critical topics than other less frequently used words since collectively the words exchanged are so general in the context of the specific research project.[7] The limitation identified is that the most commonly occurring keywords found using this approach tend to be project title words which tell us very little about the actual content of the communications. The next analysis therefore compares these lists for the most commonly occurring shared words; this approach revealed more interesting emphases in the word distribution patterns.

[7] See: Gerard Salton *Some Research Problems in Automatic Information Retrieval* International Conference on Research and Development in Information Retrieval (SIGIR) Proceedings, 252-263, 1983

The additional analyses were performed on the print document set using two different approaches: the first comparing P1, P2, P3, and P4 against P-All, thereby gaining four lists of varying length, and the second comparing P1 to P2, P2 to P3, and P3 to P4, resulting in three wordlists representing the periods of transition between the four defined segments. Importantly, the *shared* keywords revealed by comparing wordlists are assigned either positively (+) or negatively (–) thereby representing those words which occur more or less often than expected, given the texts that are compared (P1 compared with P2, etc.). The equal (=) signs represent not that these words do not occur in the texts, but that when the two texts under analysis were compared, the words were not designated as key.[8]

The individual wordlists were compared with the full document set (P-All). Twelve salient examples are selected here on the basis of their direct relevance to the research project. They are presented below in *Table 4.3: Print x All Documents*; see *Appendix A.4* for the complete results.

Word	P1 x Pall	P2 x Pall	P3 x Pall	P4 x Pall
Communication	+190	–89	=	=
Data	–189	=	+108	=
Discourse	=	–4	=	+183
Firms	–15	+253	–9	=
Leydesdorff	+115	=	=	–132
Models	+152	=	=	–135
Networks	+428	–191	=	=
Organization	=	–134	+126	=
Project	+271	=	+90	–206
Self	=	–227	+220	=
Systems	+280	–172	=	=
Task	+310	+84	+158	–282

Table 4.3: Print x All Documents

When compared by frequency and by distribution, the positively or negatively emphasized keyword occurrence provides insight into cognitive orientation of the different texts. It is interesting to note which words are (or are not) presented as keywords in the different time periods. For example, it is observed that the keywords: *Leydesdorff,* and *Models* have a peculiar distribution whereby they are not deemed central to either P2 or P3 when compared with P-All. Moreover, both words are negatively denoted in the final time period and this reveals something about the SOEIS. As a project participant it is clear why – Dr. Leydesdorff was a SOEIS project co-ordinator and was a participant for its first year; his presence explains in part why there is such a high occurrence of the word *Model*s. In the latter half of the SOEIS project the project assumed a slightly different perspective, as evidenced by the high frequency and positive designation of the word *Discourse* in the final time period, as compared to the negatively denoted *Leydesdorff* and *Models* in same time period.

[8] The *WordSmith* program identifies the words in wordlists after they have been filtered using a stop-list as keywords, and words identified by comparing texts as key-keywords. Here words located via comparing texts are referred to simply as keywords.

Other interesting examples gained from the above distribution are the keywords: *Communication, Networks,* and *Systems*. It is observed that these are deemed keywords in the first two time periods, but remain absent from the second two time periods. The three keywords are all negatively denoted in P2 suggesting that in this part of the project there was a particularly different focus – one concerning the use of the word *Firms*, which occurs with an extremely high frequency in the second time period, while exhibiting a particularly low frequency in the first and third periods. We learn that the occurrence of *Firms* was emphasized in the second time period revealing the cognitive orientation of the group to have been organized around this particular research topic, and that in terms of its overall impact, the word *Firms* did not comprise a central part of the final output.[9]

Additionally, it is interesting that both *Self* and *Organization* were deemed as keywords in the second and third time periods but not in the first and last. This shows that when compared to the entire document set these words occurred less frequently than would be expected given their status as project title words. *Task,* by contrast, was the only isolated keyword that occurred in all time periods – as one would expect, as a the word serves to collate the individual reports. It is also notable that the keyword *Project* doesn't occur in the second time period and that it is negatively denoted in the final time period. This suggests a decreasing importance of the use of the word. Finally, the keyword *Data* was found to be key in the first period where it was negatively denoted, suggesting little use of the term here; but it was found to be positively denoted in the third periods revealing that during this period the collection, exchange or discussion of data was prevalent. These examples confirm the expectation that comparing wordlists can reveal different emphases of the research project during different time periods.

Table 4.4: Print x Each Document, below, shows the results of comparing the word lists from each time period with *each other*, not the full document set.

	P1 x P2	**P2 x P3**	**P3 x P4**
Amsterdam	+76	−23	+35
Analysis	=	−333	+163
Empirical	+56	−40	+40
Firms	−15	+253	−9
Methods	+69	−31	+38
Models	+152	−54	+39
Organization	+142	−134	+126
Partners	+42	−10	+19
Progress	=	−18	=
Project	+271	−99	+90
Task	+310	−84	+158
Work	+76	−56	+51

Table 4.4: *Print x Each Document*

[9] As with many other examples used in this analysis, this can be confirmed simply by referring back to the original documents. However, the aim of this analysis is in part to illustrate the ability represent these features *without* direct reference to the specific texts under analysis.

It is notable that the keywords shown here reveal more consistency across the time periods since the ones isolated through the analysis appear to occur in most of the time periods. The keywords found through this transitional analysis are more representative of a shared and relatively core cognitive realm of the SOEIS research project members.

This second approach whereby the individual wordlists were compared with each other emphasizes the transmission of word use as a process over the time periods. Several interesting examples were found using this approach. Most notably, many keywords appear to decrease in emphasis during the middle of the research project, only to increase in relative importance in the final period; examples include: *Amsterdam*, *Empirical, Methods, Partners,* and *Task*. By contrast, there are keywords which clearly decrease in emphasis over the course of the project: *Models, Organization, Project* and *Work*. These latter examples occur with more frequency in the middle transition (from P2 to P3), yet in every case they are negatively denoted thereby suggesting they occurred with much more frequency in the first and final texts in the analysis.

These indicators suggest that the second and third texts lacked a certain orientation that was central to the first and final texts, as exemplified by the decrease in importance of many theory oriented keywords in the second transition. The fact that the project proposal and final results comprise the first and last time periods, respectively, suggest a particular mode of communication whereby the keywords which gave form to the project are maintained, but the keywords in the middle transition (represented by the middle time periods) suggest a different cognitive emphasis. This is shown by the high occurrence of process oriented keywords in the middle transition (*Models, Organization, Project* and *Work*), as compared with those project oriented words which emphasize the project's functional component (*Amsterdam*, *Empirical, Methods, Partners,* and *Task*). It may be however that the unusually high occurrence of *Firms* in the second time period somehow de-emphasizes the weight of the many negatively denoted keywords identified in the P2 to P3 transition phase, given its crucial role in the second transition.

It was also found in this transitional analysis that the word *Analysis* was not designated keyword status in the first transition stage, but occurred with a very high frequency in the second transition (from P2 to P3) and relatively high frequency in the third transition (P3 to P4). The word *Progress* was only designated keyword status in the middle transition (P2 to P3), and is negatively denoted. This shows that similar to the function oriented words identified above, the word *Progress* was not designated as central in the middle of the research project but was evidently an important statement in the beginning and end of the project.

These procedures provided an additional filtering of the most frequently occurring words in the original wordlists, and revealed important changes in emphasis. The expectation that the cognitive orientation of the SOEIS project could be shown using different forms of keyword analyses has been confirmed. The fluctuating occurrence of different words designated as 'key' in each approach has clearly illustrated these changes. However, while the observation of individual word occurrence provides a sense of cognitive orientation, capturing the *meaning* of words demands an

observation of words in context. As argued by the Structuralist, Poststructuralist, and Structurational approaches to understanding *meaning*, words only *mean* by association with other words.

To capture the meaning of the cognitive realm revealed by the network analysis of keyword distribution described above, keyword word collocates were sought out for their possible significance. A collocate analysis was performed on the four print document sets using a handful of keywords isolated in the preceding analysis. The keyword *Firms* was selected given its primacy in P2, and *Organization* was selected on the basis of its centrality as a title keyword and its designation as key in P2 and P3. *Task* and *Project* were selected because of their specific centrality to the operation of the SOEIS research project. The analysis entailed the examination of the original texts (P1, P2, P3, and P4) for the frequently occurring neighbourhood collocates of these four query keywords.

The occurrence of each query word was first plotted over the print document set, and visual displays generated to see the distribution.[10] The results of the initial analysis are presented below in *Table 4.5: Distribution of Print Keywords for the Collocate Analysis*. Here the query words are measured for their distribution across each document set, and for their relative distribution every 1000 words (as a standardized mean).

File	Words	*Firms*	/1000	*Organization*	/1000	*Project*	/1000	*Task*	/1000
P1.txt	69,859	15	0.21	142	2.03	273	3.91	310	4.44
P2.txt	143,716	253	1.76	134	0.93	99	0.69	84	0.58
P3.txt	33,947	9	0.27	126	3.71	91	2.68	158	4.65
P4.txt	347,511	364	1.05	498	1.43	209	0.60	282	0.81

Table 4.5: *Distribution of Print Keywords for the Collocate Analysis*

From the analysis of the four query words: *Firms, Organization, Project,* and *Task*, additional information concerning their distribution over the dataset was gained. The keyword *Firms* is shown to occur with a high frequency in both the second and final time periods, and this distribution is mirrored when measured for its standardized mean (every 1000 words). The distribution of the other three keywords selected for the analysis differs slightly. *Organization*, for example, occurred with a similar frequency across the first three documents sets and increased in the fourth, while when compared for standardized distribution across the four documents the terms appear more central to the first and third document sets. By contrast, the keywords *Project* and *Task* were shown to have varying distributions across the document sets while the standardized mean shows a different distribution. *Project* appears to be a central term in the first and final documents, but when standardized it is shown to be used more in the first and third document sets. Likewise, the keyword *Task* appears to be central to the first and final documents, but when standardized the distribution suggested that it was particularly central to the first and third time periods. These distributions give an immediate sense of the cognitive priorities of each time period.

In what follows, a contextualization of these words using their central neighbourhood collocates will serve to isolate the ways that each of these terms were *used*. As argued

[10] The visual comparison between the four query words can be viewed in *Appendix A*.6

in the *Research Questions & Expectations* section of this chapter, textual analysis computing tools alone cannot locate associate words (words which are linked to keywords by cognitive association), but it is possible to use such tools to locate neighbourhood keywords. Here the isolation of keywords and their central collocates aimed to locate the 'sub-symbolic' meaning of words which remains contingent on the association between them. The key collocates of each Query word were isolated using the *WordSmith* program. From these occurrences, ten to twelve words were selected for display below. Once isolated, a further selection was made of two key collocates to identify which words are associated with the query words.[11] Again, the full results can be viewed in *Appendix A.6*. The selected collocates for each keyword, and its successive co-collocates are shown below in four figures: *Figure 4.1: 'Firms' Collocate Analysis, Figure 4.2: 'Organization' Collocate Analysis, Figure 4.3: 'Project' Collocate Analysis,* and *Figure 4.4: 'Task' Collocate Analysis*.

FIRMS	**720**
SMALL	82
LARGE	55
INSTITUTIONS	*40*
LOCAL	39
NEW	33
NETWORK	*32*
ITALIAN	30
NETWORKS	*28*
PRODUCTION	27
DISTRICT	25
FOREIGN	24

FIRMS	**45**
INSTITUTIONS	***39***
NETWORK	10
NETWORKS	6

FIRMS	**63**
NETWORK	***32***
NETWORKS	***28***
SMALL	16
INSTITUTIONS	14

Figure 4.1: *'Firms' Collocate Analysis*

This collocate analysis isolated an interesting set of neighbourhood keywords for the word *Firms*, including: *Institutions*, and *Network(s)*. When the keyword and these collocate words were used together as the search terms, an additional level of specification was achieved. Here, when *Firms* and *Institutions* were used as the query words, only the words *Network* and *Networks* were identified. When *Firms*, *Network*, and *Networks* were searched together, only the words *Small* and *Institutions* were found. This approach gives us a clear sense of the structure of the discourse surrounding the use of the term *Firms* in print communication of the SOEIS project.

ORGANIZATION	**960**
SELF	667
INFORMATION	149
SOCIETY	125
EUROPEAN	110
ORDER	66
NETWORK	49
SOCIAL	49
SYSTEM	41
NETWORKS	35
PROJECT	*34*
THEORY	31
TASK	*31*

ORGANIZATION	**32**
PROJECT	***32***
SELF	29
INFORMATION	16
SOCIETY	15

ORGANIZATION	**25**
TASK	***27***
SELF	24
MODELING	8

Figure 4.2: *'Organization' Collocate Analysis*

When the keyword *Organization* was examined for its neighbourhood collocates, a self evident grouping of words was identified. From these collocates, the words

[11] The words in *italics* are the keywords selected from each collocate list for the deeper analysis

Project and *Task* were selected for the deeper analysis. Not surprisingly, when *Organization* and *Project* were queried together the words *Self*, *Information*, and *Society* were identified. These words were central to the project and are indeed, title words of the research project itself. When *Organization* and *Task* were queried together, the words *Self* and *Modeling* arose. The word *Self* is to be expected given its link with the word *Organization*. The word *Modeling*, while not exhibiting a high frequency as a collocate to the search terms *Organization* and *Task*, was identified as key suggesting that the word played a particular role in the print communications of the SOEIS project. *Modeling* is understood here to represent a link between the words *Organization* and *Task* that might otherwise escape unnoticed. All three words connote a processual concern with the carrying out of the project tasks.

PROJECT	**743**
SOEIS	*87*
RESEARCH	59
TASK	56
WILL	46
SELF	42
RESULTS	*36*
WITHIN	34
EUROPEAN	33
ORGANIZATION	32
COMMUNICATION	28
WEB	27
INFORMATION	24

PROJECT	**40**
RESULTS	***36***
ENTIRE	7
RESEARCH	7
DISSEMINATION	5

PROJECT	**100**
SOEIS	***83***
ORGANIZATION	18
TASK	18
HTTP	13

Figure 4.3: *'Project' Collocate Analysis*

When the keyword *Project* was analyzed for its collocates a wide range of neighbourhood words were identified. From these, the words *Results* and *SOEIS* were selected for the deeper analysis, as they concern the SOIES project and its motivation. When a search was performed on the keyword *Project* and the word *Results* in tandem, the words *Entire*, *Research* and *Dissemination* were identified as the central neighbourhood collocates. While the significance of the word *Entire* in this distribution remains conjectural, the words *Research* and *Dissemination* are clearly cognitively connected with the keyword *Project* and this analysis thereby reveals the importance of these terms to each other – to the operation of the SOEIS project, and to the composition of the print communication dataset itself. When *Project* and *SOEIS* were sought together the words *Organization*, *Task*, and *HTTP* arose. The relationship between these words and the keyword *Project* is clear – here the orientation of these words to each other reveals a collective cognitive orientation of the SOEIS members to the function words: *Task* and *Organization*.

TASK	**1072**
PROJECT	*60*
RESEARCH	60
POLICY	*53*
SOEIS	49
DEVIATIONS	39
SELF	38
WORK	38
NETWORKS	36
EUROPEAN	35
MODELING	33
REPORT	32
FORCES	31

TASK	**68**
PROJECT	***60***
SOEIS	17
WORK	10
DELIVERABLE	5

TASK	**59**
POLICY	***51***
IMPLICATIONS	18
RESEARCH	8
EUROPEAN	6

Figure 4.4: *'Task' Collocate Analysis*

Finally, the fourth collocate query performed in this analysis used *Task* as the query keyword. Of the resulting neighbourhood collocates the words *Project* and *Policy* were selected for further analysis. When *Task* and *Project* where used as the query terms the words *SOEIS*, *work*, and *deliverable* arose. The relationship between these types of words is clear – each are oriented toward the processual aspect of the carrying on of the research project. Similarly, when *Task* and *Policy* where queried together the words *Implications*, *Research* and *European* were revealed. These latter words are also processually, rather than conceptually, oriented.

The collocate analysis of the four keywords: *Firms*, *Organization*, *Project* and *Task* has revealed a networked interconnectivity between keywords and their neighbourhood collocates. Interestingly, the words isolated as important to the SOEIS project (*Firms* and *Organization*) tend to have conceptual words as their collocates, whereas the words selected on the basis of importance for the functioning of the SOEIS project tend to have process oriented words as their collocates.

Combined these analyses reveal a unity across the sets in that most words occur in the final document set providing another indicator of an 'aggregating text'. The emergent text is shown to accumulate over the time periods. The network dimensions of the SOEIS research group and their collective print output can thereby be understood to serve an archival function. With respect to the theoretical triad, the architecture of the print communications has been sketched in with a complex network of interrelations. By observing the fluctuations of keyword use, when compared as a time series, discernable networks of keyword usage were revealed. Similarly, and in light of Actor Network Theory, the collocate analysis revealed interrelationships between networked keywords. The analysis of the SOEIS print communication has revealed networked keyword use over the document set, but whether these are properties particular to the print medium will be more easily discernable once compared with the electronic communication database.

System

The analysis of the systemic properties of the SOEIS print communication is described below and provides an interesting juxtaposition to the network analysis in that the print behaviour of the SOEIS participants is conceptualized differently. Here the communications are viewed collectively as an overall system. Both the linear and non-linear relationships between the wordlists for each time period are compared.

The examination of the dataset for system transformation entails an assessment of the texts for critical transitions or path dependencies over the four datasets.[12] Here we measure the expected information content of each time period, as each related to the previous period or state of the communication. The analysis was performed on two levels. The first made the comparison on the shared occurrence of all words present the full reference corpus – Print All: 7627 words. The print document set was first checked for linear transitions between P1-P2, P2-P3, and P3-P4, and was then

[12] Callon 1986 – Path dependency is interpreted as 'obligatory passage points' (Leydesdorff, 1995:100). An obligatory passage point from A through B to C is found if: AB+BC<AC; in contrast, no path dependency is found if AB+BC>AC.

compared for non-linear associations; namely, P1-P3, P1-P4, and P2-P4. The results are presented below in *Figure 4.5: Four Time Periods Compared Linearly (7627 words)* and *Figure 4.6: Four Time Periods Compared Non-Linearly (7627 words)*.

Figure 4.5*:*
Four Time Periods Compared Linearly (7627 words)

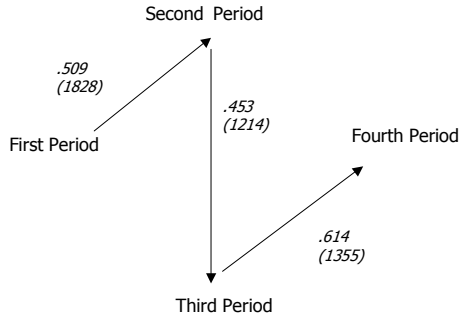
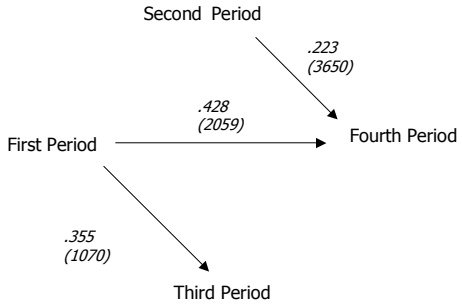


Figure 4.6:
Four Time Periods Compared Non-Linearly (7627 words)



The linear and non-linear relationships are compared in the following way. Linearly, between the first and second periods .509 bits of information was shared, and between the second and third time periods .453 bits of information was shared. To determine if the pathway between period one and period three involved a critical revision of the information (via period two), we look to the bits of information shared non-linearly between periods one and three (.355 bits of information). If the total bits of information shared between periods one and two, and between two and three is less that the bits of information shared non-linearly between periods one and three then period two can be understood to have entailed a critical revision of the information, and was thereby critical for the development of the shared information (by boosting the previous signal). When compared for the degree of continuity between the time periods no significant difference was found between the linear relationships (P1-P2, P2-P3, P3-P4), and the non-linear relationships (P1-P3, P1-P4, P2-P4). However, note that since the time periods do not contain the same amount of words shared between the time periods (for example, 1828 words were shared between periods one and two, and 1214 words between periods two and three) the calculation is presented with a division by zero.[13] The solution to this problematic is found by comparing only the shared words between the four time periods. Using this additional level of specification, the word lists were compared on the basis of the words that were shared by all four texts – Print Shared: 1009 words. The results are presented below in *Figure 4.7: Four Time Periods Compared Linearly (1009 words)* and *Figure 4.8: Four Time Periods Compared Non-Linearly (1009 words)*.

[13] Zero creates a problem because it doesn't occur as a predictor. Leydesdorff argues that given the formula for the expected information value ($I = \Sigma\ q_i\ ^2\log\ (q_i / p_i)$), we are "confronted with the division by zero in the case of the emergence of a 'new' occurrence in the *a posteriori* text" (1995:94). For Information Theory this means that the 'appearance of something which was predicted with certainty not to occur ($p = 0$) comes as a total surprise, so that this message has infinite expected information value.' (ibid:94).

Figure 4.7:
Four Time Periods Compared Linearly (1009 words)

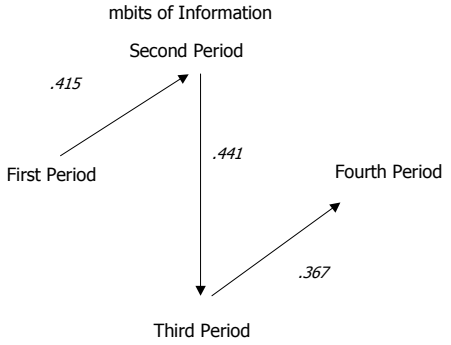
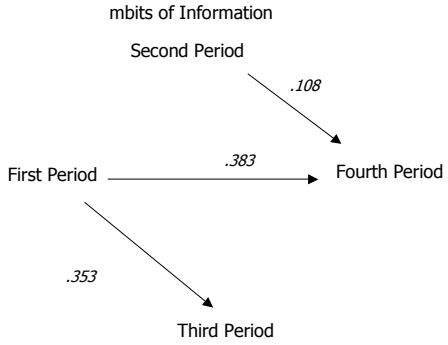


Figure 4.8:
Four Time Periods Compared Non-Linearly (1009 words)



Again, when compared for the degree of continuity between time periods no significant difference was found between the linear and non-linear relationships. Thus, contrary to the original expectation, the results do not show any evidence of critical revision or transition in the collective word use of the authors. This suggests that there was no fundamental reorganization of the word usage during the course of the research project.[14] However, this may also be interpreted to reflect a fundamental quality of collaborative research projects: that they are well organized and codified into particular discourses. As isolated by the standardized ratio of the percentage of unique words as isolated in the architecture analysis, the SOEIS print communications appear to have a lot of continuity.

Since no critical transitions were found in this analysis, a more detailed examination of the four respective wordlists for overall word distribution was performed in order to further test the expectation that self-organizational properties could be discerned. Where the previous analysis concerned the overall distribution of collective (and thereby systemic) patterns of word use, here we look again to the architectural parameters of information flow present in this mode of communication to aid the interpretation of the systemic analysis. The analysis measures for both *Specificity* and *Transmission. Specificity* is understood as the specificity of total word distribution, or more accurately: the ratio of the expected information content of the distribution relative to the maximum information content. *Specificity* is therefore a measure of the degree to which some words occur differently across the print dataset along the time dimension. By contrast, *Transmission* is the coupling of word distribution and the time dimension; it is the mutual information between word distributions over the time periods and is understood to reflect a reduction of the uncertainty (specificity): it is thereby a measure of the flow of mutual information across the dataset. *Table 4.6: Print System Dynamics*, below, shows the overall word Occurrence, Unique Words, Specificity, and Transmission of the print dataset.[15]

[14] The path dependencies tested within the print database do differ from the electronic; in the next chapter we compare the print and electronic databases for relative similarities and differences.
[15] The occurrence and unique word counts shown in *Table 4.6: Print System Dynamics* are different than the occurrence and unique word rates found in the architecture analysis above; this difference is because for this analysis the texts were pre-filtered using the stop-list.

File	Occurrence	Unique Words	Specificity	Transmission
Print-All	283992	7627	0.77	0.28
Print-Shared	226362	1009	0.81	0.08

Table 4.6: *Print System Dynamics*

The measure of *Specificity* suggests that the distributions of word use in Print-All and Print-Shared are not so different, thereby indicating a reduction of uncertainty.[16] Of the words in the Print-All dataset, 23 % are stable, compared with 19% stability of the Print-Shared words. This measure has also revealed that those words which have little effect on the specificity are not located in the Print-Shared dataset. The restriction in the number of words used during the two year time period proved more significant when compared with the shared mutual information across the time periods. While *specificity* refers to the specificity of the total word distribution, *transmission* eliminates the words not shared across the four time periods, and hence there is a reduction in the mutual information shared. The analysis revealed much less transmission in the Print-Shared dataset than the Print-All. The transmission of words in the Print-All dataset is three and a half times better than in the Print-Shared. The higher transmission in P-All is because of the inclusion of words which do not occur in each time period; thus, words which were *not shared* carried the transmission.

Generally speaking the expectations of the systems analysis were not confirmed – no evidence of self-organized criticality was found. However, the additional analyses of the levels of *specificity* and *transmission* in the print dataset showed that the distributions between the Print-All and Print-Shared shared a similar stability as regards specificity, and that the transmission of words in the Print-All document was significantly higher than the Print-Shared.

Summary

The primary objective of the architecture analysis was to identify whether the SOEIS print communications could be shown to have a discernable architecture. If so, it was expected that this architecture would reveal evidence of codification of scientific information. Confirming our expectations, the distribution of the standardized mean ratio percentage of unique words compared across the datasets revealed a stable process of information codification. Indeed, evidence was found of both an *a priori* codification and a *processual* codification. This line of argumentation was contextualized using the Medium Theory notion of the Information Network. The secondary objective here was to determine if particular qualities could be identified with a decidedly print mode of communication. Arguably the analysis has revealed architectural qualities of the print dataset, but only in juxtaposition with the results of the analysis of electronic communication can this expectation be confirmed.

The central objective of the network analysis was to identify network properties of the SOEIS print communication by comparing the fluctuations of keyword use over the

[16] The measure of *Specificity* indicates the way that the information flow is specific in deviating from 100%. The specificity of the communication in terms of collective word use in the case of Print-All is 77% specific, and in the case of Print-Shared, 81 % specific.

four time periods of the analysis. It was expected that a discernable pattern of keyword reoccurrence would be visible: some words would remain constant while others would likely occur in specific time periods, thereby showing particular emphases and evidences of information codification. These expectations were confirmed using a range of analyses. First, by comparing the top 50 keywords a general sense of the cognitive orientation of the research project was revealed. In order to gain a deeper sense of the topics that were addressed in this mode of communication, the document sets were compared with the total document set, and then against each other. These two latter approaches revealed different, and arguably more salient, sets of central topics. Substance was thereby added to the architectural frame by revealing how networks between co-words and their collocates differed over the time dimension. Actor Network Theory provided a focal point for understanding the differences in keyword use to reflect cognitive developments. Here the symbolic dimension of the SOEIS print communication is relevant and is best interpreted in light of the networks of intertextuality outlined in *Chapter II: Theoretical Grounding*.

The structural network of relations isolated by Saussure's notion of difference can be seen here to reflect the closed nature of the print dataset. Yet the dataset is not an isolated language system, it was created over time and accumulated; it was precisely the collected traces of the SOIES' *use* of the print medium. Hence the closed nature of Saussure's network of associations doesn't capture the essence of the print dataset. It is perhaps best conceptualized with respect to Derrida's notion of *différance* which highlights the inter-textual nature of the individual words and their interrelation. The print communications network of relations was contingent upon a social context, and therefore when interpreting the frequency or disappearance of keyword occurrence it proves more beneficial to appeal to the Postructuralist notions of meaning and exchange. Structuration Theory provides one important additional perspective to this theorizing about measurable meaningful exchange. The dynamic process of word-reuse can be interpreted to reflect properties of social and system integration; the social is integrated by the SOEIS members using the print medium – the structure of the language system is thereby operationalized – and the communication system writ large is also (re)integrated (which by definition remains unobservable).

Finally, the third analysis addressed the question of whether path dependencies in the SOEIS dataset could be identified, thereby indicating systemically that critical transitions were necessary for the communication to develop. Here it was expected that when examined for path dependency, points of critical transition would be discernable, thereby indicating that each stage of the project was necessary given the expected information content. This expectation was not confirmed. However the supplementary analysis performed did reveal an unexpected quality of the print communications – that the *transmission* of words over the Print-All dataset was significantly higher than that across the Print-Shared dataset. This final observation suggests that, in light of the macro perspective offered by Self-Organization Theory, despite the inability to find critical transitions or path dependencies in the dataset, the measures of specificity and transmission reveal a particular codification of information. This result may prove important when compared with the results of the system oriented analysis of the electronic communications dataset in the following chapter.

This chapter has served to characterize the SOEIS print communications with respect to its the architectural, network and systemic dimensions. In so doing the modelling aspect of mapping mediated communications was addressed, as were the symbolic, or meaning dimensions of the communication. Further, this approach has established a mode of analysis that will enable a comparison between the print communications and the electronic. Importantly, the *Architecture – Network – System* triad is central to binding this analysis. It is treated here as the core model of this dissertation, and will be repeated throughout *Part II – Analysis*. It will prove crucial to collating and comparing the results of all analyses in *Part III – Reflection.*

Chapter V: Analysis of Electronic Communication

Introduction:

This chapter subjects the electronic output of the Self-Organization of the European Information Society (SOEIS) research project to the same analyses as the print communication analysis described in the previous chapter. Again, the examination entailed a threefold analysis to explore the architectural, network, and systemic dimensions of the SOEIS communications. A computer assisted textual analysis was performed upon the body of the SOEIS electronic communications, as recorded in the email exchanged on the two project mailing lists (*EuroCon-Knowflow*, and *SOIS*). Several different techniques are employed to understand the characteristics of word use in the mailing lists for the project time period, as described in *Chapter III: Materials & Methodologies*. By using precisely the same techniques for the print and electronic analyses, a method of comparing print and electronic output is established in order to understand the roles that different media play in processes of knowledge production. In this way it proves possible to assess the degree to which print and electronic media bias different types of information organization; or, indeed, if perceived as processes, of knowledge production.

Importantly, like print, electronic writing leaves examinable traces and it is precisely these traces and their interrelation that are examined in order to uncover a network structure in the data. Similar to the print analysis, the primary aim here was to use textual analysis techniques to determine whether the SOEIS electronic communications could also be shown to exhibit architectural, network, and systemic properties. In this way the central question was addressed: can electronic knowledge production as a mediated process be shown to exhibit a particular media bias? This led to the question of whether the network architectures of print and electronic media could be compared to reveal particular biases implicit in mediated processes of knowledge production. The second aim of this research was therefore to compare the results of the textual analysis of the electronic dimension with the results of the analysis of the print dimension. Using this approach, the relevant similarities and differences between these respective modes of communication become apparent.

Research Focus

The analysis of the electronic dimension first sought a structural architecture to the data. Networks were then located through analyzing keyword fluctuations, thereby illustrating electronic communication as process of mediation distinct from print. Finally, the electronic dataset was examined for self-organized criticality and the results compared with the results of the system oriented analysis performed in the previous chapter. Media is emphasized here as something *used* – as described in *Chapter II: Theoretical Grounding* with the aid of Structural, Postructural and Structurational theories of network and meaning.

The central hermeneutic unit remains the same in this analysis: the keyword in context serves as a focal point for questions concerning both individual and collective

behaviour. Again, keywords and associates were treated as *events* that compile and complexify via networked communication and that may prove to behave systemically. Importantly, language used in email communications is expected to be fundamentally different from that used in print communication. This may be explained in part by the formal nature of print communications and publications as distinct from the ways that language use operates in email communications, as discussed in *Chapter III: Materials & Methodologies*. Notably, the SOEIS email communication is fundamentally different in its consistency than the print communication simply because it is collectively generated as individual messages, whereas the print communications were mainly co-authored communications.

The electronic output of the SOEIS members was examined for its basic architectural features including the document size, word frequency and unique-word frequency (and their ratio), for network features such as rate of word-use change, and for systemic features such as phases of 'pathway dependence' or critical revisions / transitions in the dataset, and then differences in overall word distribution. The differences in the consistency across each of the four respective electronic documents are relevant here in how they compare with the consistency across the print documents.

Research Questions & Expectations

Given that similar information was exchanged over these two different information channels it was expected that differences between the respective databases could prove instrumental in finding particular media bias. Further, given the centrality of the print medium to the functioning of the SOEIS research project, the analysis aimed to determine if print provided a decidedly different mode of communication than electronic media and if this difference had any notable impact on SOEIS communications. As with *Chapter IV: Analysis of Print Communications* the basic expectation here was that an analysis of the architectural, network, and systemic features of electronic mediation will help to reveal biases particular to this medium.

The theoretical triad of *Architecture – Network – System* framed this analysis, provided a basis for comparison, and assisted in the formulation of a number of distinct expectations. Three *research questions* were thereby identified, corresponding with the theoretical lens. The research questions are described below with the central expectations of each analysis.

First, *does SOEIS electronic communication have distinctly different architecture than the SOEIS print communication, and can particular qualities be identified with a decidedly electronic mode of communication?* As with the examination of SOEIS print communication in the previous chapter, registered changes in the mean ratio percentage of unique words in the electronic communications were used to identify cognitive orientation, and to isolate processes of information codification. In this way, a network architecture unique to the SOEIS electronic communications should be revealed. Given that the architecture analysis of the print communications in the previous chapter revealed evidence of information codification, the primary expectation here was that a comparison of the basic architectures of the print and

electronic databases would reveal qualities particular to each mode of communication. The electronic communications should appear more Mode II oriented than the print which exhibited Mode I characteristics. That is to say, the electronic communications should appear less codified by the parameters of the EU research project than the print communications. This difference should be observable through a comparison of the results of the print and electronic analyses. Importantly, these differences are expected to highlight ways in which print and electronic media codify information in distinctly different ways.

This question is informed by the Medium Theory notion of the information network, and aims to characterize electronic writing as contributing to a similar academic (information) network, but one that is expectedly different. With respect to research question one, the general expectation is that the electronic architecture will prove to be distinctly different from the print, and can be understood in this context as isolating the crux point between Mode I and Mode II types of knowledge production.

The second research question: *are network properties of SOEIS electronic communication discernable by comparing the fluctuation of keyword use over the four time periods in the analysis, and does this distribution differ significantly from the results of the print analysis?* As with the print analysis, insight into the cognitive orientation of the electronic communication is gained through examining keyword distribution in a number of different ways. Specifically: by looking to the top 50 keywords, by comparing the wordlists of each time period with the collective document set, and by comparing every time period with each other. The question is informed by Actor Network Theory and outlines the network features of electronic communication as individual communications that compile through collective interaction.

A key focus here is how individuals electronically contribute to produce texts and thereby form an information network. The primary expectation related to research question two is that the top electronic keywords will contain similar words to the print, but that a different emphasis will be located; specifically, it is expected that the electronic keywords will be more process oriented, rather than result oriented, given the use of the email communications to share and comment upon developments during the course of the research. It is therefore also expected that the electronic keywords will exhibit more of a speech bias than the print keywords, given the informal nature of email communications. The pattern of keyword distribution should prove to share certain qualities with the print dataset, and the notable differences will be interpreted in terms of electronic media bias.

Again, fluctuating changes in the position of the keywords are integral to understanding knowledge production as a process. The network dimensions isolated through ANT approaches and the theories of meaning from Structuralism, Poststructuralism and Structuration Theory provide a useful theoretical stance from which to understand the dynamics of meaningful exchange, and by extension, modes of knowledge production. Importantly, differences in the types of keywords used in the electronic database, by contrast to the print, should prove significant in the context of understanding the distinctions between formal and informal communications, by observing the variations in keyword emphases.

Fluctuations across the time series may be interpreted as evidence of changing cognitive biases as exhibited by their respective differences. In this way we can appreciate the means through which individual communications aggregate and reflect collective orientation. This reinforces the Actor Network Theory contention that textual analyses can indeed be conceptualized using network approaches, and positions the analysis toward the systemic aspects of the aggregate data sets.

Third, *can we identify path dependencies in the SOEIS electronic dataset indicating necessary transitions in the information exchanged, and does this differ significantly from the results for the print analysis?* This final analysis is contextualized using Self-Organization Theory. Again, the systems oriented analysis compares the linear and non-linear associations between the time periods of the SOEIS Communications; in this case, from the electronic dataset. By comparing the expected information content of each time period as compared to the previous state of the communication, the analysis aims to determine if the communicated information followed particular pathways over others thereby indicating processes of critical transition. However, with respect to this last research question the expectation is that since no critical transitions were located in the print database it is unlikely that the electronic will exhibit any either. In the print analysis in the previous chapter it was discovered that there was no apparent self-organized criticality in the print dataset; when compared with the results of the system oriented analysis of the electronic dataset additional perspectives may be attained. The specificity and transmission of the words in the electronic dataset is examined to expand our understanding of the differences between the print and electronic data sets.

In *Chapter VIII: Integration & Conclusions*, the results of this comparison between print and electronic modes of knowledge production will be described with the results of the analysis of SOEIS journal publication and the analyses of the EuroCon-Knowflow and Self Organization of the Information Society (SOIS) mailing list thread behaviour (covered in *Chapters VI* and *VII*, respectively). In what follows, the results of the electronic and print textual analyses are compared in tandem.

Results

Architecture

The analysis of the electronic data set entailed an initial filtering of the email data to eliminate redundancy.[1] A total of 1261 emails were compiled into four 6 month chunks denoting the same four time periods as the previous print analysis the texts were run through the *WordSmith* program to obtain a range of descriptive statistics including the number of emails, relative size, word count, unique-word count, the percentage of unique words and their mean ratio percent. The texts were then filtered

[1] The texts were filtered using three logics. First, the redundant lines of the respective emails were eliminated (next, previous, and re: subject lines), as were all signature files. Second, all messages which were a response to another message had the previous message removed. Finally the texts were filtered using an adapted stop-list (see *Appendix B.1*).

using the same adapted stop-list.[2] *Table 5.1: Electronic Architecture* shows the basic statistical information.

Name	#Emails	Size	Word Occurrences	Unique Words	% Unique Words	Mean Ratio %
E1.txt	350	807 KB	120113	3604	2.88	54.29
E2.txt	357	980 KB	140125	4498	3.21	58.61
E3.txt	293	660 KB	97552	3247	3.33	57.09
E4.txt	261	991 KB	142228	4859	3.42	60.14
E-All.txt	1261	3438 KB	500183	9679	1.94	57.67

Table 5.1: *Electronic Architecture*

In the electronic database it is observed that email activity decreases over time, suggesting an externalization of the larger SOEIS group.[3] By contrast, document size, word occurrence, and unique word occurrence all increase over time with the notable dip in the third time period. This dip may be due to the combination between the two lists (*EuroCon-Knowflow* and *SOIS*), as the third phase of the electronic communications would have been a transition period for the participants of the SOEIS research project. The mean ratio percentage of unique words shares this dip in distribution, whereas the percentage of unique words decidedly increases over time. As with the print analysis, the percentage of unique words is interpreted here as an indicator of the *style of variation* between unique words and total word occurrence, as distinct from the mean ratio percentage of unique words which is recomputed every 1,000 words.

The meaningful difference between the print and electronic architectures is discernable through a comparison of the mean ratio percentage of unique words over the four time periods. Where the mean ratio percent remained relatively constant over the four print datasets, there was a marked increase in mean ratio percentage over the four electronic datasets. This difference may suggest an accretive influx of new words and therefore new types of research interests. By implication this would mean that the print document set exhibits a more codified communication than the electronic; new ideas appear to be communicated electronically, not in the print communications.

The results from the print analysis revealed evidence of codification as both a *process,* perhaps as the result of a single author or group of authors acting as editors prior to the project submission, and an *a priori* codification. The increasing mean ratio percent in the electronic dataset suggests precisely the opposite – there appears to be evidence of resistance to codification and an embracing of new research questions, thereby confirming the expectation that an analysis of the architectural features of the electronic dataset would exhibit a different codification style than the print.

[2] The four 6 month chunks delineated in the print analysis to correspond with the four major developments of the print communications dataset: Application, Milestones, Reports and Final Results. The electronic communications were divided into the same four six month chunks to provide a basis for comparison.

[3] The decrease in email activity is interpreted as an externalization of the SOEIS group; the main thrust of project communications occurred in the print dataset. The introduction of the SOIS mailing list was a strategic move meant to expand the communications of the EuroCon-Knowflow mailing list to include non-European elements of the information society, but in effect reduced the flow of electronic communication.

Network

The network analysis of the electronic dataset involved an examination of the relationships between keywords over the four time periods represented by the four wordlists (E1, E2, E3, and E4). Network properties are exhibited by identifying fluctuations in keyword and collocate distribution over the four time periods. Shifts in keyword emphases over the course of the project are expected to provide evidence of changes in the collective cognitive organization of the project.

As shown in *Chapter IV: Analysis of Print Communication*, the keyword network analysis performed on the four wordlists involved a range of distinct approaches. The first isolated the top 50 occurring keywords for each time period; the second identified positive and negative keywords by comparing the four respective texts with the electronic dataset; the third compares each text with each other (not the full electronic data set), and finally, keyword collocates are located for a selection of representative keywords.[4] In this way major developments in the concepts being exchanged are outlined.

Ten keywords from the top 50 most commonly occurring words in each time period in the electronic data set were selected on the basis of their relevance to the SOEIS research project. They are displayed below in *Table 5.2: Top Electronic Keywords*.

Word	E1	E2	E3	E4	Total
Information	381	478	278	423	1560
Research	451	328	304	360	1443
Conference	172	356	214	427	1169
Knowledge	346	137	122	231	836
Project	406	141	157	114	818
Organization	314	190	150	154	808
Meeting	274	184	160	41	659
Task	387	90	93	47	617
Policy	202	54	135	131	522
Networks	316	80	50	44	490

Table 5.2: *Top Electronic Keywords*

The keywords and their distribution demonstrate the general research environment or context of the SOEIS group as similar to that generated through the print communication. Here we find a considerable overlap between those words found in the print and electronic databases; half of the top ten words shown here also occurred with high frequency in the print dataset: *Information, Networks, Organization, Project,* and *Task*. Interestingly, they generally appear to occur with similar frequencies across the time periods irrespective of the medium in which they were generated (print or electronic), with the exception of *Networks* and *Organization* which occur less frequently in the last period of the electronic dataset than in the print. Further, the keywords *Information, Networks, Organization, Project* and *Task* each occurred with high frequencies in the last time period of the print data set, whereas in the electronic dataset they occur with significantly lower frequencies, with the notable exception of the keyword *Information*.

[4] Only those words that occurred within five words to the left or right of the query word were included in the correlate analysis; too narrow a window limits results and too wide a window dilutes results.

Five keywords are unique to the top 50 of the electronic dataset: *Research, Conference, Knowledge, Meeting* and *Policy*. This selection of words reveals a slightly different emphasis of the research project in its use of the email lists. With the exception of *Knowledge*, it is arguable that all of these words imply some sort of activity that arguably supplements the research project itself. Also notable is that *Meeting*, *Task,* and *Networks* occur relatively infrequently in the last time period of the electronic dataset. Indeed, it is logical that the words *Meeting* and *Task* would have been used less in this medium when the project reached completion. This confirms the expectation that the keyword distributions in each medium are related to its designated function.

Because the most commonly occurring words generate noise and cloud the evidence of critical keywords, a second analysis was performed whereby critical keywords were isolated by comparing texts. Two distinct keyword analyses were performed on the electronic dataset whereby the respective wordlists (E1, E2, E3, and E4) were compared with the full document set (E-All), and then compared with each other (E1 with E2, E2 with E3, E3 with E4). In this way keywords for each time period were determined on the basis of how frequently the keywords were used over the whole project by comparison with the full document set, and then again by highlighting the transition between the time periods.

Again, the *shared* keywords revealed by comparing wordlists using the *WordSmith* program are assigned either positively (+) and negatively (–) thereby representing those words which occur more or less often than expected, given the texts that are compared. The equal (=) signs simply represent that the words were not designated as key, not that they did not occur. The comparison of the individual wordlists with the full document set isolated four lists of keywords, one for each time period. Fifteen salient examples are shown here; these were selected on the basis of their relevance to the research project, and by extension, the perceived supplementary role of the electronic medium. *Table 5.3: Electronic x All*; for the results of this analysis.

Word	E1 x Eall	E2 x Eall	E3 x Eall	E4 x Eall
Amsterdam	+153	=	=	−23
Agreement	=	−5	+69	=
Analysis	+155	=	+39	=
Bielefeld	=	+26		−5
Data	+222	=	−43	−58
Evolutionary	=	+200	−14	=
Industrial	+86	−14	=	=
Knowledge	+346	−137	=	=
Meaning	=	=	+158	−27
Network	+211	=	=	−54
Networks	+316	=	=	−44
Project	+406	−141	=	−114
System	=	=	+621	−274
Task	+387	−90	=	−47
Theoretical	+144	=	=	−34

Table 5.3: *Electronic x All*

The first notable thing about this distribution is the fact that the majority of keywords occur with a high frequency in the first time period (*Amsterdam, Analysis, Data, Knowledge, Networks Task* and *Theoretical*), and all keywords tapered in their general usage over time; indeed, words designated as key in the final time period were all negatively de-noted, suggesting a decreasing importance of these terms in the electronic medium towards the end of the project. The keywords *Evolutionary*, *Meaning*, and *System* each occurred with a high frequency in the middle time periods of the dataset, and then decreased significantly in emphasis.

Table 5.4: Electronic x Each shows the results of comparing the word lists from each time period with *each other*, not the full document set. The aim of this technique was to extract not only those words which are designated as keywords, but to isolate those that are specifically shared between texts, thereby representing periods of transition.

Word	E1 x E2	E2 x E3	E3 x E4
Data	+222	–139	=
Evolutionary	–80	+200	–14
History	–17	+106	–13
Identity	+103	–35	+89
Innovation	+138	–39	=
Integration	+57	–17	+53
Leydesdorff	+249	=	+98
Meaning	=	–71	+158
Meeting	+274	=	+160
Project	+406	=	+157
Task	+387	=	+93
Understanding	=	–73	+139

Table 5.4: *Electronic x Each*

By comparing the texts with each other instead of the full document set, one gains a better sense of the transmission of information (measured as keyword distribution) over the time periods. It is interesting, for example, that words one would relate directly with the functioning of the SOEIS research project (*Data, Meeting, Project,* and *Task*) all decreased in emphasis over the transition phases. Perhaps more significant is that those words which arguably represent *processual* aspects of the SOEIS appeared to increase in importance over the dataset (*Meaning* and *Understanding*). It is also notable that *Identity*, and *Integration* decreased in the second transition phase and then rose again in the final phase, whereas the keywords *Evolutionary*, and *History* had a high frequency and were positively de-noted in the second phase and then decreased significantly in the final. However, in the context of the SOEIS research project these latter words are not as central to the project.

When compared with the results of the print analysis, it is interesting that those words from the electronic dataset associated with the functioning of the research project (*Data, Meeting, Project,* and *Task*) all decreased in emphasis over the dataset, whereas function words in the print dataset (*Empirical, Methods, Partners* and *Task*) were designated negatively in the middle phase and increased in frequency in the final phase. This result confirms our expectations. The differences in identified keywords reinforce what was learned by analyzing the print dataset – that medium and designated function are uniquely related.

Finally, a collocate analysis was performed on the electronic dataset set using a handful of keywords repeatedly isolated in the network analyses outlined above (*Evolutionary, Meaning, Project,* and *Task*). *Evolutionary* and *Meaning* were selected because they emphasize the conceptual aspects of the SOEIS, whereas *Project,* and *Task* have been specifically selected for their direct relevance to the operation of the SOEIS project. In order to determine the occurrence of keyword collocates the electronic dataset was examined for neighbourhood collocates and their tightly associated keywords. As with the last chapter, the network analysis entailed the examination of the original texts (E1, E2, E3, and E4) for frequently occurring neighbourhood collocates of the selected keywords.

For the collocate analysis the occurrence of each query word was first plotted across the electronic document set.[5] The results of the electronic collocate distribution analysis are presented below in *Table 5.5: Distribution of Electronic Keywords for the Collocate Analysis*.

File	Words	*Evolutionary*	/1000	*Meaning*	/ 1000	*Project*	/ 1000	*Task*	/1000
E1.txt	117,595	80	0.68	30	0.26	409	3.48	387	3.29
E2.txt	137,822	200	1.45	71	0.52	141	1.02	90	0.65
E3.txt	96,062	14	0.15	158	1.64	157	1.63	93	0.97
E4.txt	140, 894	82	0.58	27	0.19	114	.81	47	0.33

Table 5.5: *Distribution of Electronic Keywords for the Collocate Analysis*

The distributions of the keywords selected from the Electronic dataset differed significantly from the distributions outlined in the collocate analysis of the print dataset. Most notable is that the frequency and standardized frequency (per 1000 words) of the keywords *Evolutionary, Meaning, Project,* and *Task* remain aligned, unlike the distributions found in the print dataset where the keywords selected for the collocate analysis were shown to have to have differing values depending on the frame of analysis. For example, *Evolutionary* occurs quite frequently in the second document set, and this is the same when measured for its occurrence every 1000 words. This level of correlation was not observed in the print dataset. This difference between the print and electronic datasets may be due to the cut and paste environment identified with EU research projects in the last chapter. The print communications dataset was found to accumulate over the time periods (as an archived dataset that was continually updated and resubmitted); by contrast, the keyword distribution in the email communications appears to be more stable over the time periods.

A further result was found here comparing the distribution of the keywords *Project* and *Task* in both the print and electronic datasets. In the case of the keyword *Project*, its frequency is high in the first time period and decreases over the course of the SOEIS project – this is the case for both print and electronic datasets. By contrast, the electronic keyword *Task* appeared frequently in the first dataset and decreased over time, whereas in the print dataset *Task* increased in relative use. As with the previous analysis, the distributions of the electronic keywords gave an immediate sense of the cognitive priorities of each time period. These words were further contextualized by isolating their central neighbourhood collocates.

[5] Visual displays revealing the collocate word distributions across the individual documents for each time period were generated and can be viewed in *Appendix B*.7 through *B.10*

The difference between associate and neighbourhood collocates is important. Associate collocate keywords are those words which one would logically group together based on association to a common theme; no computer assisted textual analysis program is able to organize collocates in this manner. By contrast, finding neighbourhood collocates (words which occur near other words) is very easily accomplished using textual analysis computing tools. Interestingly, the collocate analyses performed in this study have been able to hone in on associative words by performing not only a singular neighbourhood collocate analysis but by grouping keywords with individual collocates. In this way we gained a better perspective on the cognitive biases revealed by the words and their collocates, rather than just identifying individual neighbourhood collocates.

The key collocates of each query word were then isolated and a number of secondary collocate associations were selected for comparison; following the logic of the previous analyses, the additional words selected for the secondary collocate analysis were selected on the basis of their relevance to the SOEIS project. The secondary collocates were run through the electronic dataset with the original query word to determine its tightest word associations. The selected collocates for each keyword, and it successive co-collocates are shown below in *Figure 5.1: 'Evolutionary' Collocate Analysis, Figure 5.2: 'Meaning' Collocate Analysis; Figure 5.3: 'Project' Collocate Analysis,* and *Figure 5.4: 'Task' Collocate Analysis.*

EVOLUTIONARY	**414**
COMPUTATION	89
GENETIC	35
THEORY	30
ECONOMICS	28
SYSTEMS	27
BIOLOGY	25
PROGRAMMING	25
EVOLUTION	24
ALGORITHMS	21
UNIVERSITY	21
MODEL	20
NEURAL	19

EVOLUTIONARY	**28**
SYSTEMS	**27**
CO	6
EVOLUTION	6
FUZZY	5
NEURAL	5

EVOLUTIONARY	**26**
NEURAL	**19**
PROGRAMMING	12
NETWORKS	11
EVOLUTION	9
CO	6
GENETIC	6
ARTIFICIAL	5
SYSTEMS	5

Figure 5.1: *'Evolutionary' Collocate Analysis*

The query performed on the keyword *Evolutionary* produced a list of interesting collocates from which two additional query terms were selected: *Systems* and *Neural*. When sought in tandem, the words *Evolutionary* and *Systems* were shown to have *Co-*, *Evolution*, *Fuzzy* and *Neural* as their collocates. These words appear to be associate collocates, as they are so close in theme to the keyword. Similarly, when *Evolutionary* and *Neural* were queried together, the resulting collocates included: *Programming*, *Networks*, E*volution*, *Co-*, *Genetic*, *Artificial*, and *Systems*. Again the associations isolated in this analysis provide us with the necessary arguments to claim that cognitive networks of the SOEIS electronic communication have been identified and that these networks resemble associate collocates – that is, words clustered together by association. Arguably, one might expect that the keyword *Firms* would arise in the context of the keyword *Evolutionary*, but this is not the case for the electronic dataset.

If *Evolutionary* were used as a query keyword for a collocate analysis of the print dataset, then it is likely that the word *Firms* would arise in its neighbourhood given the centrality of both words to the second time period of the print dataset; the relationship between these words was observed in the keyword network analysis of the SOEIS print communications.

MEANING	**332**
INFORMATION	44
SYSTEM	42
UNCERTAINTY	28
LOET	26
SYSTEMS	21
PROVIDED	19
WORDS	16
PROVIDING	14
SELF	14
ABOUT	13
HENK	12

MEANING	**43**
INFORMATION	**40**

MEANING	**16**
WORDS	**16**
HENK	10
LOET	8
PETER	7
GOORHUIS	6
LEYDESDORFF	5

Figure 5.2: *'Meaning' Collocate Analysis*

When *Meaning* was used as the query word several unusual collocates were identified. In particular, for the first time we observe the appearance of personal names, a dynamic that is intensified when both meaning and words are queried together. The latter resulted in a collocate list comprised only of first and last personal names. More surprisingly, when the words *Meaning* and *Information* were queried together no collocates were found. Rather unlike the keyword *Evolutionary* which had many interesting associate collocates, *Meaning* has no associate collocates when combined with *Information*, and when combined with *Words,* only personal names as neighbourhood collocates were identified. The word *Meaning* either has little functional role here in the SOEIS or its co-occurrence with personal names is due to the use of the term *Meaning* near the end of individual email communications.[6]

PROJECT	**839**
MEETING	77
SOEIS	66
RESEARCH	63
MEMBERS	41
MANAGEMENT	40
TASK	39
MEETINGS	34
SELF	30
WORK	28
ORGANIZATION	22
INFORMATION	21
EUROPEAN	20

PROJECT	**104**
MEETING	**49**
MEETINGS	**22**
SOEIS	14
ROME	13
PURPOSE	10
MANAGEMENT	9
LOET	7
SWITZERLAND	7
BIELEFELD	6
DATE	6

PROJECT	**43**
MANAGEMENT	**40**
MEETING	31

Figure 5.3: *'Project' Collocate Analysis*

With the keyword *Project* as the query word many SOEIS project related collocates arose. Of these both *Meeting* and *Meetings* were selected for further analysis, as was

[6] Email communications often end with a personal name. Note that all email signatures were removed in the email filtering process; personal names that were part of the message were not removed.

the term *Management*. *Project* with *Meeting* and *Meetings* yielded several locations where project meetings were held (though not all), the word *Date* as well as the term *Management* and one personal name. When *Project* and *Management* were queried together for shared collocates, only the word *Meeting* arose. This collection of words suggests the planning of meetings and co-ordination of events. By contrast, the results of the print collocate analysis yielded words such as *Research* and *Dissemination* which rather suggested the 'doing' of research.

TASK	**761**
PROJECT	37
SELF	26
LOET	25
TASKS	23
MEETING	22
AMSTERDAM	21
DAVID	19
THEORETICAL	19
WP	19
BIELEFELD	18
INPUT	18
ORGANIZATION	18

TASK	**46**
PROJECT	**37**
MEMBER	6
RESPONSIBLE	6

TASK	**22**
MEETING	**22**
BIELEFELD	5

Figure 5.4: *'Task' Collocate Analysis*

The final word queried for collocates was *Task*. From the results, *Project*, *Task* and *Theoretical* were selected for the combined searches. When *Task* and *Project* were queried together the words *Member* and *Responsible* arose; with *Meeting* and *Task* the result was the word *Bielefeld*. Finally, the query of *Task* and *Theoretical* yielded absolutely no collocates. By comparison, the print collocate analysis of the word *Task* yielded words like *Implications* and *Deliverables*. The electronic communications do not appear to *discuss* the act of fulfilling the SOEIS tasks, but rather focus on the meetings, members and the project itself.

Unlike the print analysis where it was discovered that most words occur in the final document set, thereby indicating an 'aggregating text', the electronic text appears more evenly distributed. This is reinforced by the distribution between keywords as highlighted above. Thus, while the print document sets appeared to serve an archival function, the electronic appear to serve a supplementary function whereby issues are discussed that are not seen as central to the performance of project tasks, but to the evolution of the cognitive realm of those communicating. The architecture of the electronic communications has been enriched with the network analysis, suggesting different functional roles of print and electronic communications in the context of the SOEIS. The electronic distribution reveals that the types of keywords repeating across the time series prove to be more informally oriented, to contend with managerial issues of the research project, and to appeal to a larger audience than the print distribution.[7]

[7] It is notable that certain words simply do not occur in the print dataset whereas they are prominent in the electronic; the word 'dear', for example, was found among the top 50 electronic keywords. Informal words were used more frequently in the electronic medium – email communication does differ from print in this respect, as argued by Collot & Belmore (1996).

System

The third stage of analysis involved the assessment and comparison of the document sets to determine the nature of transformation in the SOEIS electronic communications system. Critical transitions or path dependencies were not located in the print database, but are measured for here in the electronic to discover if they differ significantly, and if so then to describe why. In addition, the electronic dataset is examined for the specificity and transmission of word use, and there results are compared with the results of the print system analysis.

The system transformation analysis involved the identification of critical transitions over the four electronic documents. The words in each respective time period were compared; first the linear transition periods between E1 and E2, E2 and E3, and E3 and E4 were examined for continuity, and then compared with non-linear relationships between E1 and E3, E1 and E4, and E2 and E4. The comparison will show whether the linear pathway along which the electronic writing evolved was critical for the information's development. As argued in *Chapter IV: Analysis of Print Communication* critical transitions or revisions in the dataset can be identified by comparing the bits of information exchanged linearly between the respective time periods with the bits of information shared non-linearly. However, since words occur in some of the time periods and not others, two distinct levels of analysis were performed.[8] The comparison was first performed upon the complete word lists of each respective time period (Electronic-All), and then upon only the words shared across all time periods (Electronic-Shared). The results of the comparison performed on the complete word lists for each time period are shown below in *Figure 5.5: Four Time Periods Compared Linearly (7672 words)* and *Figure 5.6: Four Time Periods Compared Non-Linearly (7672 words).*

Figure 5.5:
Four Time Periods Compared Linearly (7672 words)

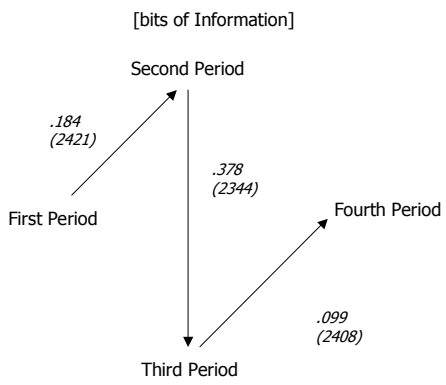
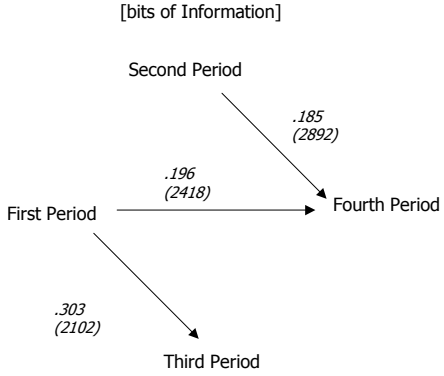


Figure 5.6:
Four Time Periods Compared Non-Linearly (7672 words)



[8] As argued in *Chapter IV: Analysis of Print Communication*, since the time periods do not contain the same amount of words shared between the time periods the calculation is presented with a division by zero; this is problematic because the word then doesn't occur as a predictor (one cannot divide by zero). The solution to this problematic was found by comparing only the shared words between the four time periods.

Between the first and second periods of the Electronic-All dataset, .184 bits of information was shared and between the second and third time periods .378 bits of information was shared. When compared with the bits of information shared non-linearly between period one and period three (.303) it was learned that no critical revision of the texts occurred between periods one and three via period two because the total number of bits was higher than the non-linear pathway. When all time periods were compared using this approach, it was learned that there were no critical transitions in the full reference corpus of 7672 words. And again, similar to the Print-Shared analysis in *Chapter IV*, when the Electronic-Shared document set (comprised of word lists based solely on the basis of their inclusion in each of the four time periods) was examined, no path dependencies were identified. These results are presented below in *Figure 5.7: Four Time Periods Compared Linearly (1759 words)* and *Figure 5.8: Four Time Periods Compared Non-Linearly (1759 words)*:

Figure 5.7:
Four Time Periods Compared Linearly (1759 words)
[bits of Information]

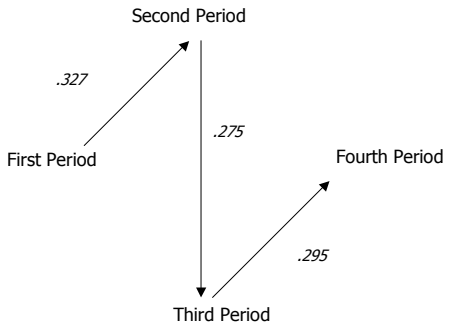
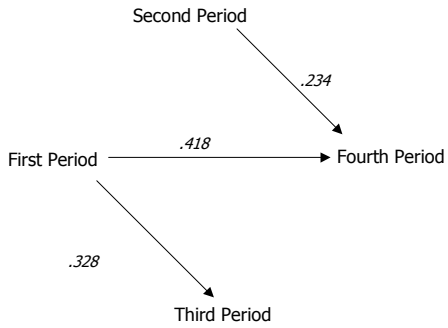


Figure 5.8:
Four Time Periods Compared Non-Linearly (1759 words)
[bits of Information]



With this analysis we find that there is no critical revision of the information at the level of the email communication, in either the Electronic-All or Electronic-Shared datasets. Thus, neither the electronic nor the print had any periods in which the overall distribution of words being communicated over the two year time period of the SOEIS project significantly changed. However, it is notable that in the Electronic-All dataset the transition between the third and fourth time periods is significantly lower than evident in the print dataset. This fluctuation in the electronic dataset may be attributable to the newness evident in email communications, or may in fact be related to the notable dip in the size, word count and unique word occurrence isolated in the architecture analysis. The lack of fluctuation in the print case reflected the codified nature of print project communications as described in *Chapter IV: Analysis of Print Communication*, which suggested a lack of innovation in heavily codified EU projects.

The final analysis of the electronic database examined the four respective wordlists for characteristics of word distribution. Since there was no critical transition apparent in the electronic communications we turn again to the architectural parameters of the

dataset to identify changes in *Specificity* and *Transmission*. Again, *Specificity* is the specificity of total word distribution across the whole dataset, as the ratio of the expected information content of the distribution relative to the maximum information content – it is the measure of the degree to which some words occur differently in the electronic dataset along the time dimension. *Transmission*, as the flow of mutual information across the dataset, represents a reduction of this specificity, or uncertainty – it eliminates the words not shared across the four time periods. *Table 5.6: Print / Electronic System Dynamics* shows the overall word Occurrence, Unique Words, Specificity, and Transmission of the print and electronic datasets.[9]

File	Occurrence	Unique Words	Specificity	Transmission
Print-All	283992	7627	0.77	0.28
Electronic-All	226362	7672	0.99	0.37
Print-Shared	173962	1109	0.81	0.08
Electronic-Shared	171364	1759	0.99	0.11

Table 5.6: *Print / Electronic System Dynamics*

The results were compared with the results of the print analysis. With respect to unique word count there was a notable difference found between the Electronic-All dataset and the Electronic-Shared dataset; the difference between the unique words in Print-Shared with Electronic-Shared indicates that print set performs the same task (the carrying of the SOEIS communications) with a smaller number of words than in the electronic set. This implies a restriction in the number of words used in the project's print communications. The restriction in the number of words used over the course of the project is significant when compared for the *Transmission* of bits of information. There appears to be more transmission between the time dimensions in the electronic case, but the difference is mainly caused by words that occur in specific periods and not in others. Thus, there appears to be a stronger process of codification in the print documents than the electronic documents. This claim is supported by the observation that *specificity* remains lower in the electronic case than the print and that this observation does not change with the shared datasets (0.99). Compared with the *specificity* of words in the Print-All dataset (23 % stability) and the Print-Shared words (19% stability), the Electronic-All and Electronic-Shared both exhibit a mere 1% stability – the word distribution in the electronic dataset is nearly random. The print dataset is therefore much more structured and codified than the electronic.

Summary

The theoretical triad of *Architecture – Network – System* as the model through which the analyses were performed and interpreted has aided in the collation of the results obtained through the analyses of the SOEIS print and electronic communications. The main objective of this chapter was to examine the electronic communications using the same methods as the print analysis in the previous chapter, and to compare the results. Elements associated with print as a Mode I type of knowledge production and

[9] The *occurrence* and *unique word* counts shown in *Table 5.6: Print / Electronic System Dynamics* differ from the *occurrence* and *unique word* counts found in the print and electronic architecture analyses (above) because the texts were filtered using the adapted stop-list.

electronic as Mode II were found. The three research questions posed in the beginning of this chapter are addressed below.

It was asked if the electronic communication of the SOEIS would prove to have a different architecture than the SOEIS print communication, and if particular qualities could be identified with a decidedly electronic mode of communication. It was found that the electronic communication does have a distinct architecture from print. It was learned that email activity decreased over time, while size, word frequency, and unique word occurrence increased over the time period under analysis. The unique word percentage and mean ratio percentage of unique words dipped only slightly in the third period due to the shift of dominant member participation from the EuroCon-Knowflow mailing list to the SOIS mailing list during this period. The mean ratio percent showed that the style of variation of the electronic database increased over the time periods, thereby suggesting an influx of new terminology, ideas, and presumably new research interests. Thus, the print and electronic architectures proved to be quite different; while the print architecture exhibited a rather stable codified communication the electronic dataset appeared to be structured differently – the increasing variation over the time periods proved more expansive than constricting. It was expected and shown that the comparison between the print and electronic unique word percentage would reveal particular qualities of each mode of communication (print, electronic). This was certainly the case, with the results of the electronic analysis suggesting a more Mode II oriented communication than the Mode I oriented print communications. The differences highlighted in the architecture analysis were interpreted in light of the Medium Theory notion of the Information Network; the differences were shown to be significant with respect to the mean ratio percentage of unique words.

The question of whether network properties of SOEIS electronic communication could be found by comparing the fluctuation of keyword use over the four time periods was then addressed. It was expected that this comparison would reveal clear differences between print and electronic modes of communication, given their respective functional roles in the SOEIS project. Using the same method as those used in the print network analysis, the top electronic keywords were found to contain similar project title words. By comparing each set of texts with the document set, and then set with each other, a number of additional conclusions were reached. The networks of electronic keywords were shown to supplement the activities of the research project, but those words associated with the functioning of the research project itself decreased in emphasis over the dataset while similar words in the print dataset were found to increase over time.

In contrast to the print dataset, where it was discovered that most words occurred in the final document set thereby suggesting an aggregative text, the word occurrence in the electronic dataset appeared more evenly distributed. Thus, while the print served an archival function where text was produced, reworked and resubmitted, the electronic served a more supplementary role whereby project issues *per se* were not discussed. The emphasis, rather, appeared to be on the use of the list as a means to communicate about the substance of the studies in the research project. The expectation of this analysis was confirmed; the networks of keyword distribution revealed herein have proven significantly different than the networks fostered via

print communication. This difference can be interpreted in light of the Poststructuralist, and Structurational networks of meaning and intertextuality. Networks of association in language were argued by both Derrida and Giddens to be contingent upon language *use* in social context; this underscores the importance of this comparison of how different contexts demand different (word) production habits. Print and electronic writing integrated the research group in different ways, but the communications were aimed toward a common goal. Structuration Theory is relevant here because the dynamic process of word-reuse, as cited in the last chapter, reflect the properties of social and system integration – importantly, this integration is different with print and electronic forms of expression. It is argued here that these two media served to integrate the SOEIS communications in measurably different ways. The meaningful networks isolated in both print and electronic network analyses emphasized how each served to socially integrate the SOEIS system in decidedly different ways.

The third and final research question addressed in this chapter asked whether path dependencies or critical transitions could be identified in the SOEIS electronic dataset. If so, this would indicate that the information exchanged went through necessary revisions to become the final product. It was also asked if this would prove to differ from the results of the print dataset. No critical transitions were found in either the print or electronic databases. However, despite this apparent lack of systemic properties, differences were found through the comparison of the transmission and specificity of word use in each respective database. With respect to unique words count, the print database appeared to perform the same task with a smaller number of words than in the electronic set thereby suggesting a completion of the same task with less talk. The SOEIS print provided a more codified communication than electronic. When compared for transmission, or mutual information, the electronic database was shown to exhibit more transmission between the time periods than the print analysis, and this difference was mainly caused by words that appeared in specific periods and not in others. Thus, the print database has proven to be more codified than the electronic, and this observation was supported by the observation that specificity was shown to remain lower in the electronic case (with only a 1% stability).

With respect to the key expectations of the dissertation, it has been shown that print and electronic media do differ in the ways that they enable scientific communication, and this comparison was made possible by the juxtaposition of different metric analyses. The theoretical triad comprising *Architectural – Network – Systemic* dimensions has proven instrumental in maintaining coherence among the various analyses performed in this and the previous chapter. The differences in respective architectures, networks of keyword use, and systemic behaviour of the electronic communications revealed the print communications to be more codified than the electronic.

This chapter concludes the analyses of the internal dynamics of the SOEIS research group. We now turn to the externally oriented print and electronic communications. In the following chapter, the journal publication of the SOEIS group is examined as a primarily Mode I, print oriented communicative domain. That will be followed by a chapter dedicated to the comparison of the EuroCon-Knowflow mailing list with a

selection of other mailing lists in the fields of Science & Technology Studies and Self-Organization Theory, which by definition is more oriented towards Mode II. The *Architecture – Network – System* triad and meaning dimension are the core elements used to correlate the results of each empirical chapter, and to compare the final results of all analyses in *Part III – Reflection*.

Chapter VI: Analysis of Journal Publication

Introduction

This chapter describes the analysis of the publication environment of the Self-Organization of the European Information Society (SOEIS) research project. The publication dimension refers to the citation environment of the research project in 1996 (the year prior to the project's inception), 1997, 1998, and 1999 (the years of the project), and 2000 (the year immediately following the project's completion). Here, publications related to the SOEIS project are examined on both local and field levels and are analyzed as Mode I processes of knowledge production. Publications are characterized by formal constraints upon their communication, from the grammar to the typeset, and indicate a strong codification of discourse. These measures insure quality control. Indeed, nowhere is there a more salient example of this codified mode of communication than scientific journal literature. The SOEIS publication environment is assessed here to explain the secondary role of SOEIS participants, as academics – to publish their findings; this is done in order to expand our understanding of the role that specifically published print media has played in this process of knowledge production.

The journal publication analysis is best perceived in juxtaposition to the other analyses performed in this dissertation. The reader will recall that print communication (analyzed in *Chapter IV*) was linked with Mode I processes of knowledge production. By contrast, electronic communication (analyzed in *Chapter V*) was defined as representative of a Mode II type of knowledge production. It serves us here to redefine the relationship between Mode I and Mode II types of knowledge production, particularly as they pertain to print and electronic media. While this definition served to provide distinct parameters around the textual analyses in previous chapters, new challenges in appropriately describing this relationship arise when analyzing the dynamics of scientific publication. Unlike chemistry and physics journals, for example, new techno-sciences like biotechnology and computer science do not build on strong institutional frameworks of discipline formation normally identified with Mode I types of knowledge production. In the techno-sciences different types of knowledge are recombined in varied multi-disciplinary foci, and appear to be driven by both social and scientific problematics, not necessarily institutional frameworks. Thus, since publication is historically a Mode I type of knowledge production it does make sense to correlate it with print, but given the new multi-disciplinary foci, it is important to understand that Mode II characteristics operate in this academic publication environment as well.

A means of understanding this overlap is provided in Fujigaki & Leydesdorff (2000). It is argued that quality control is organized differently in the Mode II production of scientific knowledge, and that differences between these modes can be understood through an examination of validation across boundaries. Indeed, the shift from Mode I to Mode II is largely argued in terms of changes to institutional parameters. Leydesdorff (forthcoming, 2003) argues that the criteria for quality control can

analytically and reflexively be examined (the formal constraints imposed upon scientific publication for example such as section headings, sentence structure, grammar and typeset). These measures can be examined to understand the validation boundaries emerging from the differences between Mode I and Mode II knowledge production.

Similar to the examination of the print and electronic communications in the previous two chapters, the SOEIS relevant publications are examined for their collective architectural parameters, networked properties, and identifiable systemic indicators. The publication environment is first examined for its architectural parameters, and then for its networked interrelationships with respect to co-authorship activity. Finally, the positioning of SOEIS relevant publications is examined in relation to journal horizons (as determined via the factorial structure of their aggregated mutual citations) in order to discern evident validation boundaries to better understand the dynamic interrelation of Mode I and Mode II types of knowledge production in the SOEIS project. The central results of this analysis will be revisited in *Chapter VIII: Integration & Conclusions* where the relevant results of the four analyses are integrated.

Research Focus

Two aspects of the SOEIS publication dimension are outlined herein: the first focuses upon those texts produced by SOEIS members and the articles they have cited. The second, in turn, explores the pool of references produced by those papers which cite SOEIS relevant papers. Cited articles (and their publishing journals) are treated as *events* that compile and collectively form a pool of aggregated references – these are viewed as the collective publication realm of SOEIS members. Citing articles, by contrast, are viewed as indicators of how the SOEIS project and its environment have been integrated into the larger science system; this is achieved by examining the relationship between the citation environments. Journal-journal relationships relevant to the SOEIS communications were thereby identified, and their relationships examined over the five year span of the analysis (1996 – 2000).

By specifying published articles as events surrounding the SOEIS project, a window between the project and the system of scientific publication is obtained. The analysis aims to determine the positions that these publications take with reference to the journal literature; and more specifically, how these disciplinary positions change over the five years of the analysis. The communication structure that exists at this level (academic publication) yields a network architecture that remains independent of individual actions or motivations (as authors). That is not to say that individual's ideas and foci do not change over the course of a research project, but rather that the publication an author may contribute will not necessarily register a dramatic change in the communication structure since the mode of communication may reflect the embedded-ness of the codification of their publications. The positioning of different publications in relation to the journal horizons enables the analyst to discern evident validation boundaries. In this way the networks of journal communication that are relevant to the SOEIS research group members were examined for change, thereby illustrating disciplinary emphases their respective shifts in priority, as revealed by the

changes specified by journal-journal communications. The analysis thereby provides this study with a richer perspective of the role of the SOEIS project in the larger context of the science system.

Research Questions & Expectations

The reader should understand publications here in the sense of *events*, in light of the perspectives outlined in *Chapter II: Theoretical Grounding*. As with the previous analyses, the theoretical triad of *Architecture – Network – System* frames this analysis, thereby providing means of integrating different analyses herein, and a basis for comparison with other results in the conclusions of this dissertation. Three *research questions* have been identified, corresponding with the three nodes of the theoretical triad. These research questions and their central expectations are described below.

First, *what are the architectural parameters of the SOEIS publication environment with respect to its Cited and Citing dimensions, and to what degree does their overlap reveal a cognitive bias; and further, can our understanding of the publication architecture be enhanced by comparing the rates of co-authorship and national orientation in the cited dimension?* Here the parameters of the SOEIS publication environment are shown by calculating the frequency of publication activity for each year, in both the *cited* and *citing* dimensions. It is expected that there will not be a high number of SOEIS related publications from the *cited* dimension near the end of the 5 year scope (1996 – 2000), since related publications would presumably be published in years subsequent to the project. The analysis will reveal certain types of journals used in both the cited and citing dimensions, and when compared they should prove to overlap considerably. It is expected that given the nature of the research group, Policy and Informatics oriented journals should take precedence. This question is informed by the Medium Theory notion of the information network, and aims to characterize publication as central to academic network formation by emphasizing the interactive nature of this mode of knowledge production.

Second*, given the architecture found by comparing the cited and citing dimensions of the SOEIS publication environment, what networks of interrelationship between these dimensions can be discerned by comparing the sum of most cited and most citing referenced journals?* A key focus here is to illustrate how individual publications compile and collectively form network architectures. A central concern is how these relationships change over time, and to what degree these dimensions are interrelated. The shared information network is highlighted by comparing the sum of most *cited* journals and sum of most *citing* journals for their respective fluctuations in referencing activity.

It is expected that this analysis will reveal a cognitive overlap between the two with respect to the similarity of journals operating in each dimension, thereby revealing a cognitive overlap or similar disciplinary emphasis. If so, this will reveal a cohesion between the two dimensions, and differences between them could then be interpreted as deviations from this core. Fluctuations between *cited* and *citing* articles by year are therefore interpreted as changes in the networked architecture of the SOEIS publication environment. The question is informed by Actor Network Theory and

outlines the network features of this interconnectivity as a product of collective action.

Finally*, using the relations among journals (as measured through the factorial structure of their aggregated mutual citations) as the baseline*[1]*, can parallels be found in journal-journal distributions over time in the Cited and Citing databases, thereby revealing changes at other levels of analysis?* The survey is performed using *Research Policy* and *Scientometrics* as the seed journals for the factor analysis, and the subsequent factor loadings for each are then compared for each year (1996 to 2000). Both journals are important for the SOEIS project and have been identified (in the following architectural and network oriented analyses) as the most central journals in both the *cited* and *citing* dimensions. Given the relatively small scope of the SOEIS communications and its immediate neighbourhood, by comparing the publication datasets for crucial changes in the disciplinary focus over the five year span of the study, the relationships in the identified clusters of journals should provide a sense of changing disciplinary development when compared with the field level of the SOEIS group as the baseline.

In the context of the SOEIS, when compared for yearly development we expect to find that the two journals will have a unique relationship vis-à-vis each other. The changing nature of the network structure of this relationship over the five years, as perceived using *Research Policy* and *Scientometrics* as the seed journals, will reveal that the SOEIS project was instrumental in binding otherwise disparate research foci. Self-Organization Theory informs the approach.

Results

Architecture

The hermeneutic units of analysis sought here are individual scientific publications and their references. Two distinct databases were created in this initial stage of the analysis. The first was the *Cited*, and it included all articles referred to by SOEIS members and associates over five years: 1996 through 2000. The second database was the *Citing*, and it included all articles which in turn have referenced the SOEIS related papers that comprise the first database; thus, the *citing* contains similar information to the *cited*, but from the alternate perspective – who refers to the SOEIS related materials?

The first step in the analysis of the publication dimension entailed a collection of all of the publication information for the 15 core publishing members of the SOEIS research project (SOEIS-Core), as well as for the participants of the EuroCon-Knowflow mailing list (the original mailing list of the SOEIS) which also included the core SOEIS group (SOEIS-All). In all, some 74 names were collated, and their publication information for the years 1996 through to 2000 was collected from the *Science Citation Index* (*SCI*), the *Social Science Citation Index* (*SSCI*), and the *Arts &*

[1] See Studer & Chubin (1983) where the issue of using a baseline is raised, and Leydesdorff (1986) and Leydesdorff & Schaar (1987) for approaches which make use of the factorial structure of aggregated mutual citations as the baseline for analyzing the field level of scientific publication.

Humanities Index (*A&HI*). The publication data obtained from these sources was filtered through the *BibExcel* and *Dialogue* programs.[2] The procedure resulted in the formation of a database that included all references cited by the SOEIS group in their publications over the five year time period, hereafter referred to as the *Cited* Database.

A second step was then performed in which the *SCI, SSCI* and *A&HI* were queried for all articles which cited the entire SOEIS publication environment (not just the core members) as established by the first database, and thereby created a second database. The second database is hereafter known as the *Citing* Database. In what follows is a description of the key results from the architecture analysis; detailed results showing the variance of this publication data for both the *cited* and *citing* environments can be viewed in *Appendix C*.

The basic architectural parameters of both databases are shown below in *Table 6.1: Publication Architecture*. Note that the cited articles are differentiated between those publications made by the SOEIS – Core (15 publishing members), and then those that are also written by the periphery group of the SOEIS research project (in total, 74 members and associates)[3]. SOEIS Articles refers to all publications by both the project members and the periphery group, and citing articles refers to all publications which refer to SOEIS related materials.

	1996	**1997**	**1998**	**1999**	**2000**	**Total**
Articles (SOIES-Core)	6	13	5	5	12	41
Articles (SOIES-All)	28	30	25	30	29	142
Citing Articles	22	54	32	20	8	136

Table 6.1: *Publication Architecture*

It was found that the total number of cited and citing articles for each year of the SOEIS shared a frequency between 20 and 40 articles, with the exception of the citing articles for 2000 in which only 8 publications referred to SOEIS relevant materials. For the cited articles the number of articles published in each year remained relatively consistent. By contrast, the number of citing articles increased substantially in 1997 and gradually decreased in each year thereafter. Perhaps more interesting is the SOEIS-Core distribution which shows high publication rates in 1997 and again in 2000. These initial observations suggest that the cited Articles of the whole SOEIS group substantially contributed to the relative journal publication literature over the years 1996 – 2000.

While the total number of *citing* and *cited* articles revealed basic information concerning the architectural parameters of the SOEIS publication environment, a more detailed look at the journal distribution shows the disciplinary emphases of the *cited* and *citing* dimensions, and thereby reveals more about the substance of the

[2] The BibExcel program written by Olle Persson assists in analysing bibliographic data by generating data files that can be exported to Excel. The Dialogue Program written by Loet Leydesdorff was adapted to fit the needs of this particular research project.

[3] For reference, the larger group of 74 was determined by drawing together the membership lists of the project mailing lists. This list of 74 individuals is also used in *Chapter VII: Analysis of Mailing List Environment*.

SOEIS publication communications. Below, *Figure 6.1: Journals Cited in SOEIS Articles* and *Figure 6.2: Journals in Citing Articles* show the distribution of different journals in each dimension, and reveals both to be oriented towards policy and informatics oriented journals.

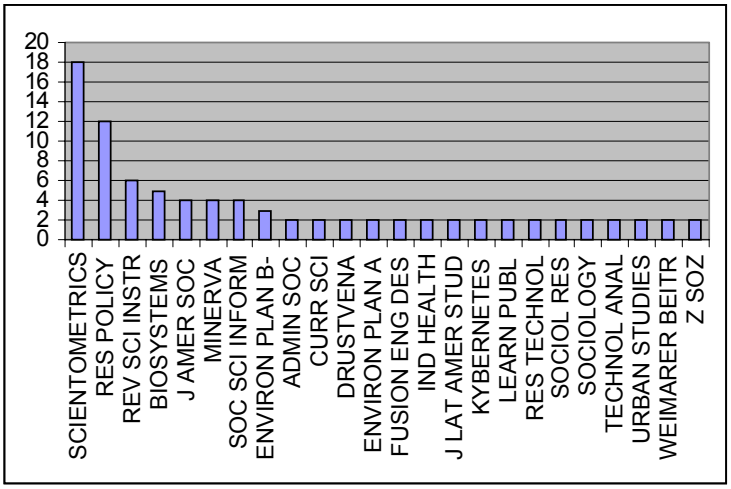


Figure 6.1: *Journals Cited in SOEIS Articles*

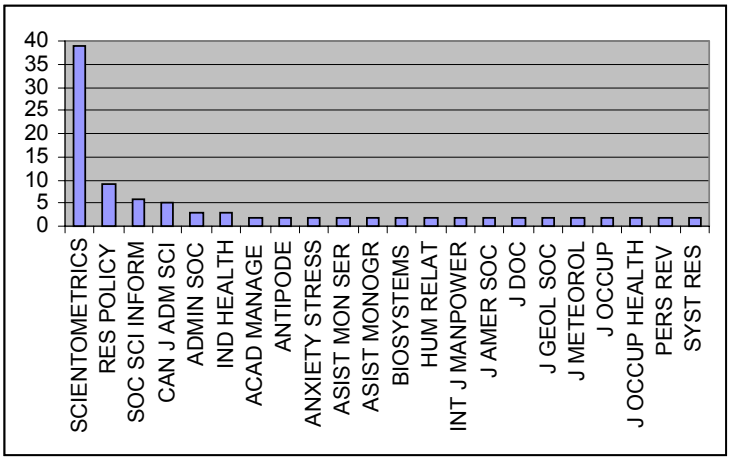


Figure 6.2: *Journals in Citing Articles*

As expected there was a Policy and Informatics bias found as evidenced by the most frequently occurring journals; namely: *Scientometrics* and *Research Policy*, and by *Social Science Informatics* in the Journals in Citing articles. Next, we observed the country distribution for the SOEIS member and associates publications. *Figure 6.3: SOEIS – All Publications by Country* shows the most frequently published countries in the SOEIS citation environment.

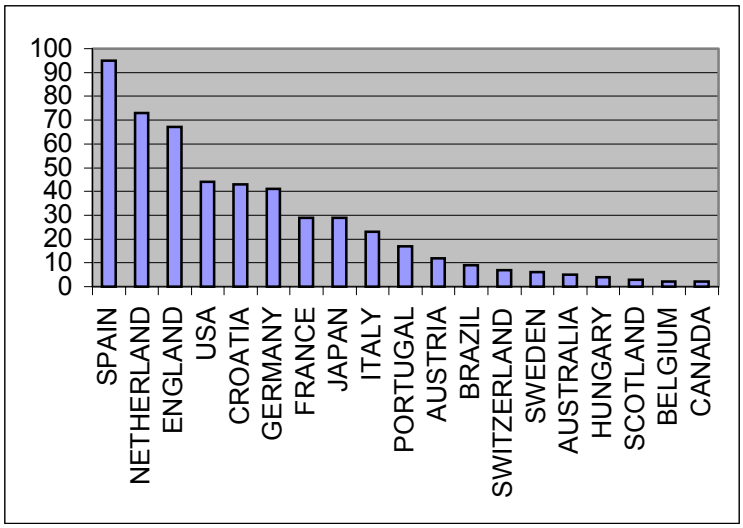


Figure 6.3: *SOEIS – All Publications by Country*

It was unexpected to find Spain as the most frequently published country as it was not one of the six countries that directly participated in the SOEIS research project. Upon closer inspection it proved to be due to an unusually high number of co-authors in the relatively few Spanish contributions. The Netherlands, England, Germany, Italy, and Switzerland all appear in *Figure 6.3*; all countries directly involved with the SOEIS are represented, with the notable exception of Greece.[4] The publications of the SOEIS core were then compared on the basis of most frequently published country; these results are shown below in: *Figure 6.4: SOEIS – Core Publications by Country*.

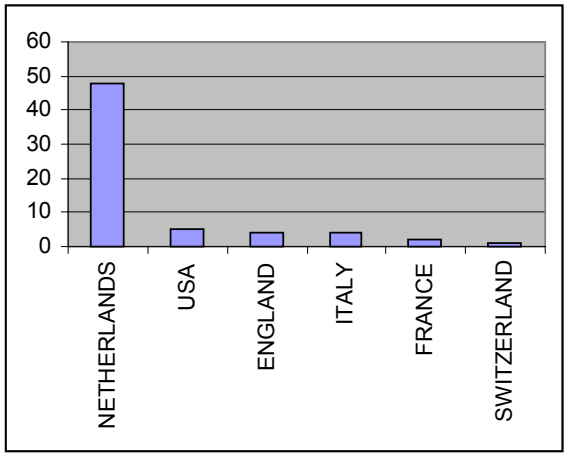


Figure 6.4: *SOEIS – Core Publications by Country*

The core publications of the SOEIS members was heavily represented by the Netherlands, and was trailed by the USA, England, Italy, France and finally Switzerland. The USA and France are the only non-project countries here. It is

[4] This is not to say that there were no Greek publications during this period; electronic publications were not included in this analysis as they are not included in the *Web Of Science* databases.

notable that neither Germany nor Greece were identified as central publishing countries for the SOEIS group, and that the publications from the USA and France claimed priority over Switzerland (and England, in the case of the USA).

Next the co-authorship distribution between the SOEIS group, and the SOEIS members proper was compared. A final means of understanding the architecture of the publication environment of the SOEIS was obtained through the calculation of co-authorship activity in the *Cited* database. Clearly, pursuing the co-authorship relations in the *Citing* database would prove interesting for its overlap with the *Cited* database; however, since the analysis is focused on the dynamics of the SOEIS communication system the co-authorship analysis was limited to just the articles *cited* by the SOEIS group. *Table 6.2: Co-authored Publications*, below, shows differences between the SOEIS-Core and the SOEIS-All.

	1996	**1997**	**1998**	**1999**	**2000**	**Total**
Co-Authorships (SOEIS-Core)	4	6	4	4	6	24
Co-Authorships (SOEIS-All)	13	14	12	21	16	76

Table 6.2: *Co-authored Publications*

The rate of co-authored publications per year in the cited database remained consistent with the rate of the overall publication in the cited architecture, with the exception of 1999, as outlined above. The number of co-authorships between the people in the SOEIS group was highest in 1999 and 2000. More generally, it was found that the co-authorships were proportionately higher in the SOEIS group than in the SOEIS core.

Network

A means of measuring the network parameters of the SOEIS publication environment was then performed. Note the difference between the SOEIS – Core and SOEIS – All; the Cited references were obtained by searching the citations of the individual authors in the SOEIS group and SOEIS core.[5] The tabulated results are displayed below in *Table 6.3: Total Cited & Citing References*.

	1996 (%)	**1997 (%)**	**1998 (%)**	**1999 (%)**	**2000 (%)**	**Total**
Cited References (SOEIS-Core)	235 (*21*)	315 (*28*)	138 (*12*)	92 (*8*)	340 (*31*)	1120
Cited References (SOEIS-All)	707 (*22*)	802 (*24*)	535 (*16*)	655 (*20*)	601 (*18*)	3300
Citing References	893	2440	1004	570	385	5292

Table 6.3: *Total Cited & Citing References*

When the percentage ratio was compared between the cited references of SOEIS-Core and SOEIS-All, the core was to found fluctuate greatly over the five years, with a notable dip in the 1998 and 1999 where the SOEIS members arguably spent more effort on the project than on the publication of articles. By contrast, the cited

[5] The *SCI*, *SSCI* and *AHI* indexes were queried for the individual authors of the SOEIS group, and their cited were references collated. It should be noted that in some cases we were unable to confirm if all publications identified with each respective name were attributable to that specific individual. All results found using the author names were used in the analysis.

references for the whole SOEIS group were found to remain relatively consistent over the five years.

The following three charts clearly illustrate the referencing preferences of the *cited* (who the SOEIS cited) and *citing* (who were citing SOEIS relevant publications) dimensions of the SOEIS publication environment. We begin with the sum of the most frequently cited references by the SOEIS core: *Figure 6.5: Sum of Most Cited Referenced Journal Frequency (SOEIS-Core*), then the sum of most frequently cited references of the whole SOEIS group: *Figure 6.6: Sum of Most Cited Referenced Journal Frequency (SOEIS-All*), and finally the sum of most frequently citing references: *Figure 6.7: Sum of Most Citing Referenced Journal Frequency*.

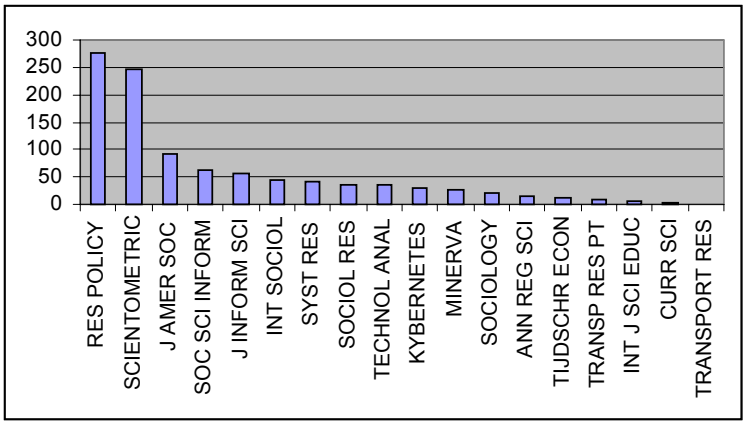


Figure 6.5: *Sum of Most Cited Referenced Journal Frequency (SOEIS-Core)*

The most cited journals referenced by the SOEIS-Core reflect the bias towards Policy and Informatics Journals as described above. The top five most frequently occurring referenced journals in the publication environment include *Research Policy, Scientometrics, The Journal of the American Society for Information Science, Social Science Informatics,* and the *Journal of Information Science,* respectively. Of these top five journals, the most frequently occurring (*Research Policy*) stands alone; that is, without journals with which one would expect it to be clustered (such as *Science Public Policy* and *Research Evaluation*, for example). By contrast, *Scientometrics* shares a relatively high frequency of being cited with those journals with which it is often clustered (*The Journal of the American Society for Information Science, Social Science Informatics, and the Journal of Information Science*). Collectively these journals suggest a cognitive bias of the SOIES-Core publication environment towards Policy and Informatics, with an emphasis on the Social Sciences. Next, all articles referenced by the SOEIS group and its associates were grouped and tabulated by journal. Using the aggregate publication data for the five year period between 1996 through 2000, a summation of the most cited referenced journal frequency was calculated. The results are shown below in *Figure 6.6: Sum of Most Cited Referenced Journal Frequency (SOEIS-All)*.

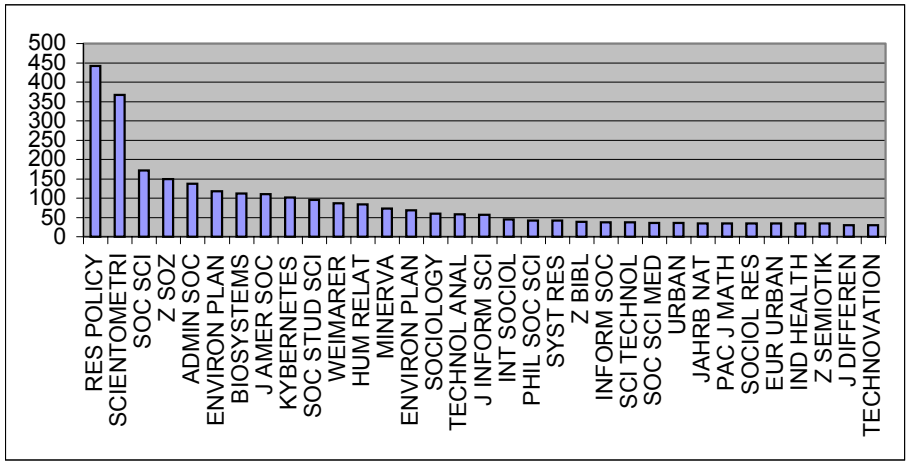


Figure 6.6: *Sum of Most Cited Referenced Journal Frequency (SOEIS-All)*

Similar to the SOEIS-All, the SOEIS-Core sum of most cited referenced journal distribution (shown above in *Figure 6.6*) reveals a cognitive bias towards policy and informatics journals. *Research Policy* figures as the most frequently referenced journal by the SOEIS group, closely flowed by *Scientometrics*. However, neither journal is shown to cluster with similar journals as witnessed in the distribution for the SOEIS-Core.

Next, all of those articles which referenced the SOEIS related publications (the *citing* articles) were grouped and tabulated by journal. Using the aggregate publication data for the five year period between 1996 through 2000, a summation of the most *citing* journal frequency was calculated. *Figure 6.7: Sum of Most Citing Referenced Journal Frequency*, below, shows the results.

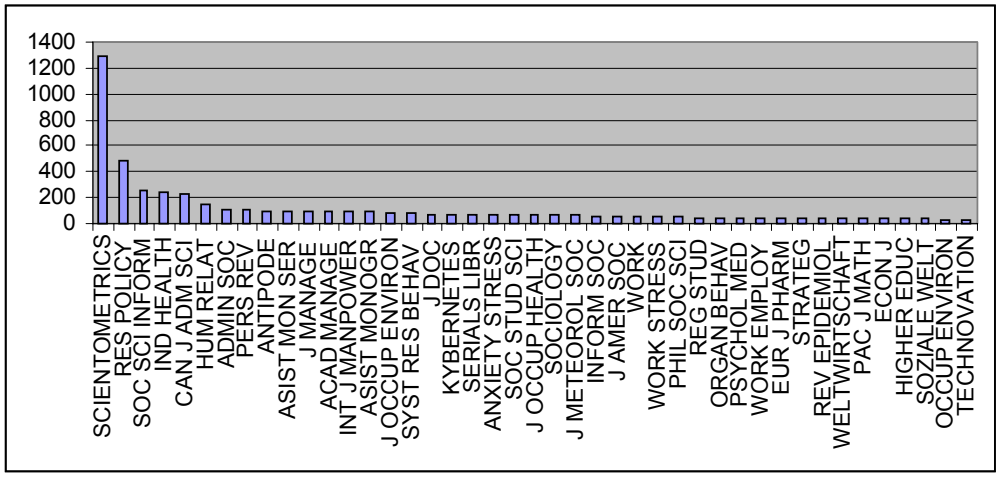


Figure 6.7: *Sum of Most Citing Referenced Journal Frequency*

The sum of the most citing referenced journal frequency analysis identified *Scientometrics* as the main journal authors use most frequently to cite SOEIS materials, followed by *Research Policy* and *Social Science Informatics*. Similar to the results of the Most Cited Frequency analyses, described above, *Research Policy*

stands alone, without journals one would expect to be of similar citing frequency, such as *Science Public Policy* and *Research Evaluation*. Unlike the most cited analysis, here in the most citing it is found that with the notable exception of *Social Science Informatics*, *Scientometrics* does not share high citation frequency rates with any of the journals with which it clustered in the cited analysis (the *Journal of the American Society for Information Science, Social Science Informatics,* and the *Journal of Information Science)*. Similar to the cited analysis, when taken together these three most frequently occurring journals (*Scientometrics*, *Research Policy*, and *Social Science Informatics*) suggest a cognitive bias towards Informatics and Policy of those who cite SOEIS related materials.

As illustrated above, once the sums of most frequently occurring journals in both *cited* and *citing* dimensions were compared, it was determined that *Research Policy* and *Scientometrics* were the most crucial journals for the SOEIS publication environment. The network analysis has found that there is a direction in the information flow evident here: the SOEIS group has been shown to predominantly cite *Research Policy*, while it is itself cited by articles in *Scientometrics*. It would appear that the SOEIS group uses *Research Policy* to be visible in the *Scientometrics*, or 'infometric', community. In the following section: *System*, the publication environments of specifically these two journals on both the *cited* and *citing* dimensions are addressed. This will aid an understanding of these environments with respect to which journals cluster with *Scientometrics* and *Research Policy*, and more importantly how these journals in turn appear to interact upon each other. The concern here is what happens at the interface between these journals, given their centrality to the SOEIS' citation environment.

System

The system oriented analysis entailed the aggregation of journal-journal citation data over the years 1996 – 2000 using *Research Policy* and *Scientometrics* as the entrance journals for the analysis. These two journals have been selected as the seed journals because they are the two with the highest sum of most cited and most citing journal frequencies, as described above. A cut-off rate of 1% has been used of the total cited and total citing of *Research Policy*, and a cut off rate of 0.5% for *Scientometrics*.[6] The total is normalized over the journals contained in the *Social Science Citation Index* (SSCI). Examined together, the *cited* and *citing* environments of these two journals reveal the relevant relationships between these journals, and show the significance of changes in the disciplinary focus of the SOEIS group over the time dimension.

The resulting factor loadings are described below and are graphically represented using multi-dimensional scaling plots in order to illustrate the significance of changes taking place. The cited environment is examined as distinct from the citing. The *cited* database, as the collective sum of the texts referenced by SOEIS members and the periphery group of researchers, refers to the systemic aspect of the SOEIS that

[6] Originally this research was performed using a cut-off rate of 1% for both *Research Policy* and *Scientometrics*. It was determined that a more effective means of comparing these results would be to lower the cut-off threshold for *Scientometrics* since so few journals were revealed using the higher cut-off rate.

remains the stable variable: it is the *structure* or *methodology* of the system. By contrast, the examination of the *citing* environment of both *Research Policy* and *Scientometrics* (1996 to 2000), addresses the active, *action* oriented or *applied* part of the system, thereby revealing its structural development in terms of journal patterns.

Cited Environment:

Research Policy and *Scientometrics* have been selected as the seed journals for the analysis of the systemic dimensions of the SOEIS publication dimension precisely because they have both been identified as crucial to both the *cited* and *citing* environments. It is important to explore the journal-journal relationships for each seed journal in order to provide a basis for comparison. What concerns us here is the interface between these journals which we have identified as central to the operation of the SOEIS publication dimension. In what follows I will first review the cited environment of both *Research Policy* and *Scientometrics* chronologically for the years 1996 to 2000, and in the next section will address the citing environment for the same period.[7] Commentary concerning the overlap of these two fields and their interface will be provided at the end of the section.

Cited 1996

In the *Research Policy* cited environment of 1996, *Research Policy* loaded with *Scientometrics*, and appeared near to the Sociology, Regional Planning, and Traditional Management clusters. *Scientometrics* was also near Sociology, but appeared closer to STS, Innovation, Research & Development, and Technological Management than *Research Policy*. There was also a notably significant Economics cluster in the environment, though distant. The SOEIS referencing behaviour in 1996, at least in the context of *Research Policy*, exhibits an interesting link between *Research Policy* and *Scientometrics* as they load together yet appear divided between certain literatures given their positioning.

In the *Scientometrics* cited environment for 1996, *Scientometrics* loaded with Informatics Journals and appeared near to the STS, Information Science, and Education literatures, and near *Research Policy* which loaded with the Management cluster. Similar to the cited environment of *Research Policy* for 1996, Economics and Sociology clusters were evident. Interestingly, *Scientometrics* and *Research Policy* clustered near each other – *Research Policy* loading with Management, and near the Economics cluster.

The factor analyses performed here are best perceived using multi-dimensional scaling plots whereby the distances between relevant clusters can be visually approximated. Only a selection of the results will be presented here to highlight the central findings. Below, *Figure 6.8: Research Policy Cited 1996* and *Figure 6.9: Scientometrics Cited 1996* reveal the approximated distances between journal clusters. See *Appendices C-II* and *C-III* for larger versions of the plots displayed below, and for the respective factor loadings of *Research Policy* and *Scientometrics* 1996 – 2000.

[7] For the full names of the abbreviated journals referred to in this analysis, see *Appendix C-I*.

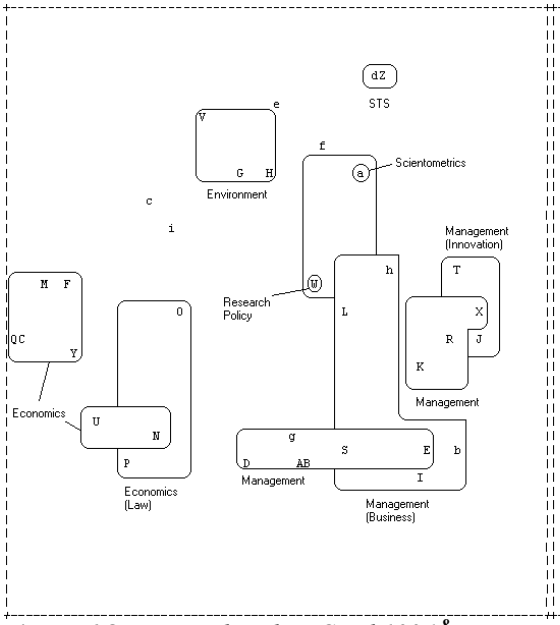


Figure 6.8: *Research Policy Cited 1996* [8]

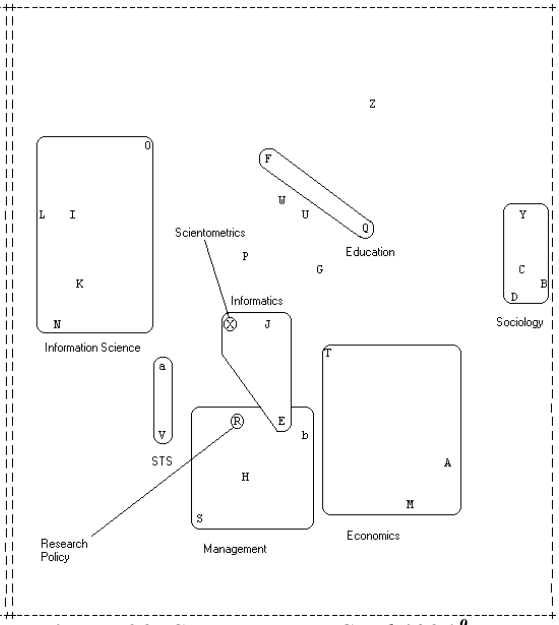


Figure 6.9: *Scientometrics Cited 1996* [9]

Cited 1997

In the *Research Policy* cited environment for 1997, *Research Policy* again loaded with *Scientometrics*. *Research Policy* appeared near the Management and Innovation clusters, whereas *Scientometrics* did not appear close to any other significant journal clusters. As with the Cited environment for *Research Policy* in 1996, there was a significant Economics cluster apparent here, and this time with a large Industrial Economics cluster. Similarly, in the *Scientometrics* cited environment for 1997, *Scientometrics* and *Research Policy* again loaded together, this time both with the Innovation literature. *Scientometrics* appeared near the Information Society and STS clusters, and again *Research Policy* appeared near economics. A psychology cluster was also visible in the citation environment of this year, and was more closely associated with *Research Policy*. We find evidence of a pattern forming over these two years whereby Scientometrics is associated with the STS and Information Science Literature, and Research Policy is associated with the Economics literature, and in the case of the *Research Policy* environment, with the Management Literature.

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[8] Research Policy – Cited 1996 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *ADMIN SCI QUART*; C: *AM ECON REV*; D: *AM J SOCIOL*; E: *CALIF MANAGE REV*; F: *ECON J*; G: *ENVIRON PLANN A*; H: *ENVIRON PLANN C*; I: *HARVARD BUS REV*; J: *IEEE T ENG MANAGE*; K: *IND MARKET MANAG*; L: *INT J TECHNOL MANAGE*; M: *J ECON LIT*; N: *J IND ECON*; O: *J INST THEOR ECON*; P: *J LAW ECON*; Q: *J POLIT ECON*; R: *J PROD INNOVAT MANAG*; S: *MANAGE SCI*; T: *R&D MANAGE*; U: *RAND J ECON*; V: *REG STUD*; W: *RES POLICY*; X: *RES TECHNOL MANAGE*; Y: *REV ECON STAT*; Z: *SCI TECHNOL HUM VAL*; a: *SCIENTOMETRICS*; b: *SLOAN MANAGE REV*; c: *SMALL BUS ECON*; d: *SOC STUD SCI* ; e: *SOCIOL TRAV*; f: *SOZ WELT*; g: *STRATEGIC MANAGE J*; h: *TECHNOL FORECAST SOC*; i: *WORLD DEV*.

[9] Scientometrics – Cited 1996 – Abbreviation / Journal Name: A: *AM ECON REV;* B: *AM J SOCIOL*; C: *AM SOCIOL REV*; D: *ANNU REV SOCIOL*; E: *EVALUATION REV*; F: *HIGH EDUC*; G: *HUM COMMUN RES*; H: *IEEE T ENG MANAGE*; I: *INFORM PROCESS MANAG*; J: *INT FORUM INFORM DOC;* K: *J AM SOC INFORM SCI*; L: *J DOC*; M: *J ECON LIT*; N: *J INFORM SCI*; O: *LIBR TRENDS*; P: *MINERVA*; Q: *RES HIGH EDUC*; R: *RES POLICY*; S: *RES TECHNOL MANAGE*; T: *REV ECON*; U: *REV SAUDE PUBL*; V: *SCI TECHNOL HUM VAL*; W: *SCIENTIST*; X: *SCIENTOMETRICS*; Y: *SOC FORCES*; Z: *SOC SCI INFORM*; a: *SOC STUD SCI*; b: *TECHNOL FORECAST SOC.*

Cited 1998

In the *Research Policy* cited environment for 1998, *Research Policy* again loaded with the Management Literature, close to the Regional Planning cluster (as in 1996) and with Business Studies and Organizational Management clusters. There was also a large economics cluster again in 1998. Here *Scientometrics* loaded with Sociology, and near the STS cluster (again). It would appear that in the *Research Policy* cited environment for 1998, *Research Policy* and *Scientometrics* moved further apart. However, in the *Scientometrics* cited environment for 1998, the opposite was true. Here, *Scientometrics* loaded with Library Sciences and appeared close to the Information Sciences which clustered with some Library Science journals. As before, *Research Policy* loaded with the Management literature, but interestingly, this cluster not only overlapped with STS, but both Economics and Psychology clusters were absent from this environment. In the *Scientometrics* cited environment for 1998, *Research Policy* and *Scientometrics* therefore appeared closer than ever.

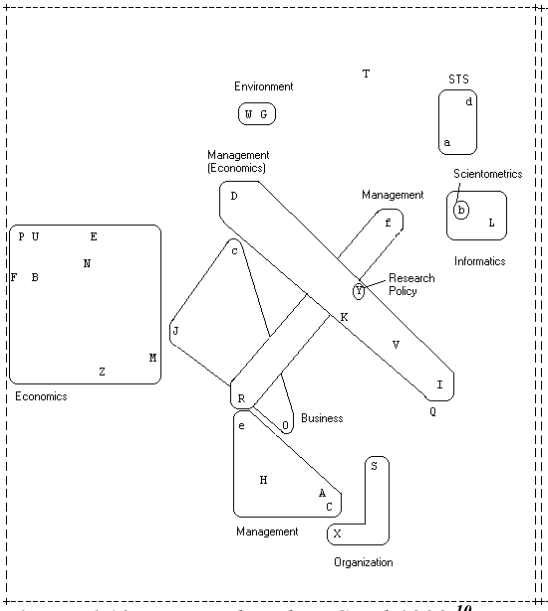

Figure 6.10: *Research Policy Cited 1998* [10]

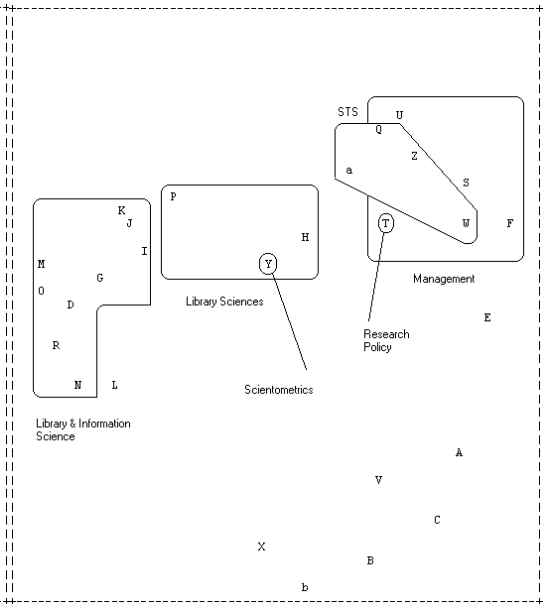

Figure 6.11: *Scientometrics Cited 1998* [11]

[10] Research Policy – Cited 1998 – Abbreviation / Journal Name: A: *ADMIN SCI QUART*; B: *AM ECON REV*; C: *CALIF MANAGE REV*; D: *CAMBRIDGE J ECON*; E: *ECON J*; F: *ECONOMETRICA*; G: *ENVIRON PLANN A*; H: *HARVARD BUS REV*; I: *IEEE T ENG MANAGE*; J: *INT J IND ORGAN*; K: *INT J TECHNOL MANAGE*; L: *J AM SOC INFORM SCI*; M: *J ECON BEHAV ORGAN*; N: *J ECON LIT*; O: *J INT BUS STUD*; P: *J POLIT ECON*; Q: *J PROD INNOVAT MANAG*; R: *MANAGE SCI*; S: *ORGAN STUD*; T: *POLICY STUD J*; U: *Q J ECON*; V: *R&D MANAGE*; W: *REG STUD*; X: *RES ORGAN BEHAV;* Y: *RES POLICY*; Z: *REV ECON STAT*; a: *SCI TECHNOL HUM VAL*; b: *SCIENTOMETRICS*; c: *SMALL BUS ECON*; d: SOC STUD SCI; e: *STRATEGIC MANAGE J*; f: *TECHNOL FORECAST SOC*.

[11] Scientometrics – Cited 1998 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *AM PSYCHOL*; C: *AM SOCIOL REV*; D: *ANNU REV INFORM SCI*; E: *CAMBRIDGE J ECON*; F: *IEEE T ENG MANAGE*; G: *INFORM PROCESS MANAG*; H: *INT FORUM INFORM DOC*; I: *J AM SOC INFORM SCI*; J: *J DOC*; K: *J INFORM SCI*; L: *KNOWL ORGAN*; M: *LIBR QUART*; N: *LIBR RESOUR TECH SER*; O: *LIBR TRENDS*; P: *LIBRI*; Q: *MINERVA*; R: *P ASIS ANNU MEET;* S: *R&D MANAGE*; T: *RES POLICY*; U: *RES TECHNOL MANAGE*; V: *SCI COMMUN*; W: *SCI TECHNOL HUM VAL*; X: *SCIENTIST*; Y: *SCIENTOMETRICS*; Z: *SOC SCI INFORM*; a: *SOC STUD SCI*; b: *TURK PSIKOL DERG*

Cited 1999

In the *Research Policy* cited environment for 1999 *Research Policy* loaded with Economics journals, and appeared near the Innovation, Management, Economic Management, Economics, and Regional Planning clusters. *Scientometrics* appears to be of diminishing relevance to the *Research Policy* cited environment from 1996 to 1999. Again, precisely the opposite trend was identified in the *Scientometrics* cited environment for 1999, where *Scientometrics* loaded with the Sociology literature and appeared very close to *Research Policy (*which loaded on a single factor). There was also a significant Library and Information Sciences cluster here, as well as periphery STS and Psychology clusters. The earlier observation is therefore reinforced – in the environment of *Research Policy*, *Research Policy* and *Scientometrics* appear to be drifting apart, and in environment of *Scientometrics*, *Research Policy* and *Scientometrics* come together.

Cited 2000

In the *Research Policy* cited environment for 2000, *Research Policy* loaded with the Research & Development literature, and *Scientometrics* with the Innovation literature. Interestingly, these two clusters overlapped significantly; indeed, the Research & Development cluster was encapsulated within the Innovation Management Literature cluster suggesting that at the end of the five years under analysis, *Research Policy* and *Scientometrics* began to move together. Also evident here were significant Management, Industrial Management and Economics clusters. In the *Scientometrics* cited environment for 2000, *Scientometrics* again loaded with *Research Policy*. *Scientometrics* appeared near the STS and Information Sciences clusters (the latter now without any Library Sciences). *Research Policy* again appeared more closely aligned with the Economics and Sociology clusters, which is similar to its positioning in 1996.

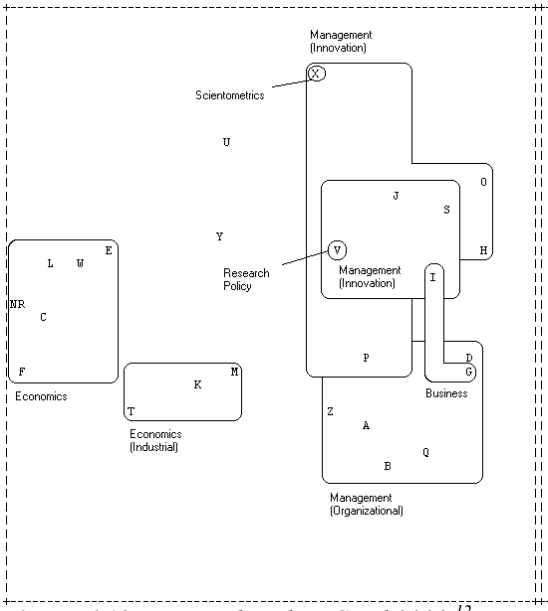

Figure 6.12: *Research Policy Cited 2000* [12]

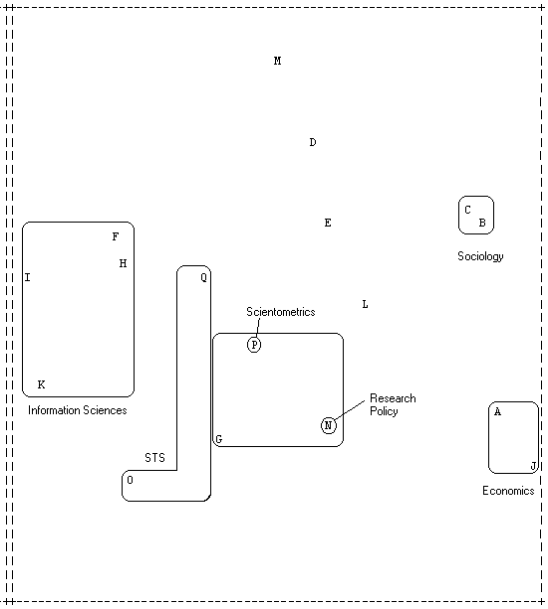

Figure 6.13: *Scientometrics Cited 2000* [13]

[12] Research Policy – Cited 2000 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *ADMIN SCI QUART*; C: *AM ECON REV*; D: *CALIF MANAGE REV*; E: *ECON J*; F: *ECONOMETRICA*; G:

Taken together, the *Research Policy* and *Scientometrics* Cited environments for 1996 through 2000 tell an interesting story. There are some remarkable changes over the years and this is most marked in the relationship between *Research Policy* and *Scientometrics*. In the *cited* environment 1996-2000 for *Research Policy*, we witness *Scientometrics* and *Research Policy* progressively moving away from each other, with the exception of 2000 where they appeared closer. In the *cited* environment 1996-2000 for *Scientometrics*, however, we witness *Scientometrics* and *Research Policy* beginning as disparate, and over the course of 5 years becoming closer.

With respect to the changing nature of relationships between the journal clusters in each year, additional features of the SOEIS cited environment were identified. For example, in the overall cited environment of *Research Policy,* we saw the STS literature just barely hanging in with appearances in 1996 and again in 1998. Economics and Management literature appeared to be the stable features of the cited environment for *Research Policy*. And despite not featuring in 1997, the Innovation literature appears to become more central. By contrast, in the overall cited environment of *Scientometrics*, the STS literature, Information Sciences (which are notably Library Information Sciences in 1998 and 1999), and Economics appear to be the stable features in this environment. The more volatile features of this environment include Education (which appeared only in 1996), Sociology (which appeared in 1996, 1998 and again in 2000), and Psychology (which appeared only in 1997 and 1999).

It would seem that the SOEIS project itself appears to be positioned precisely in the middle of these developments between *Research Policy* and *Scientometrics*. On the side of *Research Policy* we witness a general move away from *Scientometrics* in 1996 through 1999, only to shift back again in 2000. The dynamics here suggest that this shift may be related to the increasing role of the Innovation literature on the side of *Research Policy*. On the side of *Scientometrics* it is clear that *Scientometrics* and *Research Policy* grew closer over the years; however, note that the *Research Policy* / Management cluster relationship is evident in 1996 and again in 1998. In 1998, where Management and *Research Policy* overlapped considerably with the STS literature, it is clear that the relationship between *Scientometrics* and *Research Policy* was stronger than before.

HARVARD BUS REV; H: *IEEE T ENG MANAGE*; I: *INT J OPER PROD MAN*; J: *INT J TECHNOL MANAGE*; K: *J ECON BEHAV ORGAN*; L: *J ECON LIT*; M: *J IND ECON*; N: *J POLIT ECON*; O: *J PROD INNOVAT MANAG*; P: *MANAGE SCI*; Q: *ORGAN STUD*; R: *Q J ECON*; S: *R&D MANAGE*; T: *RAND J ECON*; U: *REG STUD*; V: *RES POLICY*; W: *REV ECON STAT*; X: *SCIENTOMETRICS*; Y: *SMALL BUS ECON*; Z: *STRATEGIC MANAGE J*.

[13] Scientometrics – Cited 2000 – Abbreviation / Journal Name: A: *AM ECON REV*; B: *AM J SOCIOL*; C: *AM SOCIOL REV*; D: *DRUS ISTRAZ*; E: *HUM COMMUN RES*; F: *INFORM PROCESS MANAG*; G: *INTERLEND DOC SUPPLY*; H: *J AM SOC INFORM SCI*; I: *J DOC*; J: *J ECON LIT*; K: *J INFORM SCI*; L: *J OPER RES SOC*; M: *PUBLIC OPIN QUART*; N: *RES POLICY*; O: *SCI TECHNOL HUM VAL*; P: *SCIENTOMETRICS;* Q: *SOC STUD SCI*.

Citing Environment:

Citing 1996

In the *Research Policy* citing environment for 1996, *Research Policy* loaded with a Sociology journal (*Sociologie Du Travail*), as does *Scientometrics* (*American Journal of Sociology*). Similar to the cited environment of *Research Policy*, the citing environment has significant Management, Economics and Regional Planning literatures. Here *Scientometrics* remained distant from *Research Policy* and appeared near the STS cluster. In the *Scientometrics* citing environment for 1996, *Scientometrics* loaded with the *Journal of Documentation* and appeared near the Information Science cluster. Here *Research Policy* loaded with the Management literature and appeared near to the Economics, Sociology and Education literatures. STS was present in the *Scientometrics* environment, but appeared more distant than expected. Finally, *Minerva* loaded here on a single factor and was positioned in between *Scientometrics* and *Research Policy*; this latter observation suggests that in 1996 the *Scientometrics* citing environment appears to be divided into two camps with *Scientometrics* near Information Science, and *Research Policy* near Economics, Sociology and Education – Minerva remains precisely on the cusp between these two camps.

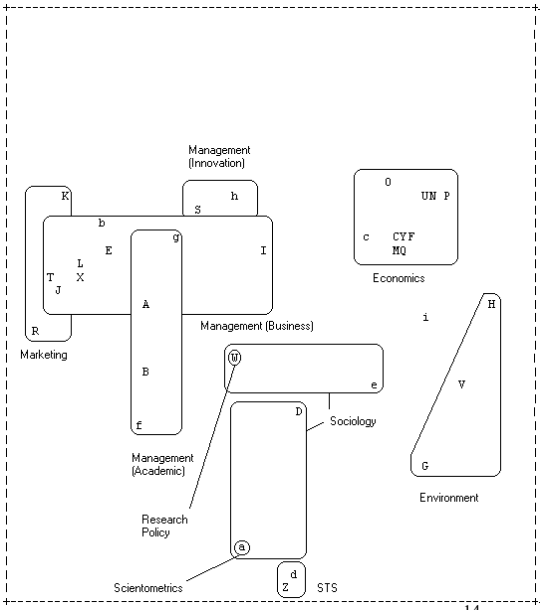

Figure 6.14: *Research Policy Citing 1996* [14]

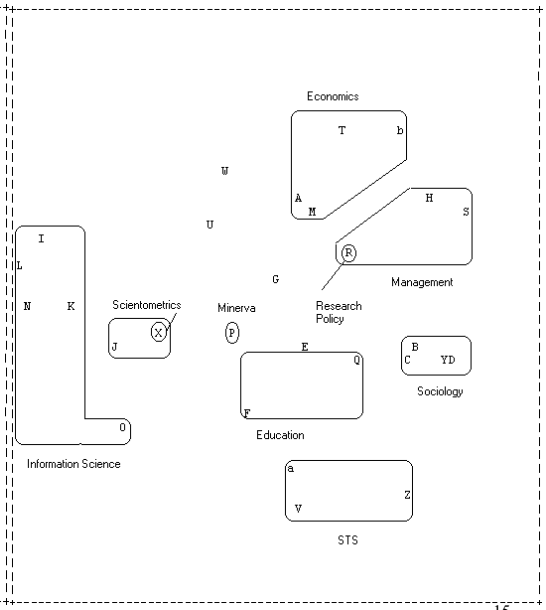

Figure 6.15: *Scientometrics Citing 1996* [15]

[14] Research Policy – Citing 1996 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *ADMIN SCI QUART*; C: *AM ECON REV*; D: *AM J SOCIOL*; E: *CALIF MANAGE REV*; F: *ECON J*; G: *ENVIRON PLANN A*; H: *ENVIRON PLANN C*; I: *HARVARD BUS REV*; J: *IEEE T ENG MANAGE*; K: *IND MARKET MANAG*; L: *INT J TECHNOL MANAGE*; M: *J ECON LIT*; N: *J IND ECON*; O: *J INST THEOR ECON*; P: *J LAW ECON*; Q: *J POLIT ECON*; R: *J PROD INNOVAT MANAG*; S: *MANAGE SCI*; T: *R&D MANAGE*; U: *RAND J ECON*; V: *REG STUD*; W: *RES POLICY*; X: *RES TECHNOL MANAGE*; Y: *REV ECON STAT*; Z: *SCI TECHNOL HUM VAL*; a: *SCIENTOMETRICS*; b: *SLOAN MANAGE REV*; c: *SMALL BUS ECON*; d: *SOC STUD SCI* ; e: *SOCIOL TRAV*; f: *SOZ WELT*; g: *STRATEGIC MANAGE J*; h: *TECHNOL FORECAST SOC*; i: *WORLD DEV*.

[15] Scientometrics – Citing 1996 – Abbreviation / Journal Name: A: *AM ECON REV;* B: *AM J SOCIOL*; C: *AM SOCIOL REV*; D: *ANNU REV SOCIOL*; E: *EVALUATION REV*; F: *HIGH EDUC*; G: *HUM COMMUN RES*; H: *IEEE T ENG MANAGE*; I: *INFORM PROCESS MANAG*; J: *INT FORUM INFORM DOC;* K: *J AM SOC INFORM SCI*; L: *J DOC*; M: *J ECON LIT*; N: *J INFORM SCI*; O:

Citing 1997

In the *Research Policy* citing environment for 1997, *Research Policy* loaded with Economics literature and near another Economics Cluster. A Management cluster and an Industrial Economics cluster were also evident here, while *Scientometrics* loaded on its own factor and was not positioned near any significant clusters. This observation confirms the results of the *Research Policy* cited environment, which revealed that *Research Policy* and *Scientometrics* were not tightly coupled. However, in the *Scientometrics* citing environment for 1997, *Scientometrics* loaded with *Research Policy*; again, this reinforces the results found in the previous section. In this environment *Scientometrics* appeared near the Information Science and STS clusters, whereas *Research Policy* appeared near Psychology and Economics clusters.

Citing 1998

In the *Research Policy* citing environment for 1998, *Research Policy* loaded with the Management literature which overlapped with the Organizational Studies and Innovation clusters. There were also notable Business, Economics and Regional Planning clusters here, yet the latter two were not nearby to either *Scientometrics* or *Research Policy*. *Scientometrics* and STS were closely coupled yet far from the other clusters. In the *Scientometrics* citing environment for 1998, *Scientometrics* loaded on its factor and appeared near Information Science and Library Science clusters (the later encapsulating the former), and near Sociology. Here *Research Policy* loaded with *Minerva* in a *R&D Management* cluster which also overlapped with another Management cluster. Interestingly, STS appeared farther from *Scientometrics* than *Research Policy*. The citing environment of *Scientometrics* appears to illustrate an increasing relationship between the *Research Policy* / Management camp, and clusters often associated with the *Scientometrics* camp such as STS and Sociology.

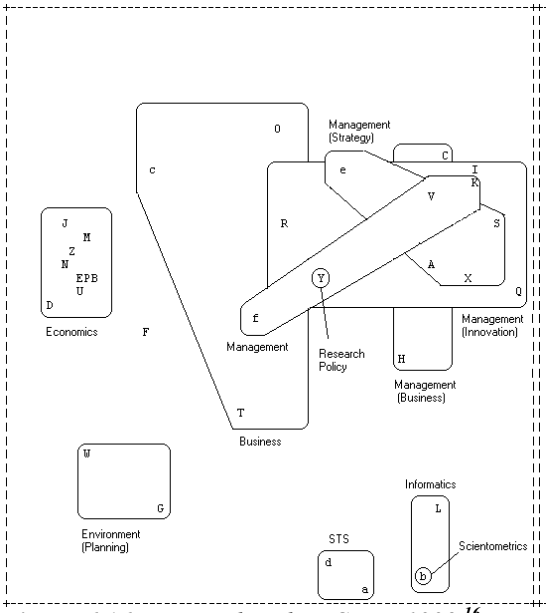

Figure 6.16: *Research Policy Citing 1998* [16]

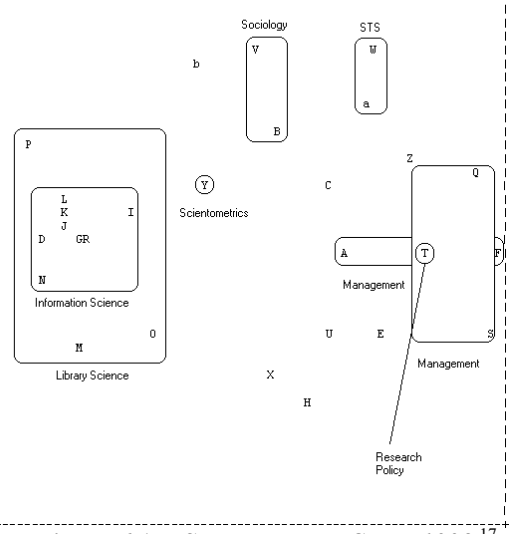

Figure 6.17: *Scientometrics Citing 1998* [17]

LIBR TRENDS; P: *MINERVA*; Q: *RES HIGH EDUC*; R: *RES POLICY*; S: *RES TECHNOL MANAGE*; T: *REV ECON*; U: *REV SAUDE PUBL*; V: *SCI TECHNOL HUM VAL*; W: *SCIENTIST*; X: *SCIENTOMETRICS*; Y: *SOC FORCES*; Z: *SOC SCI INFORM*; a: *SOC STUD SCI*; b: *TECHNOL FORECAST SOC.*

[16] Research Policy – Citing 1998 – Abbreviation / Journal Name: A: *ADMIN SCI QUART*; B: *AM*

Citing 1999

In the *Research Policy* citing environment for 1999, *Research Policy* loaded with *Technological Forecasting & Social Change*, and nearby the Management, Innovation Management, and Business Management clusters. Both Economics and Environmental Planning clusters were evident but far from both *Research Policy* and *Scientometrics*. *Scientometrics* loaded in an Informatics cluster, near the STS cluster. In the *Scientometrics* citing environment for 1999, *Scientometrics* and *Research Policy* load together. Again, *Scientometrics* appeared close to the Library & Information Sciences cluster. *Research Policy* appeared close to the STS, Sociology, and Psychology clusters, and near *Minerva*. This distribution reflects the citing environment of *Scientometrics* in 1996, where *Minerva* also loaded on a single factor positioned between *Scientometrics* and *Research Policy*. These two camps are reinforced here where *Scientometrics* coupled with Library Information Sciences, and *Research Policy* with Sociology, Psychology and STS.

Citing 2000

In the *Research Policy* citing environment for 1999, *Research Policy* loaded in its own factor, as does *Scientometrics*. *Research Policy* appeared relatively near the Management and Innovation Management clusters. There was also a notable Economics cluster again in this environment. As with the citing environments of *Research Policy* in 1996 through 1999, in 2000 we again witness an apparent divide between *Research Policy* and *Scientometrics*. In the *Scientometrics* citing environment for 1999, *Scientometrics* loaded with *Research Policy*. As usual, *Scientometrics* appeared close to the Information Sciences (forming one camp), and *Research Policy* appeared near the STS, Sociology, and Economics clusters (thereby forming another).

ECON REV; C: *CALIF MANAGE REV*; D: *CAMBRIDGE J ECON*; E: *ECON J*; F: *ECONOMETRICA*; G: *ENVIRON PLANN A*; H: *HARVARD BUS REV*; I: *IEEE T ENG MANAGE*; J: *INT J IND ORGAN*; K: *INT J TECHNOL MANAGE*; L: *J AM SOC INFORM SCI*; M: *J ECON BEHAV ORGAN*; N: *J ECON LIT*; O: *J INT BUS STUD*; P: *J POLIT ECON*; Q: *J PROD INNOVAT MANAG*; R: *MANAGE SCI*; S: *ORGAN STUD*; T: *POLICY STUD J*; U: *Q J ECON*; V: *R&D MANAGE*; W: *REG STUD*; X: *RES ORGAN BEHAV;* Y: *RES POLICY*; Z: *REV ECON STAT*; a: *SCI TECHNOL HUM VAL*; b: *SCIENTOMETRICS*; c: *SMALL BUS ECON*; d: SOC STUD SCI; e: *STRATEGIC MANAGE J*; f: *TECHNOL FORECAST SOC*.

[17] Scientometrics – Citing 1998 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *AM PSYCHOL*; C: *AM SOCIOL REV*; D: *ANNU REV INFORM SCI*; E: *CAMBRIDGE J ECON*; F: *IEEE T ENG MANAGE*; G: *INFORM PROCESS MANAG*; H: *INT FORUM INFORM DOC*; I: *J AM SOC INFORM SCI*; J: *J DOC*; K: *J INFORM SCI*; L: *KNOWL ORGAN*; M: *LIBR QUART*; N: *LIBR RESOUR TECH SER*; O: *LIBR TRENDS*; P: *LIBRI*; Q: *MINERVA*; R: *P ASIS ANNU MEET;* S: *R&D MANAGE*; T: *RES POLICY*; U: *RES TECHNOL MANAGE*; V: *SCI COMMUN*; W: *SCI TECHNOL HUM VAL*; X: *SCIENTIST*; Y: *SCIENTOMETRICS*; Z: *SOC SCI INFORM*; a: *SOC STUD SCI*; b: *TURK PSIKOL DERG*

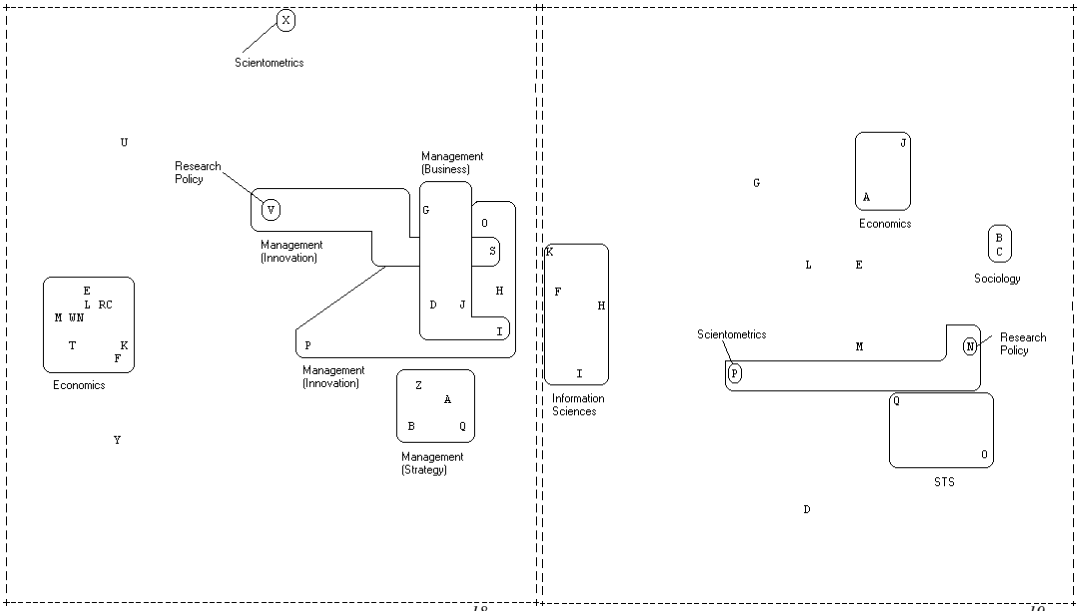

Figure 6.18: *Research Policy Citing 2000* [18]

Figure 6.19: *Scientometrics Citing 2000* [19]

The *Research Policy* and *Scientometrics* citing environments for the years 1996 through to 2000 were similar in their overall distribution to the *Research Policy* and *Scientometrics* cited environments of the same period. On the side of *Research Policy* we again observe that *Research Policy* and *Scientometrics* do not couple closely. While in the cited dimension the two journals loaded in the same factor in 1996, and appeared to grow slightly closer in 2000, in the citing environment of *Research Policy, Scientometrics* and *Research Policy* never load in the same factor. However, the opposite appeared true for both the cited and citing environments of *Scientometrics* in 1996 – 2000. In these cases, *Research Policy* and *Scientometrics* loaded together in 1997, 1999, and 2000, thereby suggesting a closer linkage between the two in this environment.

Several interesting observations can also be made with respect to the types of journal clusters which tended to side with either *Research Policy* or *Scientometrics*. In the case of the total citing environment of *Research Policy* 1996 – 2000, Management, Economics and Regional Planning clusters always appeared, while others more sporadically. The STS cluster only appeared in 1996 and 1998 and in both occurrences, rather marginally; other sporadic appearances include Industrial Economics (1997), and Sociology (1996). The Innovation Management literature

[18] Research Policy – Citing 2000 – Abbreviation / Journal Name: A: *ACAD MANAGE J*; B: *ADMIN SCI QUART*; C: *AM ECON REV*; D: *CALIF MANAGE REV*; E: *ECON J*; F: *ECONOMETRICA*; G: *HARVARD BUS REV*; H: *IEEE T ENG MANAGE*; I: *INT J OPER PROD MAN*; J: *INT J TECHNOL MANAGE*; K: *J ECON BEHAV ORGAN*; L: *J ECON LIT*; M: *J IND ECON*; N: *J POLIT ECON*; O: *J PROD INNOVAT MANAG*; P: *MANAGE SCI*; Q: *ORGAN STUD*; R: *Q J ECON*; S: *R&D MANAGE*; T: *RAND J ECON*; U: *REG STUD*; V: *RES POLICY*; W: *REV ECON STAT*; X: *SCIENTOMETRICS*; Y: *SMALL BUS ECON*; Z: *STRATEGIC MANAGE J*.

[19] Scientometrics – Citing 2000 – Abbreviation / Journal Name: A: *AM ECON REV*; B: *AM J SOCIOL*; C: *AM SOCIOL REV*; D: *DRUS ISTRAZ*; E: *HUM COMMUN RES*; F: *INFORM PROCESS MANAG*; G: *INTERLEND DOC SUPPLY*; H: *J AM SOC INFORM SCI*; I: *J DOC*; J: *J ECON LIT*; K: *J INFORM SCI*; L: *J OPER RES SOC*; M: *PUBLIC OPIN QUART*; N: *RES POLICY*; O: *SCI TECHNOL HUM VAL*; P: *SCIENTOMETRICS;* Q: *SOC STUD SCI*.

appeared to increase over the years 1998, 1999, and 2000, thereby suggesting an increasing activity in this domain. Similar findings were identified in the *Research Policy* cited environment, described above. In the case of the total citing environment of *Scientometrics* from 1996 through 2000, both STS and Information Sciences were always present, the latter sometimes occurring with the Library Sciences (1998, 1999). Sociology figured in every year with the exception of 1997, and Psychology only appeared in 1997 and 1999.

In general, it can be argued that the cited and citing environments for *Research Policy* and *Scientometrics* appear rather similar from the period 1996 – 2000. On the side of *Research Policy*, *Scientometrics* and *Research Policy* appeared to grow apart (with the one exception of an apparent close proximity between the two in the cited environment 2000). On the side of *Scientometrics*, the two journals appear to get closer. One possible catalyst for this is evidenced by the appearance of the Innovation literature in the *Research Policy* cited environment (in all years except 1997) and *Research Policy* citing environment (in increasing frequency from 1998 through 2000). Overall, it would seem that *Scientometrics* cites *Research Policy* in an effort to authenticate the policy relevance of scientometric research; *Research Policy* is where scientometric research (as the context of application) is used and thereby legitimized, this reveals a one way publication flow.

Summary

The analysis of SOEIS related scientific publications, as the third of four empirical analyses that employ the theoretical triad of *Architecture – Network – System* through which the analyses are performed and interpreted, has shown Journal Publication to be an integral component of the SOEIS research project. As with the two previous analyses, three research questions were posed in tandem with the different expected results of each the respective analysis. The theoretical triad was employed in such a way as to enable a comparison between this analysis and the other analyses in *Part III – Reflection*.

The architectural parameters of the SOEIS Journal Publication domain were presented here as having two distinct environments: a cited environment which comprised the referencing behaviour of the SOEIS core and associate members, and a citing environment which comprised the body of articles and references which cited SOEIS relevant materials. The publication dimension was shown to have architectural properties in the Medium Theory sense of the term *information network*. Scientific publication was shown to operate as a unique mediated environment defined by a particular architecture.

It was asked: what are the architectural parameters of the SOEIS publication environment with respect to its Cited and Citing dimensions, and to what degree does their overlap reveal a cognitive bias? The publication activity in the cited and citing dimensions proved to be strongly represented by *Scientometrics* and *Research Policy*, confirming our expectations that the SOEIS would be to be cognitively oriented toward policy and informatics oriented journals in this respect. A secondary question was also addressed here, concerning the ability to enhance our understanding of the

publication architecture by comparing the national orientation of the cited dimension, and rates of co-authorship. As expected, when analyzed for journal distribution by country the national dimensions revealed a European bias. It was unexpected that Spain would prove to be the most productive country in the context of the SOEIS; it was later understood to be a byproduct of a high number of co-authors in the relatively few Spanish publications. Finally, the rate of coauthored publication was shown to be relatively consistent, and the SOEIS-All was shown to be more productive than the SOEIS-Core.

The network analysis asked what networks of interrelationships could be found between the sum of most cited and most citing journals, given the results of the architecture analysis. It was expected here that, as with the micro cited and citing dimensions, the sum of most cited and sum of most citing would prove to be Policy and Informatics oriented. This was confirmed, as both *Scientometrics* and *Research Policy* were found to occur most frequently. The orientation of the SOEIS related publications has been identified as to exhibit a unidirectional relationship: *Research Policy* was shown to be very important to *Scientometrics*; *Scientometrics* has less influence upon the citation environment of *Research Policy*.

The systemic networks obtained from the Journal Publication analyses using *Scientometrics* and *Research Policy* as the seed journals for the analysis, has revealed an interconnectivity over the five years of the analysis that has reinforced the science system relevant to the SOEIS project. It was asked whether using the relations among journals (as measured through the factorial structure of their aggregated mutual citations) as the baseline, could find parallels between *Scientometrics* and *Research Policy* with respect to its journal-journal distributions in the cited and citing databases. By comparing the years 1996 through 2000, an evolving interconnectivity was located. It was expected that the relationships between the identified clusters of journals would provide a sense of the changing disciplinary emphases evident in the science system during the course of the project, when compared with the field level of the SOEIS publications as a baseline. *Research Policy* and *Scientometrics* were shown to have a unique relationship vis-à-vis each other. The cited and citing environments of *Research Policy* and *Scientometrics* proved to overlap considerably. On the side of *Research Policy, Scientometrics* and *Research Policy* appeared to move apart with the exception of the year 2000. By contrast, on the side of *Scientometrics* the two journals were observed to converge over the five year time period. It was concluded that a probable catalyst for this phenomenon was the emergence of a strong Innovation literature in the Research Policy Cited and Citing environments. *Scientometrics* was shown to cite *Research Policy* to authenticate its policy relevance, and *Research Policy* was identified as the place where scientometric research as the context of application was used and legitimized.

In the following chapter the results of the final empirical analysis of this study are reviewed. Using the framework produced through theoretical triad of *Architecture – Network – System* the analysis assessed the potential of internet mailing lists to enhance networked communication. Again, *Chapter VIII: Integration & Conclusions* will review the conclusions of the four distinct analyses of this study, using the theoretical triad as the shared reference.

Chapter VII: Analysis of Mailing List Environment

Introduction[1]

The chapter addresses the potential of Internet mailing lists to enhance academic research with respect to Gibbons' (*et al.*, 1994) distinction between Mode I and Mode II knowledge production. The threaded email messages from a selection of Self-Organization and Science & Technology Studies oriented Internet mailing lists were examined using cybermetric techniques, as described in *Chapter III: Materials & Methodologies*. The central drive was to illustrate the internal dynamics involved in the electronic production of knowledge from a different angle than the previous analysis of the internal electronic communications of the SOEIS members as described in *Chapter V*.

Arguably, the introduction of the Internet mailing list has contributed a new dimension to academic research and its communication. The primary aim of this chapter is to outline the dynamics of Internet mailing lists with respect to their potential to enhance networked communication, and by extension, influence the process of knowledge production. It is argued that network relationships fostered by the use of electronic media can be understood, in part, through an examination of threaded email messages. Importantly, email messages do not occur at random but are the product of collective directed action – they are events that occur in succession, often with reference to each other. Email messages in threads are best understood to be like words in sentences – they achieve meaning within context. This analysis is therefore focused upon how threaded email messages, as individual units of communication, can be understood together as concerted collective action.

The secondary aim of this study is to outline the key similarities and differences between the EuroCon-Knowflow mailing list, which houses the electronic communication of the Self-Organization of the European Information Society (SOEIS) research project, and a selection of ten other related mailing lists. The frequency of interaction is compared with the size of the threads to reveal network dynamics particular to the Internet mailing list. Clearly the examination of threaded messages as instances of interaction is what makes this study unique. As with the previous sections, several distinct but overlapping theoretical perspectives are incorporated into the analysis to describe the *architectural, network* and *systemic* dimensions of knowledge production enabled by the Internet mailing list. Additionally, the Self-Organization and Science & Technology Studies mailing lists were selected to reflect the theoretical perspectives employed in the analysis.

[1] This research has been partially funded by the European Union under the Targeted Socio-Economic Research (TSER) program (SOE1–Dt97–1060). Sections of this chapter were published in Zelman, A. & Leydesdorff, L. "Threaded Email Messages in Self-Organization and Science & Technology Studies Oriented Mailing Lists" in *Scientometrics* 48(3), 361-380. The author would like to thank Moses Boudourides and Loet Leydesdorff for valuable contributions to this research.

Research Focus

The research focuses upon the discussion threads of mailing lists. The use of threaded messages as our hermeneutic units of analysis provides the basis for a reflection upon the theoretical lens described in *Chapter II: Theoretical Grounding*. In particular, with respect to Self-Organization Theory, we measure for self-organized criticality by comparing the frequency and size of threaded messages. Using this and other methods as operationalized modes of theorizing, the *architectural, network* and *systemic* dynamics particular to the Internet mailing list are revealed.

As suggested in the review of the relevant literature in *Chapter I*, there appears to be a gap in the literature related to how *threaded* email communications can be understood as a mode of knowledge production particular to the technology of the Internet. Accordingly, this contribution to the discourse analyzes *threaded messages* to illustrate the production of knowledge as an ongoing process, and it employs the model of the theoretical triad to position electronic communication via mailing lists as a unique mode of knowledge production.

A thread is a string of messages originating around a single topic of discussion; it is a series of messages in which each message refers to the previous. The focus on threaded messages permits a perspective to aid in understanding how information is exchanged, and how this mode of exchange differs among lists. Arguably, the use of theoretical positions that concern *architectural, network* and *systemic* (not individual) behaviour may enhance our understanding of mailing lists as contributing to a unique mode of knowledge production.

In particular, Self-Organization Theory is useful to this project as the phenomenon of threaded messages can be seen as a recursive operation through which knowledge is recursively produced via collective interaction. Like Medium Theory and ANT, Self-Organization Theory helps frame the *thread* as the key unit of analysis. Importantly, it theoretically grounds our comparison of the frequency of interactions (how often threads occur) with the size of interactions (the length of the thread) as a test for self-organizational properties in Internet mailing lists.

Each of these theoretical perspectives provides a window upon the network dynamics of mediated communication. Clearly each helps frame the context of the examination through highlighting the networked dimensions of the Internet mailing list, and each lends a perspective that permits a more detailed description of the distinction between Mode I and Mode II knowledge production. Together, these theoretical bodies frame this analysis in the sense that the node through which they intersect is the notion of the thread: the observation of threaded messages achieves a different meaning with each perspective.

In light of Medium Theory, individual email messages can be understood to collectively form an information network along a historical axis; list activity thus becomes the measure of the degree of shared informational world formation. In light of Actor Network Theory, *threaded* email messages can be understood as an indicator of information network formation created and sustained through individual actions. This extends the notion of the information network as an architecture since actions are

isolated as the means through which the information network is continually reproduced, thereby illustrating its interconnectivity. Finally, with Self-Organization Theory the notion of information network is lifted from local actors and actions to a next-order perspective that treats thread size and frequency as fingerprints of the recursive operation of the social system, above and beyond individual agency. These key theoretical positions align with the three stages of the results described below.

Research Questions & Expectations

Email messages are the key unit of analysis because they serve as a focal point for questions concerning both individual and collective behaviour. Through analyzing threaded email messages as *events*, using the theoretical perspectives outlined in *Chapter II: Theoretical Grounding*, a new perspective is gained, thereby lending a unique understanding of the networked dynamics of the Internet mailing list. Three *research questions* have been isolated, each with reference to a particular theoretical body.

The first research question concerns the architectural dimensions of mailing list communication. *Does the Internet mailing list operate as an information network, and can qualities common to all lists be identified, or do different lists perform specific functional roles in academic communication?* This question is informed by the Medium Theory notion of the information network, and aims to characterize each list architecturally with respect to its perceived function in the academic network. With respect to this research question, the primary expectations concerned the variation among the lists with respect to their descriptive statistics; it was expected that the lists under examination would vary according the status of each. The EuroCon Knowflow mailing list, for example, functions in the context of the SOEIS research project and in this sense was expected to differ in relation to lists at the field level. Three levels have been identified: project, intermediary, and field. This is of concern to the analysis because printed communication fostered a distinction between formal and informal communications, and it can be expected that this distinction may blur with electronic media use. A related research question is relevant here: what does this blurring mean for formal communication at the field level and for informal communication at the level of research practice? Accordingly, this analysis should prove insightful for mailing list participants involved with project, intermediate and field level lists.

Second, *Are there notable differences between Internet mailing lists with respect to their networked communication statistics, and if so, what can we determine about each list given the threaded-ness of it's communication?* The question is informed by Actor Network Theory and aims to outline the network qualities of the Internet mailing list as a product of collective actions. The key focus here is how individual messages compile to form information networks. The primary expectations of research question two concerned how the EuroCon-Knowflow list compares to the sample set. The comparison relates to the communicative statistics – the *threaded-ness* of each list. Unlike the aforementioned expectation of a blurring between formal and informal knowledge production at the project, intermediary and field levels, it was expected here that these differences could be located through an examination of

threaded messaging behaviour. Given the intentional positioning of email-listings at the project, intermediary or field levels, it was therefore expected that these differences would be reinforced despite the blurring capacity of electronic media. Electronic communication would therefore appear to supplement rather than supplant traditional print media. The analysis was aimed to discern whether individual emails (actions) reinforce the distinction between formal and informal communications or whether the dynamics of the net erased the original differences.

Finally, research question three concerns the systemic dimension of the mailing list: *Can discernable self-organizational network properties of the Internet mailing list be identified, and if so, which lists appear to be self-organizational, which do not, and why?* Self-Organization Theory informs this research question; by comparing the size and frequency of threads irrespective of their individual contributors, the recursive aspects of the information system are outlined. With respect to research question three, the expectations concerned net dynamics in a collectively produced sense. When observed from a macro perspective it was expected that some mailing lists would exhibit self-organizational properties while some would not. The key issue here was how the system dynamics could be compared as to make this distinction. Accordingly, by comparing thread size and frequency using Bak & Chen's (1991) measure of self-organized criticality, the expectation was that an analysis of Internet mailing lists as information networks that are collectively created and maintained (regardless of individual action) could be discerned.

Each additional theoretical perspective enables a new type of question to be posed and a new frame of analysis to be employed. In the following section the results of the analyses performed on the data collected from these eleven lists are described. Briefly stated, the data are analysed for their *architectural, network,* and *systemic* dimensions to illustrate the degree of 'information network' formation, its interconnectivity, and possible systemic aspects of the communication to determine which lists operate self-organizationally and which operate hierarchically.

Results

Architecture

Once the materials were gathered the critical information for each list was outlined. This information included the member list, email address list, messages per member, and the total number of messages. *Table 7.1: List Information (up to and including 6/11/98)*[2] provides an overview of the relevant critical features of each mailing list, including date of list inception, duration in days, number of subscribers, and total number of mails.

[2] The analysis of this SOIES Communicative domain commenced on November 6, 1998; this was the cut-off date for all mailing lists under analysis.

Mailing List	List Inception Date	Duration in Days	Number of Subscribers[3]	Total Number of Mails
Autopoiesis	9 / 5 / 96	910	300	653
CyberUrbanity	30 / 5 / 95	1255	68	1151
Deukalion	8 / 4 / 97	577	51	580
ETK	11 / 5 / 97	544	41	558
EuroCon-Knowflow	17 / 6 / 96	872	110	672
Luhmann	13 / 12 / 95	1058	355	1553
Principia Cybernetica	10 / 5 / 94	1640	127	1767
Sci-Tech-Studies	1 / 1 / 97	675	967	950
SimSoc	14 / 4 / 97	571	413	366
SOIS	22 / 4 / 98	198	77	190
Xaos	14 / 1 / 97	661	171	835

Table 7.1: *List Information (up to and including 6/11/98)*

Once the preliminary data for each list was collected we were able to gain an initial sense of the role that each list played in the academic environment. Three distinct levels of analysis were performed in this study. Respectively, the three steps entailed the analysis of descriptive (*architectural*), communicational (*networked*), and self-organizational (*systemic*) statistics. Again, these steps align with the three key theoretical positions employed in this analysis: Medium Theory, Actor Network Theory, and Self-Organization Theory. For the calculation of descriptive statistics, the member lists, email address lists, messages per member, and the total number of messages were compiled for each of the eleven mailing lists. List activity was then calculated by dividing the total number of mails by list duration (in days). *Figure 7.1: List Activity: Mails / Day*, shows the results.

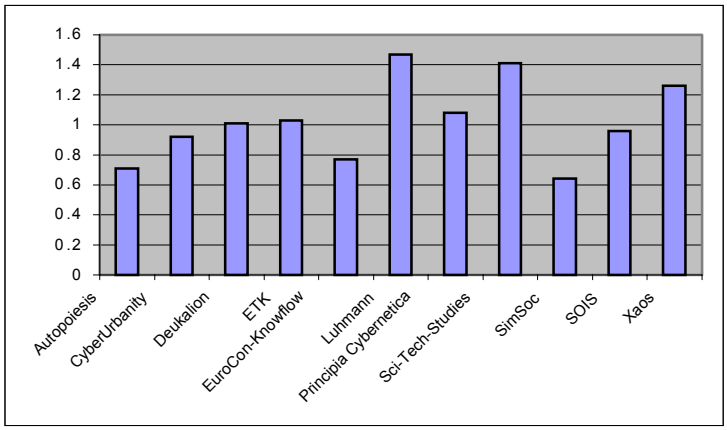

Figure 7.1: *List Activity: Mails / Day*

From the information presented here it is learned that over half of the mailing lists under observation have a list activity of at least one email per day; the mean is just over 1, and has a standard deviation of .27. Here *list activity* is best understood as an indicator of architecture formation – in the sense of the Medium Theory 'information network'. Interestingly, there are three groups of lists visible here. The first are the cognitively driven lists with field-type characteristics (Luhmann, Principia Cybernetica, and Sci-Tech-Studies); these exhibit particularly high traffic density. The second group of lists are project related (EuroCon-Knowflow, SOIS, SIMSOC,

[3] The number of subscribers in each list is *cumulative*.

and Autopoiesis) and they exhibit lower levels of traffic density. Finally, the third grouping includes national lists with an in-between level of traffic density. At this level of the analysis it appears that the national level relates the cognitive dimension with an institutional one. This runs counter to the expectation that electronic media blur the formal / informal distinction reinforced by print media – there is variation between project, intermediary, and field level lists.

Equally meaningful are the *list participation* statistics calculated as a percentage of active subscribers.[4] List participation provides a means of comparing each mailing list on the basis of the architectural dynamics involved in the fostering and maintenance of an Internet mailing list as an information network. *Figure 7.2: List Participation %*, below shows the results of this calculation.

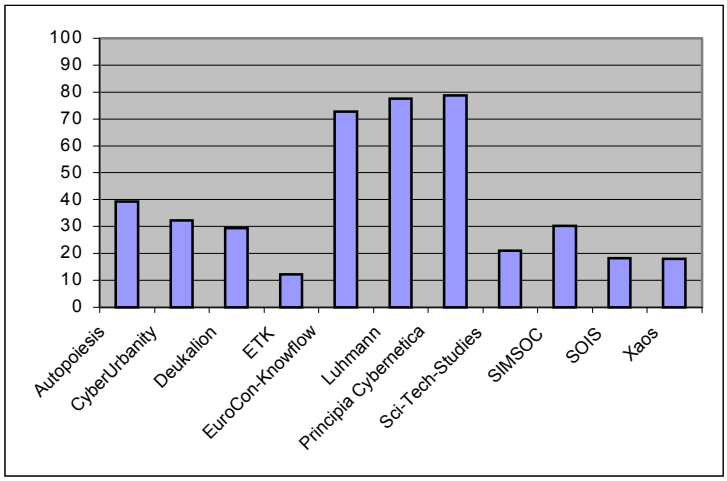

Figure 7.2: *List Participation %*

From this second calculation it appears that some lists (like Sci-Tech-Studies) have a remarkably high list activity, while the actual list participation remains considerably low. This indicates that for some lists there are few very active subscribers, and an overwhelming amount of members who subscribe but do not participate. Perhaps more interesting is that the EuroCon-Knowflow list ranked among the top three lists with particularly high degrees of participation. The Luhmann and Principia Cybernetica lists both operate at the field level, whereas the EuroCon-Knowflow list operated at the project level. Interestingly, in these cases a high degree of 'active' information network formation can be observed. These lists are very related in terms of the subject matter addressed, and in this respect it is possible that there may be some degree of self-organization in the case of these three lists.

As with the results obtained from the calculation of list activity, the results of the list participation calculation conformed to our expectations. It was expected that electronic networking would blur formal and informal dimensions traditionally associated with print when general list activity was considered. This was confirmed by the distribution illustrated above in *Figure 7.1: List Activity: Mails / Day*. Then,

[4] Those who do not contribute to the list are referred to as lurkers (non-active). Mailing list activity is calculated as the percentage of members who have contributed at least one message.

given the intentionality involved in sending messages in response to one another (thereby forming threads), it was expected that differences between project, intermediate and field levels could be identified. This was indeed the case – the calculation of list participation seems to indicate that the lists with the highest degrees of participation are generally field level lists with the exception of the EuroCon-Knowflow. This observation is further reinforced in the next section where list participation in *threads* is examined for its network dimensions.

Network

The second step entailed the calculation of the communication statistics for each list, and reflects the ANT theory of network formation. For each list the number of threads and the number of individuals participating in each thread were counted. Once collected, the percentage of members participating in threaded mails was measured to enhance our understanding of how individual mailing lists are the collective product of distinctly individual actions: network formation. The *percentage of threaded mails* was determined by dividing the number of messages occurring in threads by the total number of messages. The *percentage of contributing members* was then calculated by dividing the number of members participating in threaded messages by the total number of active subscribers. *Figure 7.3: Participation in Threaded Mails %* illustrated below shows the results of this calculation.

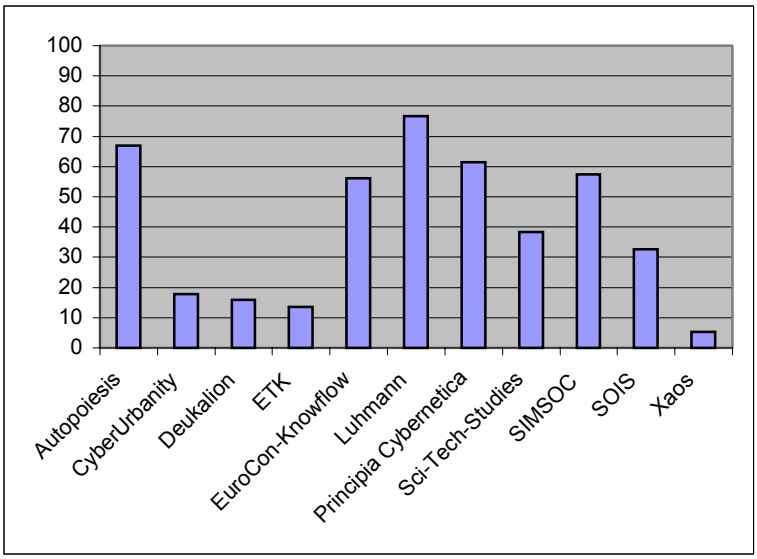

Figure 7.3: *Participation in Threaded Mails %*

The chart reveals that the intermediary (Greek) lists do not function in terms of threads. They will be left out from further analysis because here the primary concern here are the *thread* dynamics. Additionally, it has also been identified that the lists with a cognitive focus on self-organization seem to be organized more in threads than the others. Threaded-ness, used here, should therefore be considered here as a codification of cognitive organization.

The expectations concerning the lack of blurring between formal and informal dimensions traditionally associated with print were not confirmed by the calculation

of list participation. Here too, as indicated in *Figure 7.3: Participation in Threaded Mails* % (above) we find that the distinctions between project, intermediate, and field level lists are reinforced. Thus, there is a correlation between the total list participation and the level of thread participation. The Pearson correlation is 0.96; *Figure 7.4: Total List Participation % & Thread participation %* below shows this correlation graphically.

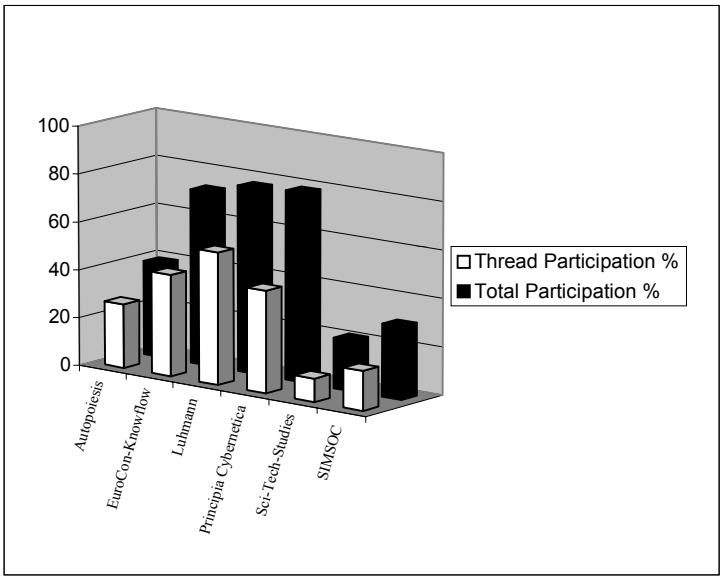

Figure 7.4: *Total Participation % & Thread Participation %*

As an additional task in this step, each thread was categorized into one of six different message topics (*administrative, announcement, maintenance, miscellaneous, query,* and *theory*). These topics were then calculated as a percentage of total threaded mails. Figure *7.5: Overall Thread Distribution,* shown below, displays the results of this step.

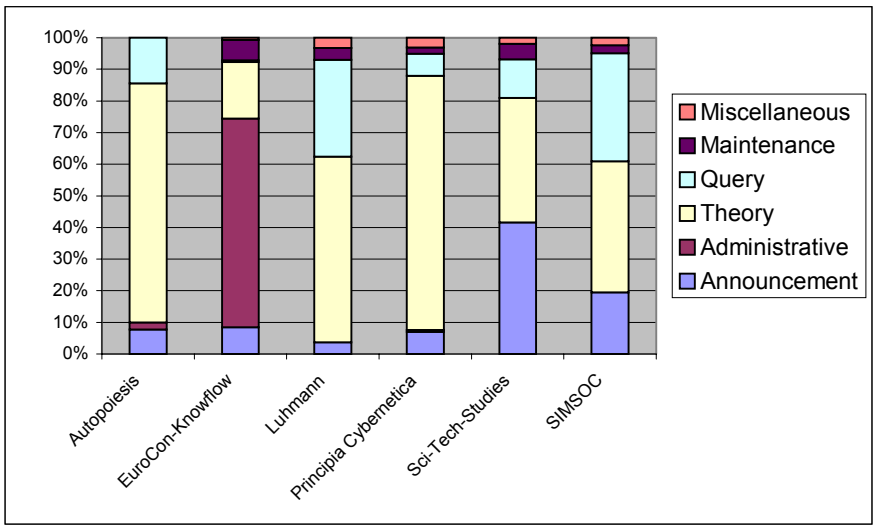

Figure 7.5: *Overall Thread Distribution*

Again, an emphasis is placed on the relevance of Actor Network Theory in understanding (information) network formation as a product of collective action. By specifying thread activity by topic, the communicative value of each mailing list was assessed. By specifying thread topics, different types of threads were isolated to identify each list as exhibiting certain characteristics.

In *Figure 7.5: Overall Thread Distribution* we see little correlation between field, intermediate and project levels in the thread distribution. Administrative threads figure particularly low (if at all) in all mailing lists except EuroCon-Knowflow. However, this is not surprising as it was the only project-related list under analysis. It is notable that theory threads figure particularly high in all lists examined in this step, with the exception of the relatively low theoretical count of the EuroCon-Knowflow list. When the respective theory, query, or announcement distributions were compared, a better sense of the collective priorities of each list was obtained.

Here the nature of the cognitive exchange in the lists was theorized. Given the intertextual (meaning) network offered by Poststructuralist analyses, certain liberties were taken in interpreting the structural differentiation between lists by focusing solely on thread distribution. The majority of lists exhibit relatively high theory counts and low administrative counts, but it is also significant that announcements figured low in some field lists like Luhmann, and yet high in others like Sci-Tech-Studies. The similarity between project (SIMSOC) and field level (Luhmann) lists is also notable in the case of query threads. Additionally, the Structuration Theory distinction between social and system integration proves useful here. Thread distribution can be understood to reflect (architectural) elements of system integration, while list participation (above) reflects elements of social integration.

System

Step three involved a slightly more detailed analysis of the thread communication statistics for each mailing list. The additional detail concerns the analysis of variance in the size and duration of threads in order to deduce self-organizational or systemic dynamics particular to Internet mailing list communication. This procedure stems from the theory of self-organized criticality and involved the counting of the number of messages per thread, and calculating how long each thread of messages lasted in days (by specifying the start day for each thread). The results were translated into logarithmic scale to obtain the x-function for each list. *Figure 7.6: EuroCon – Messages Log* and *Figure 7.7: Luhmann – Messages Log* show two examples of the graphs produced in this step.

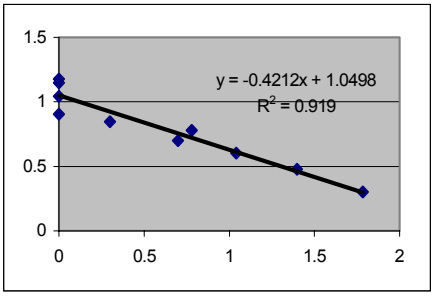

Figure 7.6: *EuroCon - Messages Log*

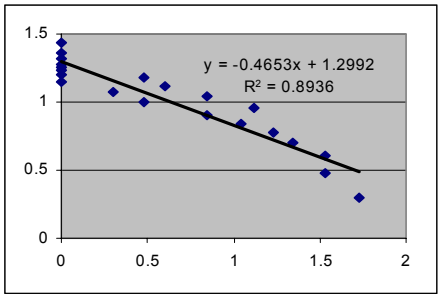

Figure 7.7: *Luhmann - Messages Log*

Table 7.2: Log Formulae Comparison (below) displays the log formulae revealed through this analysis.

LIST	Log (Y)	R2
All Lists	-0.4592 Log(x) + 3.502	0.8835
Autopoiesis	-0.05169x + 1.1533	0.8076
EuroCon-Knowflow	-0.4212x + 1.0498	0.919
Luhmann	-0.4653x + 1.2992	0.8936
Principia Cybernetica	-0.6234x + 1.3955	0.7533
SimSoc	-0.6616x + 1.1104	0.7085
STS	-0.8952x + 1.248	0.4842

Table 7.2: *Log Formulae Comparison*

From this analysis it proves difficult to determine which lists are self-organizational and which are hierarchical. While none of the lists appear to be self-organizational, it cannot be concluded that there are none at all, because it remains impossible to determine which level would in fact indicate self-organization given the limited size of the dataset. Since there is a middle grouping that has an average of roughly -0.5518, while there are periphery lists ranging from -0.05169 to 1.3955, it may be the case that we have isolated mixtures of self-organization and non-self-organization. Nonetheless, Self-Organization Theory remains a relevant stance here. While it was expected that some semblance of self-organization could be observed, the data sets themselves appear to be too limited to reveal any self-organized criticality. Indeed, more traditional measures of self-organized criticality employ much larger data sets, and the measure of self-organizational properties employed here is of little use given the limited amount of thread frequencies in each of the lists.

The reader should note that this does not necessarily imply that there are *no* self-organizational elements operating here, but that the data sets as they have been compiled are not suited to this type of analysis. Thus, while the third research question highlighted the difference between hierarchically and self-organizationally oriented dynamics, the possibility that there may be self-organizing aspects at hand has not been abandoned. While self-organization cannot be observed here, one cannot conclude that mailing lists do not exhibit any self-organizing qualities; it may be that hierarchical and self-organizational dynamics operate in tandem.

Summary

The primary aim of this analysis was to outline the dynamics of the Internet mailing list with respect to its potential to enhance networked communication. Addressing this aim involved a detailed study of the processes of knowledge production evident in the email messages that constitute the exchange between members of Internet mailing lists. A selection of Science & Technology Studies and Self-Organization oriented mailing lists were examined to understand the *architectural, network* and *systemic* relationships fostered by the use of electronic media, and significant results were found.

The list comparison provided us with evidence that Internet mailing lists operate as information networks and have a discernable architecture; here Medium Theory was used to emphasize the connectivity in mediated relations. These networks were then shown to be actively produced and maintained through concerted collective action, and Actor Network Theory was used to reflect upon the implications of mapping this cognitive interconnectivity. Postructural and Structurational theories of meaning and network were also used in this sense. It was learned that field level lists perform roles particular to their specific functions with respect to participation in general, and that there is a strong correlation between list participation and thread participation. This reflected the original expectations that despite the blurring capacity of electronic media (which was evident with list activity), the formal / informal distinction is maintained with respect to project, intermediate and field level lists when examined for their respective levels of participation.

Additionally, it was expected that since mail-listings are intentionally posted, the formal distinctions apparent in traditional (print) media would be discernable. However, it appears that electronic relations do not supplant these original distinctions, but reinforce them. But that is not to say that they remain identical. Clearly electronic media do foster new and unique types of network relations but they also appear to reinforce those relations associated with the use of traditional (print) media. Electronic media, therefore, do not replace earlier dynamics but in fact supplement them – the Internet does not erase these original differences. Such communication does not occur in a vacuum, but with reference to substantive communication, and here was found a mixture of transition.

For formal communication at the field level, and for informal communication at the level of research practice, these results imply that one may expect significant differences in the ways that individuals may electronically communicate with each other regardless of rank or experience. But, despite this observation, the formal / informal distinction is nevertheless imported into this new media environment. Finally, with respect to the primary aims, and contrary to the expectations, the analysis proved unable to discern self-organizational network properties in any of the Internet mailing lists under analysis.

The secondary aim of this study was to outline the key similarities and differences between the EuroCon-Knowflow mailing list, which houses the communication of the Self-Organization of the European Information Society (SOEIS) research project, and a selection of other related mailing lists. It was found that while the EuroCon-Knowflow list exists primarily as a project meeting place, its dynamics reflect those of field level lists. This is a positive sign in the sense that there appears to be a rich level of theoretical discussion, making the list both interesting and dynamic. This changes the relation between informal and formal since it brings the field dynamics within the control of intentional action.

As with *Chapter V: Analysis of Electronic Communication*, it has been shown here that electronic media were integral to the functioning of the SOEIS project, and more generally that the processes of knowledge production evident in electronic communication differ from print. The Internet mailing list was shown to supplement and thereby enhance academic exchange. The use of this cybermetric approach has

broadened the possibilities of metric analyses, and the complete set of metric approaches used in tandem with the theoretical model has permitted a means of comparing the results of all empirical analyses. The *Architecture – Network – System* triad will be employed again in *Part III – Reflection* to compare, map, and reflect upon the complex interlacing of the different communicative domains under observation in this analysis.

PART III – REFLECTION

Chapter VIII: Integration & Conclusions

Review

In the introductory chapter of this study a central problematic was identified: given the centrality of media to academic communications, the need to understand the impact of media form increases with the advent of electronic media into the academic environment. The impact of this new media landscape on the scientific process is not yet well represented, nor is it well understood. It was argued that the previously dominant media (print) fostered particular types of networking, and that new electronic media can be expected to foster different ones. Importantly, sorting the complexity between media biases demands that we not only observe the new media environment in terms of how it compares to the former, print networks, but that we acknowledge these print networks to also be in transition. The identified challenge of the dissertation was 'how do we compare media bias given this complexity of interrelation?' The *Architecture – Network – System* triad was used as a heuristic model for the empirical analyses, and thereby enabled a means of classifying and comparing the different network architectures fostered by each medium.

We first turned to the history of the metric approach in order to highlight similar analyses which could inform this study. The review included a short history of bibliometrics as a tradition that stretches back to the scribal culture of the Middle Ages, scientometrics as a related tool to map the publication behaviour of scientists and the evolution of disciplinary foci, and cybermetrics as a means of coping with the myriad of new accessible datasets available for analysis given electronic media. In this way it was argued that metric analyses could be used to address this problematic. Further, it was argued that the various existing metric approaches lacked sufficient comparison of media forms with each other, and that such an approach could be achieved with operationalized theorizing.

In *Chapter II: Theoretical Grounding* a range of approaches relevant to the problematic of mediation were addressed to provide a theoretical grounding for the study. It was argued that existing metric analyses were largely not theoretically informed and it was expected that by providing a rich theoretical backdrop to this study, we might be able to enhance the interpretation and integration of the metric results in the respective chapters. Medium Theory was introduced as the theoretical baseline for the study, as the approach covered both the historical use of media through time as an epochal framework encompassing oral, literate and electronic stages of mediation, and the notion of transformation between these stages. We can understand the current study to be primarily concerned with the transformative stage implied with the shift from print to electronic media as the predominant medium of social intercourse. An important concept was introduced here: the *information network*, which Meyrowitz argued was a viable heuristic for understanding the changing nature of social relations through time as mediated phenomena.

In addition to the theoretical backbone provided by Medium Theory, two other modelling approaches were addressed: Actor Network Theory (ANT) and Self-

Organization Theory. ANT provided the theoretical lens that enabled a means of comparing the print and electronic communicative domains of the Self-Organization of the European Information Society (SOEIS) research project, as the approach has a rich history of use as a grounding to perform and interpret textual analyses. Importantly, the ANT provided a means of conceptualizing how individual events (as word use, publications or threaded emails) compile to form networks of interrelation. Self Organization Theory was then employed to provide a birds-eye view perspective whereby these networks of interaction could be understood from a macro perspective which sought systemic properties of the SOEIS communications, that in principle remained outside the full comprehension of the individual actors of the network. These three bodies collectively helped form the dissertation heuristic: the *Architecture – Network – System* model.

The theory chapter also reviewed a number of approaches concerning the symbolic aspects of mediated communication. Here the central proponents of Structuralism, Poststructuralism, and Structuration Theory were addressed. These theoretical bodies were introduced to help interpret the results of the analyses which pertained more to changes identified with the cognitive orientation of the SOEIS group. This laid the foundation for the analyses to follow, precisely because each of these theoretical bodies speak to the problematic of mediation as it relates to knowledge production, as introduced in *Chapter I: Introduction – Key Concepts*. The theoretical framework, while dense in its appropriation of concepts from a broad range of disciplines, proved to be an effective means of assessing the empirical analyses (with respect to both modelling and symbolic aspects) and thereby helped illustrate the unique relationship between print and electronic media.

Chapter III: Materials & Methodology, the third and final chapter of *Part I*, served to bind the theoretic triad of *Architecture – Network – System* with the metric analyses identified in the introduction. Here the particular metric analyses to be performed on the different communicative domains of the SOEIS research project were aligned with the points of the theoretic triad. This provided the conceptual link between the theoretical priorities of this study and their operationalization using metric analyses. In this way both were positioned into an overall framework, and geared towards a common end – the exploration of the differences between print and electronic media given the problematic introduced by the centrality of both media forms to processes of knowledge production. Accordingly, the chapter produced an overarching research question for the dissertation; this integrated the priorities of the analysis, and juxtaposed them with a set of general expectations.

Given the centrality of media to processes of knowledge production, and the responsibility of these changes as related to media (as argued by Gibbons *et. al.,* 1994, the OECD publications introduced in *Chapter I*, and Medium Theory as described in *Chapter II*), it was assumed that Information and Communication Technologies (ICT) affect the ways that scientists communicate. To address this problematic both empirical approaches and theoretical bodies were reviewed and integrated into a framework to carry out a series of analyses. This gave rise to more central expectations: that metric analyses and modelling techniques could aid in understanding the different roles that print and electronic media play in academic environments, and thereby help accurately describe the dynamic character of the

evolving research practice. And finally, that the theoretical triad as created for the analysis could both contextualize and aid in the interpretation of the results of the empirical analyses.

With these expectations a guiding research question was then asked: "*Given that mediated communication and mediated processes of knowledge production are mutually implicated phenomena, and given that the changing information environment in academic contexts can be theorized with respect to differences between print and electronic media, can the application of metric techniques to academic communications in tandem with applied theorizing show biases particular to each medium and thereby reveal the nature of said changes?*" The metric analyses upon the mediated traces of the SOEIS communicative domains has shown that ICTs impact academic communications in different ways, and that this difference was attributable in part to the function of each medium (print and electronic) as conduits of knowledge production. This observation was made possible through the use of the theoretic triad heuristic to interpret the results of the metric analyses. The central research question has been answered with respect to the expectations of this *exploratory* analysis.

The following section: *Integration* will review the results of the individual analyses with respect to how the respective questions were answered and their respective expectations met (or not). Here the theoretic triad of *Architecture – Network – System* is used to bind the central findings of each analysis. In this way the main architectural, network, and systemic features of the SOEIS group were collated and a core set of results isolated. A concluding section will then highlight the central findings of the dissertation. The final chapter of the dissertation will address the limitations identified through the execution of this analysis, and will provide relevant guidelines for those interested in pursuing similar analyses into the future.

Integration

This section will serve to conceptually integrate the four previous empirical analyses together, using the theoretical triad of *Architecture – Network – System* to bind their central findings. Overall, *Chapter IV: Analysis of Print Communication* and *Chapter V: Analysis of Electronic Communication* served to isolate and characterize the internal communicative dynamics of the SOEIS research group by analyzing the patterns of word exhibited by the group as the key units of analysis. By contrast, *Chapter VI: Analysis of Journal Publication* and *Chapter VII: Analysis of Mailing List Environment* served to delimit the external communicative dynamics of the SOEIS by focusing upon word use, but here the focus of the analysis did not revolve around patterns of word use, per se, but rather from the next order perspective – where words were used in combination to generate journal articles and emails. By analyzing and then comparing the internal and external dynamics of the SOEIS using the theoretical triad, a general set of conclusions concerning the role of media in processes of knowledge production was generated.

While running the risk of being repetitive, each of the four empirical chapters of this study is reviewed in this section by addressing their central research questions and

expectations in tandem with a integrative review of the central findings of each sub-analysis. In this way, we gain a general understanding of the overall *architecture* of the SOEIS mediated environment, its *networked* properties, and finally its *systemic* dimensions.

Architecture:
As argued in *Chapter II: Theoretical Grounding*, the notion of architecture is best understood in the context of the *information network* as characterized by Meyrowitz, the central proponent of second generation Medium Theory. It was argued that while social reality is constituted through interactions among people, it is the patterns of information flow which operate as the catalyst for change, not physical setting. Social situations (such as the SOEIS research project) are therefore best perceived as *information networks* whereby different actors, events, and (by default) media converge to create social reality. Thus, the aim in introducing the notion of the information network was to provide a useful metaphor with which to understand the architectural parameters of the different communicative domains examined in this study. The term *architecture*, as used in this analysis, was employed to encapsulate the complex structure of these four communicative domains of the SOIES research project with the ultimate aim of integrating them into a general understanding of the *architecture* of mediated processes of knowledge production.

In *Chapter IV: Analysis of Print Communications* it was asked: "do the SOEIS print communications have a discernable architecture, and can particular qualities be identified with a decidedly print mode of communication?" It was expected that an analysis of the fluctuation of the percentage of unique words across each time period of the print dataset would reveal elements of information codification. The results proved greater than the original expectations: it was shown that not only did the print communications exhibit an *a priori* codification, as expected given the nature of the print medium, but also exhibited evidence of a *processual* codification. It was found that this *processual* codification could be attributed to the fact that the print dataset operated as an aggregating text, suggesting that many contributions in earlier time periods were 'cut' and 'pasted' into later submissions, thereby constraining the evolution of the print dataset.

By contrast, when the same question was asked in *Chapter V: Analysis of Electronic Communications* regarding the electronic dataset, it was expected and confirmed that the architecture of the electronic communications would be less constrained than similar communications in the print dataset. Indeed, the electronic dataset was shown to behave in a more Mode II fashion than the Mode I oriented print communications, as evidenced by the continued increase of word frequency and percentage of unique words over the four time periods. The architectural features of the internal communications of the SOEIS research project were therefore shown to have behaved differently in the print and electronic datasets, and this difference was argued in terms of evidence of information codification in the print dataset, and the resistance to codification in the electronic.

The architectural analysis of the communicative domains external to the SOEIS project entailed a slightly different approach than that employed for the analysis of the

internal communications. Instead of prioritizing 'codification', which was effective for the analysis of the internal communications, here the emphasis was placed on the 'cognitive biases' or realms that could be identified in the publication and mailing list datasets. The analyses of these latter two communicative domains focused on aggregate word use (i.e.: journal articles and emails) rather than on patterns of word use. The analyses of the communications external to the SOEIS therefore entailed different priorities.

In *Chapter VI: Analysis of Journal Publication* the question was posed: "what are the architectural parameters of the SOEIS publication environment with respect to its Cited and Citing dimensions, and to what degree does their overlap reveal a cognitive bias?" The subsequent analysis of the publication architecture showed that the citation environment of the SOEIS was predominantly oriented towards Policy and Informatics journals; this cognitive bias was evidenced by the centrality of *Scientometrics* and *Research Policy*. The publication architecture was further enriched by highlighting the European bias of SOEIS publications, and the consistency of co-authorship frequency which proved to be proportionately higher in the SOEIS group than in the core membership. In this way the SOEIS publications were shown to exhibit a particular architecture that operated as an information network in the Medium Theory sense of the term.

Similarly, the mailing lists analysed in *Chapter VII: Analysis of Mailing List Environment* were shown to operate as information networks, but there the emphasis was less on the cognitive orientation of the lists, as this was 'given' due to the restriction of the analysis to Science & Technology and Self-Organization Theory oriented mailing lists. Here it was asked: "can qualities common to all lists be identified, or do different lists perform specific functional roles in academic communication?" Prior to performing the analyses it was expected that the different lists under examination should vary with respect to the status of each as either project, intermediary, or field level lists. When compared, the lists were found to have discernable network architectures that were actively created and maintained; a direct correlation was found between list participation and thread participation, and the field level lists were found to perform roles particular to their expected function as evidenced by the participation levels of project, intermediary, and field level lists.

Given that the communicative domains differed so much in their composition, the examination of each necessarily entailed a different set of analyses. It was possible to compare the results of the analyses of the internal print and electronic communications, since their databases were so similar, but it remains a matter of comparing apples and oranges when the different architectural parameters of the external communicative domains of the SOEIS. Nevertheless, each was shown to operate as an *information network* in its own right, and they can be conceptually linked in this way. That is to say, the SOEIS research project certainly operated as a 'social situation' defined by a myriad of different patterns of information flow which collectively comprised the information network of the SOEIS. The analyses of the different architectural parameters of each communicative domain as an essential part of the collectively created and maintained information network of the SOEIS permitted an initial means of collating the results of these and subsequent analyses.

Network:
Where the architecture analyses used the metaphor of the *information network* to discern the overall parameters of the four communicative domains of the SOEIS, the network oriented analyses were generally more concerned with the dynamics of information exchange via these information networks. *Chapter II: Theoretical Grounding* introduced Actor Network Theory (ANT) as a discourse often used in the field of Science & Technology Studies to contextualize textual analyses. The ANT provided this study with a grounding for the analyses of the network properties of the respective SOEIS communicative domains under analysis. Whether comparisons between print and electronic keyword networks, citing and cited dimensions of SOEIS related publications, or threaded email communications, the ANT provided a soluble means of simultaneously appreciating the significant differences between the communicative domains while rendering a general network metaphor to bind the analyses. To assist with the interpretation of the 'meaningful' content of the communications analyzed, several *meaning,* or *symbolic,* oriented discourses from Structuralism, Poststructuralism and Structuration Theory were also reviewed. The dominant network metaphors obtained therein provided a number of different conceptualizations of where meaning could be 'located'.

It was argued that where the structuralist discourse maintained a transcendent and relatively closed meaning system devoid of human context, poststructuralist approaches were shown to localize meaning in the social: in the act of communicating. Structuration Theory was then introduced to incorporate both approaches. Meaning is something that is both social in the sense of being created, but is also structural by definition – our operationalization of language through speech or writing systemizes the language structure. Spoken language leaves only traces in the mind, whereas the written word leaves traces that can be observed both synchronically and diachronically. Each discourse offered a network metaphor that proved instrumental to understanding the overlap of the four communicative domains of the SOEIS. The datasets under analysis were all necessarily 'closed', by definition; the time periods selected for analysis were finite, but one can appreciate the evolutionary nature of communications geared to a collective end. Given the SOEIS as a research project with an advent and a termination, the datasets are best perceived as 'closed' in the structuralist sense of the term, but 'open' in the sense that the information *content* is expected to be different in each of the respective datasets and time periods under analysis. Hence, the SOEIS communicative domains were each assessed as time series.

For the analysis of the print and electronic communications the two years of the SOEIS research project were each divided into four periods of six months; for the analysis of journal publication the scope was stretched to five years to incorporate those publications which occurred before and after the SOEIS; and finally, the analysis of mailing lists measured the duration of threads over a finite period of analysis. Simply stated, the value of the symbolic approaches was to provide a sense of 'meaning making' in each of these communicative domains, thereby illustrating how each operated as an individual domain of knowledge production.

The first network analysis compared the fluctuations of keyword use over the four time periods of the SOEIS print communications, expecting that a discernable pattern of keyword reoccurrence would be visible. By comparing the top 50 keywords general topic words were found to be predominant and little was learned. Comparing each time period with the overall dataset proved more useful as particular emphases were found for each time period. The most impressive results of the keyword network analyses were found by comparing each period with the subsequent period, to reveal the transmission of word use over the four periods of the project as a process. Here it was found that words which concern the general *functioning* of the SOEIS research project appeared to increase in frequency over the time periods.

When the electronic communications were assessed as a time series, it was asked: "does this distribution differ significantly from the results of the print analysis?" It was expected that the top electronic keywords would contain similar keywords as the print, but that a different emphasis will be located. Indeed this proved to be the case. With the comparison of the top 50 keywords similar topics as the print dataset were predominant – hardly surprising given their shared participation to a common end. Yet when the individual time periods were compared with electronic dataset, and with each other, it was found that keywords which appeared to supplement the *activities* of the SOEIS actually increased over time, whereas words which supplement the *functioning* of the SOEIS decrease. This is in stark contrast to the results of the print analysis where the occurrence of *function* oriented keywords appeared to increase.

Thus, internal communicative domains of the SOEIS were shown to be different; the difference between the print and electronic datasets can be partially explained by the role of each medium through the course of the project. The email communications were more process oriented, in terms of activity; rightly so, as it was largely by using this medium that SOEIS participants mutually decided upon meeting locations, introduced new ideas and suggested alternatives. Writing, as a formalized mode of communication, was shown here to be geared towards the functioning of the project and this can be understood with respect to the constraints placed upon communication by the pressure to create milestones and final reports.

The external communicative domains of the SOEIS were then assessed. Journal referencing activity and mailing list activity were subjected to different kinds of analyses, but were assessed with the same conceptual grounding. That is to say, both domains were unique in their manifestation, but were conceptually similar: both journal articles and threaded messages are written as *responses* to the literature relative to their respective domains, and are characterized by *continued* discourse. As representative of the internal dynamics of the SOEIS, print was selected as the exemplar of a Mode I oriented process of knowledge production and the electronic as more Mode II oriented. Similarly, journal publication is traditionally Mode I oriented, whereas mailing lists are Mode II. One must take caution, however, not to assume these to be mutually exclusive, since the dynamics of journal publication are certainly affected by the rise of new disciplines and hence new journals, as evidenced by the appearance of the Innovation literature in the citation neighbourhoods of *Research Policy* and *Scientometrics*, as shown in the publication systems analysis. Similarly, mailing lists were shown to exhibit traditional print oriented Mode I characteristics.

In *Chapter VI: Analysis of Journal Publication*, it was asked: "can networks of interrelationships be discerned by comparing the sum of most cited and most citing referenced journals? The SOEIS reference environment was shown to be policy and informatics oriented with the predominance of references going to *Research Policy* and *Scientometrics*. The SOEIS group was found to heavily cite *Research Policy*, while the group was itself cited primarily by *Scientometrics* articles which revealed a cognitive bias of the SOEIS group. It was shown that the publication environment exhibited a unidirectional flow of citation behaviour – *Scientometrics* was shown to heavily cite *Research Policy*. *Research Policy* is understood here to be the context of the application of analyses performed in *Scientometrics*; *Research Policy* is where scientometric studies are used and authenticated.

The network analysis performed in *Chapter VII: Analysis of Mailing List Environment* answered the question of whether Internet mailing lists differ significantly with respect to their list participation and threaded-ness. Differences were found between project, intermediary and field level lists and the examination revealed that the national lists did not operate in terms of threads. It was found that email communication via Internet mailing lists do foster unique network relations but also reinforce network relations associated with print media; a mixture of transition was found.

System:

The SOEIS communications have been observed as unique domains through which knowledge has been produced. Self-Organization Theory was used, in part, to describe how print and electronic media use should be understood as mutually implicated phenomena as they have formed the single operation of the system of SOEIS communication. The systemic analyses performed on the four communicative domains analyzed treat each as a unique operation (of the collective SOEIS system), responsible in part for the recursive production of knowledge. By observing patterns in the observable phenomena, the analyses sought to identify the (largely unobservable) system of communication.

It was expected that an analysis of the print communications would reveal points of critical revision, showing path dependencies in the dataset. Each stage was expected to be instrumental to the furthering of the project communications in this medium. The measure juxtaposed each time period with each successive time period for its expected information content. Contrary to the expectation, critical transitions were not found to be necessary for the communication to develop over the dataset. While path dependencies were not found in this analysis, it was shown that the transmission of words was better over the entire document set than the transmission over the document set of shared words. Similarly, for the systemic analysis of the SOEIS electronic dataset, no path dependencies were found to indicate critical revisions in the information exchanged. When the electronic dataset was subjected to an analysis of word transmission and specificity, and the results compared with the results of the print analysis, transmission was found to be better across electronic datasets, which was caused by the occurrence of words in some time periods and not in others. Specificity remained lower in the electronic dataset. The systems analyses of the internal communicative domains of the SOEIS revealed that the print dataset achieved

the same communication as the electronic with less words, yet it was also shown here that the transmission of words was better in the electronic dataset than in the print.

Differently oriented analyses were employed to assess the systemic dimensions of the external communicative domains of the SOEIS. The systems analysis of the SOEIS publications analyzed the co-citation relationships between *Scientometrics* and *Research Policy* given their centrality to the citation environment of the SOEIS. Using the relations between these two journals as the baseline as measured through the factorial structure of their aggregated mutual citations, the question was asked: "can parallels be found in journal-journal distributions over time." In accordance with the expectations of the analysis, the relationships between the identified clusters of journals provided an overview of the changing disciplinary emphases in the science system relevant to the SOEIS during the time period 1996 thorough 2000. *Research Policy* and *Scientometrics* were shown to have a unique relation vis-à-vis each other. On the side of *Scientometrics* the two journals appeared to grow closer together over the five years of the analysis; on the side of *Research Policy*: the two journals grew apart, with the exception of the year 2000 in which they appeared closer. The systemic analysis of the SOEIS publication environment has shown a cognitive orientation of the SOEIS group toward policy and informatics journals and has reinforced the finding of the network analysis that revealed a unidirectional citation behaviour: *Scientometrics* relies upon *Research Policy* for the legitimization and authentication of published analyses, but *Research Policy* was not shown to cite *Scientometrics* with the same fervour.

The systemic analysis of the SOEIS mailing list environment aimed to find self-organizational properties of the project and field level Internet mailing lists under analysis (the intermediary or national level lists were left out of the analysis, as it was shown before that they do not operate in terms of threads). When observed from this macro perspective it was expected that some mailing lists would exhibit self-organization while some would not, thereby enabling a distinction. When compared for thread size and frequency none of the mailing lists were found to exhibit these properties. It was concluded that the datasets as compiled were not suited to the analysis since it became evident that much larger datasets would be needed to find statistically significant evidence of Self-Organization.

Conclusions

Finally, the concluding section of this chapter will highlight the central findings of the dissertation. Here the core findings are listed in rank order with the most significant findings down to those of lesser significance. The findings are also divided into those which concern the internal communicative dynamics of the SOEIS and those which concern the external.

1. Internal: Print and electronic writing differed in their architectural make-up; the SOEIS print communications proved to be heavily codified and aggregative, whereas electronic communications appeared resistant to codification. These findings were argued in the architecture and system

analyses in *Chapter IV: Analysis of Print Communication* and *Chapter V: Analysis of Electronic Communication*.

2. Internal: Print and electronic keyword distributions were different in their respective emphases; the SOEIS print communications were shown to bias *function* oriented words, which were shown to increase over the dataset, in contrast to the electronic communications which were shown have a decreasing occurrence of *function* words in favour of words which contributed to the *activity* of the SOEIS project; email communications were found to supplement project activity. These results were shown in the network analyses of *Chapter IV: Analysis of Print Communication* and *Chapter V: Analysis of Electronic Communication*.

3. External: SOEIS publications were shown to bias Policy and Informatics oriented journals as evidenced by the strong predominance of *Scientometrics* and *Research Policy*. The SOEIS group was shown to cite *Research Policy* articles in an effort to authenticate the policy relevance of scientometric research; the group was in turn cited by journals published in *Scientometrics* thereby revealing a one way publication flow. This result was shown in the network and system analyses in *Chapter VI: Analysis of Journal Publication*.

4. External: SOEIS mailing list environment revealed that email does foster unique network relations between researchers, but that email serves to supplement the print medium as evidence was found to support the expectation that the informal / informal distinction associated with print was found to be imported into this new medium as project, intermediary and field level lists. The project mailing list EuroCon-Knowflow was found to behave like field level lists, as revealed by its high level of mail activity and thread participation as shown in the architecture and network analyses of *Chapter VII: Analysis of Mailing List Environment*.

Overall it can be argued that the internal dynamics of the SOEIS as contained in the print and electronic communications conformed to the expected distinction between Mode I and Mode II processes of knowledge production, respectively. However, in the external communicative domains it was found that although predominantly Mode I, journal publication did exhibit Mode II characteristics (Innovation literature) and the mailing lists were shown to exhibit characteristics associated with the print medium such as the distinction between formal and informal communications, and was therefore also Mode I oriented. The distinction between Mode I and Mode II was clear in the analyses of the internal communicative domains of the SOEIS, but was less so in the analysis of the external domains thereby revealing the intricacy of the overlap.

This exploratory analysis has highlighted some specific ways in which we can examine these phenomena into the future. In the last and final chapter the limitations identified in the course of this research will be discussed, suggestions for further analyses provided, and finally it will deliver some design specifications for an envisaged software program to aid in the performance of similar analyses into the future.

Chapter IX: Discussion & Relevance

Discussion

The preceding chapters have addressed the key problematic identified in the introduction: understanding the role and impact of print and electronic media use in processes of knowledge production. The central research question was asked: "do media foster unique types of information environment, and are different modes of knowledge production and meaningful exchange thereby implied with each medium and its use?" Given the conclusions outlined in the final section of the previous chapter, it is now possible to answer this question in light of the knowledge gained through this study. Different media were shown to foster different types of information exchange, and different modes of knowledge production were found with respect to each medium and its designated function in the SOEIS.

By establishing new exploratory research methods using a range of computer assisted research software, this analysis has contributed to the fields of *Science & Technology Studies* and *Communications Studies*. This contribution was achieved by formalizing a research methodology that was theoretically informed using both traditions. Symbolic and modelling approaches were integrated using the *Architecture – Network – System* heuristic model; the theoretic triad thereby enabled the development of a standardized methodology. Both *Science & Technology Studies* and *Communications Studies* have been enhanced by using this combinatory framework, as each emphasizes the importance of understanding the relationship between social processes of knowledge production and the technological means through which communication is made possible. The analysis has shown that these processes are inextricably linked. By providing a distinction between communications that share similar content but use distinctly different media this study has isolated the dominant features of print and electronic communication and has highlighted their centrality in processes of academic communication.

The central problematic identified in the introduction was addressed. Basic differences were found between print and electronic media in the context of the shared communications of the SOEIS research project. In short, print writing was shown to exhibit both *a priori* and *processual* codification, and networks of keyword distribution that emphasized words associated with the *functioning* of the research project. Electronic writing was shown to resist the codification evident in the set of print communications, and to have keyword distributions which emphasized the *activities* of the SOEIS group such as arranging meetings. SOEIS print publications identified a unidirectional flow of citation from *Scientometrics* to *Research Policy*. Finally, the EuroCon-Knowflow mailing list of the SOEIS research project was shown to behave like field level lists.

It can be stated that this study rests in an steadfastly emerging academic discipline. The Internet is growing exponentially.[1] Accordingly, the amount of studies

[1] Internet growth and usage statistics: http://cyberatlas.internet.com/big_picture/stats_toolbox/article

concerning the relationship between academe and the Internet is likewise growing dramatically, as are other Internet related analysis which monitor user behaviour in a myriad of different ways. Given this, it is striking that the *difference* and *relationship* between print and electronic media remain sorely under-represented issues in the field. This study was motivated in part by this apparent lack, and has established a general methodology through which issues of media overlap could be addressed. It is expected that increased understanding of the overlap between media in academic and other social environments will encourage, or indeed demand, similar types of analyses into the future.

This final chapter will reflect upon the challenges encountered and limitations identified through the course of performing this research. The aim is to provide relevant guidelines for those interested in pursuing similar analyses in *Science & Technology Studies* and *Communication Science*. In the following section, I will reflect upon the challenges and limitations involved with maintaining an empirical – theoretical balance and the process of model building involved therein. The section will also provide suggestions for future research. It is also important in this reflection to acknowledge the limitations implied with the manual collection and analysis of data using such a diverse range of software programs employed throughout this study. In response to the constraints identified in the course of performing such exploratory research, the concluding section will introduce the Media Analysis Toolbox (MAT). The MAT is a proposed software toolbox comprised of a modularized set of tools to aid in the collection, collation, and analysis of 'media generated' traces of communication.

Future Research

For the benefit of those who may pursue argumentation along these lines in the future, it is important to emphasize that the analysis of media overlap should not be restricted to the observation of academic environments. However, while other environments may exhibit the richness of media overlap, it can be problematic to find enough data to make the analysis viable. Academe does provide an ideal set of communications to study the phenomenon of mediation, in the sense that it is rich with *traces* of human communication. In part, this is why the SOEIS research project was selected – within the scope of the project we have print and electronic communication about the *same* subject matter, an identifiable time line, and a relatively stable body of participants. Arguably, a similar analysis could be performed whereby the oral communications of a group could be recorded, transcribed and then compared with the group's print and (or) electronic communication. There are also a range of other salient environments one could study to gain insight into the impact of media overlap. Examples include the comparison of traditional print oriented citation patterns with the emerging phenomenon of online citations as hyperlinks (Rousseau, 1999), the comparison of related websites on the basis of their textual content, the comparison of on and offline newspapers, and the comparison of oral and print processes of knowledge production in research environments such as the SOEIS.

One central challenge encountered in the course of this research was that of *model building*. Once the research group had been selected and its respective

communications assessed for analytic potential, it became clear that a stable framework would need to be established in order to contain the diversity of materials and methods. It simply would not have been possible to co-ordinate all of the heterogeneous research foci, research questions and expectations, much less compare two distinctly different media, were it not for the grounding of the work into a theoretical context using what was termed the theoretic triad of *Architecture – Network – System*. By developing this heuristic model it was possible to coordinate these otherwise disparate approaches into a workable framework.

It is necessary to realize that the development of new analytic techniques using computer assisted research tools also introduces new analytic challenges. Importantly, using techniques of this sort provides the researcher with entirely new subject matter to interpret. The research output becomes, in essence, another body of information that should be read through the lens of abstraction. That is, the researcher must appreciate that the information has been filtered using certain logics, and one must therefore interpret these new research objects in that light. Making the research object-oriented makes the simulated object a 'real thing' that can be manipulated. Thus the graphic image becomes a key instrument for research. The rationale behind a visually oriented representation is that everyone viewing an image will agree on its meaning, provided they each understand the signs. The researcher must be aware how the use of such programs affects the research process. S/he must appreciate the difference between the interpretation of a text, and the interpretation of an interpretation. A text is an interpretation by definition; the author interprets the world and inscribes it. With hermeneutic examination of a text, the researcher is interpreting the interpretation. This double-bind is referred to by Giddens as the Double Hermeneutic. (1991) With the increased use of visual representations of data, researchers must acknowledge this double bind, lest their research lead to spurious conclusions.

The remainder of this section provides a brief description of the limitations perceived in the respective analyses performed in the previous chapters. With respect to the textual analyses performed in *Chapters IV* and *V*, the individual datasets proved relatively easy to overlay, despite the difference in precise origin and termination dates of the print and electronic communications. The four time periods were roughly delineated according to the project application, two milestone report periods and the final report, as contained in the print communications dataset. The limitation in the data was that the SOEIS project output was collectively written as print documents, whereas the emails which comprised the project mailing lists were individually written and collated in the same four time periods of six months. The email documents were manually filtered for redundancy as there was no tool available to perform the filtering process.

Where the analysis of the print and electronic communications revealed the internal communicative dynamics of the SOEIS, the publication analysis and mailing list analysis uncovered its external communicative dynamics. Both analyses imparted valuable information concerning the larger scientific environment in which the SOEIS operated, yet neither database was truly comparable as print versus electronic modes of publication. It would be valuable if a means of collecting comparable datasets were developed. One could conceivably compare traditional journal publication – as

recorded by the Web of Science in the *Science Citation Index* (SCI), *Social Science Citation Index* (SSCI) and the *Arts & Humanities Index* (A&HI) – with indexes of online articles such as the *NEC Research Index*[2], though arguably it is likely to be some time before the latter becomes more of an academic standard. Nevertheless, efforts are underway to map the hyper-linking between websites in a manner similar to scientometric approaches (Rogers, 2000)

The mailing list analysis performed here observed threaded messages, not online journals, indexes or individual web pages. Nevertheless, comparisons of email archives or the content of web pages would arguably present new and interesting research avenues. Webmasters and mailing list providers alike employ a myriad of different programs for enabling, indexing and archiving messages – presenting the problematic that there is no standardized form of archiving mailing list output, or of copying and filtering a web site. It is possible to write a program to perform the necessary standardization of indexical, archival, and retrieval functions, in principle, but there remains the need for a standardized mark-up language among information providers.

There is a general consensus that there should be a move towards the development of an encoding standard. In 1994 the Text Encoding Initiative (TEI) was published. However, the flexibility of TEI permits individual scholars to create their own marking schemes thereby making it much more difficult to develop a standard data interchange format. Future developers will need to decide whether to provide a standard mark-up (like TEI), or XML (eXtensible Mark-up Language). Such standardization of mailing list archival functions, for example, would enable much more potential to compare larger datasets. If future researchers were to find evidence of self-organized criticality in Internet Mailing lists, for example, the examination would necessarily demand that a much greater amount of raw data be collected. Moreover, an analysis performed on a greater amount of emails would reveal even richer keyword distribution.

The research performed in this dissertation has clearly shown that in order to perform effective research of this sort into the future it would be wise to aim towards the development of a software program to aid in the performance and integration of a range of related tasks. While the lack of standardized formatting of email archives and the like remains a limitation, it is not an obstacle and indeed, the recent acceptance of XML as a *de facto* Internet standard yields promise. Thus, among the most interesting insights obtained during the process of this research can be communicated here in a number of recommended features of a modularized software program that would enable such integrated analyses.

MAT Program Design:

The core of this final discussion and suggestions for future research lies in a proposal for the development of a modularized software program for a Media Analysis Toolbox (MAT) to aid in the performance and integration of particular tasks which

[2] The Computer Science oriented Research Index is located at http://citeseer.nj.nec.com/cs

have proven problematic in this research. This line of argumentation is pursued purely as an intellectual enterprise, thereby providing another type of reflection upon the understanding gained through this study. The design parameters of any academic software tool would necessarily have to consider several basic features such as an indexing program to record, archive and retrieve one's data, and an exportation function to enable further interpretation of the results in standard statistical and graphing programs. Below I will outline major considerations concerning the design and integration of 3 core tools and 3 periphery tools, collectively containing a range of distinct sub-modules, all encompassed under the general rubric of MAT.[3] The program could be written using *Visual Basic* software, in order to permit the easy development of additional modules. The program under consideration is open ended and infinitely expandable, in principle.

The need to develop new forms of scientific instrumentation in order to understand the dynamics of the technological shift from print to electronic as the predominant medium of exchange has never been more salient. The development of electronic publishing, sophisticated modes of online indexing, and academic emailing lists (to name but a few developments) have introduced radical changes to the traditionally print-biased modes of knowledge production, and print based modes of information storage. How can we further assess the impact of ICT's on current modes of knowledge production? One possible means is the development of a research software program to aid the execution of analyses similar to those covered in this dissertation.

The proposed modularized software package incorporates advantages from a range of existing research tools, and implies the formalization of new research methodology similar to that developed in this study. The research methodology enables researchers to use a combination of existing tools to locate relevant networks of academics, institutes and research foci, and to compare the substance of publications, websites and emails based on their textual content. The proposed modularized software package will provide researchers with a unique set of research tools to categorize, analyze and compare both online and offline research behaviour. Here I will outline several major considerations concerning the design of the MAT software package, and thereby outline the parameters of what would constitute a program more suited to the analysis of emails, websites and the content of other online textual environments.

It is important to highlight that any research software tool designed for academic or other purposes should keep the program as simple as possible, as the people who are likely to use it will not be familiar with programming *per se* (i.e.: not scientists or engineers), but rather people involved with the Social Sciences (namely: Communication Science), and the Humanities (namely: Hermeneutics). With respect to program users the interactivity of the design must be considerate of all of the distinct modules used in the program. While the seasoned researcher may know and understand all of the different calculations being performed, a novice may not understand the issues. Thus, designers and developers would be wise to consider an interactive program that provides immediate feedback to changes made in the

[3] This program design has been largely inspired by the design specifications of the Réseau-Lu Network Laboratory Research Software Package, and the textual analysis tool: EyeConTACT. See: Monger & Rockwell (1999), and Rockwell & Bradley (1998).

program map. That is, if one aspect of an analysis is changed then that change should be registered by each of the linked displays, presuming the different programs are modularized.

The 3 core tools of the MAT are: the Visual Mapping Tool (VMT), the Web Harvester Tool (WHT), and the Data Filtering Tool (DFT). The 3 periphery tools are: the Textual Analysis Tool (TAT), the Citation Analysis Tool (CAT), and the List Analysis Tool (LAT). Each individual tool is comprised of several sub-modules that can be added or replaced as needed. The aim is to develop a cohesive set of modules and sub-modules to perform multiple tasks on a myriad of related data sets. In what follows, the tools and their respective sub-modules are described in detail. *Figure 9.1: Media Analysis Toolbox*, below, shows the interrelation of the conceptualized research software toolbox and its constituent parts.

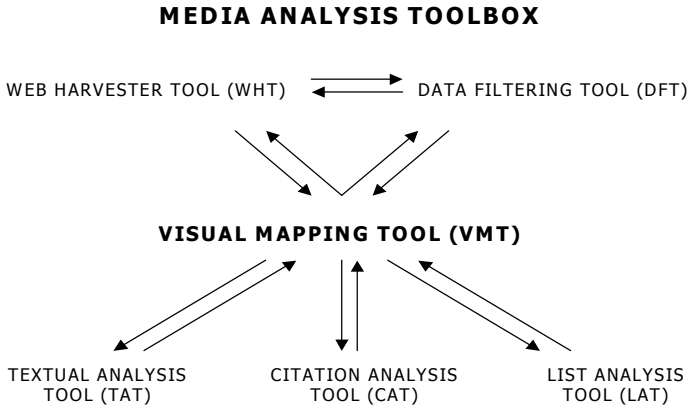

Figure 9.1: *Media Analysis Toolbox (MAT)*

Of the three core tools of the MAT (VMT, WHT, and DFT), the most integral to the program is the Visual Mapping Tool (VMT). There are 2 integral components of the VMT: the *visual display module*, and the *mapping module*. The VMT is conceptualized to be the centre of analytic operations – it is through this tool that the entire research project can be conducted, tracked and visualized.[4] The *visual display module* permits the researcher to visually organize all data under analysis, and additionally permits the use of other tools in the MAT from the same interface. The *mapping module* permits the analyst to record all tasks performed in the research, and to manipulate the results accordingly.

The Web Harvester Tool (WHT) and the Data Filtering Tool (DFT) are also core tools of the MAT. The WHT permits the gathering of data from various online resources through two sub-modules: the *crawler module* and the *site ripper module*. The *crawler module* permits users to browse the World Wide Web (WWW) in a way similar to *Netscape* or the *Microsoft Internet Explorer*, in order to locate relevant information to be imported for analysis. The *site ripper module* serves to download and filter the content of websites relevant for the analysis. This results in output that

[4] The Visual Mapping Tool reflects the design of the Réseau-Lu software in which the network laboratory operates as the central visualization and project mapping tool.

can be used for text analysis using the TAT, or for citation analysis using the CAT. The DFT serves as the tool for filtering a variety of different data forms; its sub-modules include: a *text filter module*, a *citation filter module*, and a *list filter module*. In addition, the DFT has a *general conversion module* to convert documents (e.g.: .doc, .rtf) into ASCII text files in preparation for analysis in one of the three periphery modules described below; in addition, the *general conversion module* permits the viewing and splitting of texts.[5] The *text filter module* permits the analyst to create and use stop lists to filter texts prior to analysis; the *citation filter module* permits analysis to filter *Web of Science* and *Dialogue Medline* data obtained from the WWW or CDROM in order to perform Scientometric analyses using the CAT periphery tool.[6] The *list filter module* enables the researcher to filter and standardize the output of mailing list archives on the WWW. Indeed, one of the major limitations identified in *Chapter VII: Analysis of Mailing List Environment* was that Internet Mailing List providers use a myriad of different ways of archiving messages; the list filter module would permit the standardization of mailing list output into comparable units for analysis.

Collectively the VMT, WHT and DFT comprise the core elements of the proposed Media Analysis Toolbox; each is integral to functioning of the software program. In short, it is through these 3 core tools that data is collected in preparation for analysis in the periphery tools. The output of the periphery tools is in turn imported and displayed using the VMT, uploaded for publication on the web using the WHT, and finally converted into a range of formats for use in other programs such as *Microsoft Word, Excel*, or *Access* using the DFT.

The 3 periphery tools: Textual Analysis Tool (TAT), Citation Analysis Tool (CAT), and List Analysis Tool (LAT) are all additional components created to perform particular research tasks (corresponding with those performed through the course of this dissertation). Importantly these individual programs can be added or subtracted as deemed necessary by the analysis, and are fully compatible with the other programs of the MAT. Moreover, the MAT is conceptualized to be expandable in order to incorporate the development of new tools and sub-modules to perform additional tasks as necessary. As indicated, the program would be best designed to permit the easy creation of modularized tools to be used in combination with existing tools. The three periphery tools are best conceptualized as enabling *architectural, networked* and *systemic* analyses as exemplified by the methodology developed in this study.

The Text Analysis Tool (TAT) will permit the same basic analyses as the *WordSmith* program used for the textual analyses of *Chapter IV: Analysis of Print Communication* and *Chapter V: Analysis of Electronic Communication*. Traditionally, textual analysis programs have been designed to do text-retrieval on literary texts. The

[5] Provided that Visual Basic was used to generate visual displays of data in texts, one would want the texts to be in XML. Rendering software permits the inclusion of images and non-textual elements of documents that can be very important in the case of some texts. Finnegan's Wake provides a salient example of a text which contains drawings, unique means of displaying text (using blank characters), as well as obscure references and symbols (from the *I Ching*, the Masonic tradition, the chakra system, etc.). Including these features can be crucial to the hermeneutic examination of complex texts.

[6] The *citation filter module* performs a similar role to the filter component of the BibExcel program used in *Chapter VI: Analysis of Journal Publication*. See: http://www.umu.se/inforsk/Bibexcel/

TAT is designed with the rapid expansion of digital information in mind, and is conceptualized to be capable of performing wide-area textual analysis on a variety of different datasets. Its programs are combined to retrieve occurrences of a word, word patterns, and word combinations, and to display the results in an understandable and meaningful way. The TAT is comprised of several sub-modules including a *wordlist module*, *keyword module*, and a *concordance module*. These tasks are easily described as performing the same basic analysis as performed in the two aforementioned chapters. Using the output of the *text filter module* of the Data Filtering Tool (DFT), the *wordlist module* reduces text files to mere wordlists and organizes the words by frequency and by alphanumeric rank permitting the analyst to contain the architectural elements of the dataset under analysis. The *keyword module* enables the comparison of texts to identify networks of keywords, and the *concordance module* serves to locate the neighbourhood collocates of query words; both aid network analyses. Once analyses have been performed using the TAT, the results can be automatically updated using in the central interface of the program: the Visual Mapping Tool (VMT) – this permits the generation and comparison of visual displays to understand word distribution.

The Citation Analysis Tool (CAT) consists of a *bibexcel module*[7] and a *link module*. The *bibexcel module* would be designed to carry out essentially the same analysis performed upon the SOEIS citation environment. Using the output of the *citation filter module* of the Data Filtering Tool (DFT), the *bibexcel module* assists the analysis of bibliographic data by performing combinatory searches over the datasets to generate a range of results concerning the architectural distribution of co-authorships, journal citation patterns, and title words.[8] By extension, it is anticipated that similar networks of citation behaviour can be harvested online by examining the hyper-linking between relevant websites. Relevant here is the potential to locate networks of academics, research institutes, or shared research foci. There are currently two existing tools which can be used to locate networks of related internet sites; they are the Net-Locator software and the Issue Atlas Software, the latter being a more refined version of former.[9] Accordingly, the *link module* would be designed to locate the inter-linked relationships between relevant websites (selected via the site ripper module of the WHT). These link typologies could then be compared with traditional citation networks (as found using the *bibexcel module*), or the textual content of the sites themselves could be downloaded using the *site ripper* module of the WHT to be compared using the TAT.

Designed in this way, the Media Analysis Toolbox (MAT) is able to incorporate a variety of important features. As identified, there is an increasing need to expand the capacities of current metric programs to provide more possible avenues of research. The modularized design parameters of the MAT permit the filtering, integration, and analysis of a myriad of accessible datasets from websites, indexes, and archives. In light of the *Architecture – Network – System* theoretic triad, the research tools

[7] The module is also inspired by the BibExcel program used for the Journal Publication Analysis, above, and carries the same name; Bibexcel (literally: Bibmap before Excel) was developed by Professor Olle Persson, from Inforsk, Umeå University, Sweden.
[8] The title words could then be analyzed for significance in the TAT.
[9] The two programs were developed by the Govcom.Org foundation.

modularize a range of different tasks; many of these methodological tasks were manually carried out in course of the analysis described in this dissertation. The combination of tools in the MAT would make similar research into the future far more do-able.

In short, the MAT would enable the researcher to record one's work (i.e.: the processes and decisions made), as well as publish and thereby share one's work. By contrast with the programs used in the analysis and later referred to here (*BibExcel, WordSmith, and IssueAtlas*), the MAT is designed specifically to provide a much more user friendly and visual oriented user interface (via the Visual Mapping Tool) upon which to perform textual, citation, and mailing list analyses. Moreover, every aspect of the program could be modified, in principle, as the needs of the researcher change, and the modular design could be modified and extended through easily added modules. The *mapping module* would record the decisions of the researcher, so that the researcher could pursue different avenues of research easily, and it would save the results as a visual map through which the entire project could be viewed at a glance and then adjusted as the research matures. Importantly, the program would record not only the logic of the research and the flow of research decisions, but also the flow of data between the modules.

The design of the MAT software package serves as a useful reflection given the type of modelling employed in this study; namely, the *Architecture – Network – System* theoretical triad. It should be understood that the design of the MAT is provided here as an intellectual enterprise, providing another type of reflection upon the integration of the theoretical positions and empirical analyses pursued in this study. The theoretic triad employed in this study has relevance to the interpretation of results generated through the MAT. Generally speaking, the core tools of the MAT (VMT, WHT, and DFT) provide the raw data for subsequent analyses using the periphery tools (TAT, CAT, and LAT). The results generated from the analyses performed using the periphery tools can be correlated into *architectural, network,* and *system* oriented results and can be compared in this way.

Perhaps the best way to conceptualize the MAT program is as a set of building blocks (containing struts, beams, wheels and gears). Once these components are created, the analyst can line up the modules as necessitated by the particular analysis; the individual components can be recombined to '*n*' different systems once they are working for particular analyses. The operationalized modes of theorizing isolated by the selection of metric techniques from bibliometrics, scientometrics and cybermetrics, in combination with the theoretic triad developed herein has permitted the combination of deep theorizing with empirical analyses. Indeed, among the most challenging aspects of this study was the integration of different theories (both modelling and symbolic) with metric analyses using a range of different software packages (as well as the manual collection and manipulation of data where programs did not exist). The MAT program design helps to integrate these different features into an overall program that is both theoretically informed and empirically viable, thereby bypassing many of the limitations identified in this dissertation. There are no easy solutions to the problematic of adequately addressing and sorting the complexity of media impact and overlap. Clearly, as the Internet grows the demand for this type of research and this class of academic software program will become more salient.

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Appendix Index: List of Appended Tables & Figures

Appendix A: Archive of Print Communications Analysis

Appendix A.1 – *Stop-List used for Print Analysis*

A	EVERYTHING	MOSTLY	THEN	WON'T
ABOUT	EVERYWHERE	MR	THENCE	WOULD
ABOVE	EXCEPT	MRS	THERE	WOULDN'T
ACCORDING	F	MUCH	THEREAFTER	X
ACROSS	FEB	MUST	THEREBY	Y
ACTUALLY	FEW	MY	THERE'D	YES
ADJ	FIFTY	MYSELF	THEREFORE	YET
AFTER	FIRST	N	THEREIN	YOU
AFTERWARDS	FIVE	NAMELY	THERE'LL	YOU'D
AGAIN	FOR	NEITHER	THERE'RE	YOU'LL
AGAINST	FORMER	NEVER	THERE'S	YOUR
ALL	FORMERLY	NEVERTHELESS	THEREUPON	YOU'RE
ALMOST	FORTY	NINE	THERE'VE	YOURS
ALONE	FOUND	NINETY	THESE	YOURSELF
ALONG	FOUR	NO	THEY	YOURSELVES
ALREADY	FRI	NOBODY	THEY'D	YOU'VE
ALSO	FROM	NONE	THEY'LL	Z
ALTHOUGH	FROM	NONETHELESS	THEY'RE	
ALWAYS	FURTHER	NOONE	THEY'VE	
AM	G	NOR	THIRTY	
AMONG	H	NOT	THIS	
AMONGST	HAD	NOTHING	THOSE	
AN	HAS	NOV	THOUGH	
AND	HASN'T	NOW	THOUSAND	
ANOTHER	HAVE	NOWHERE	THREE	
ANY	HAVEN'T	O	THROUGH	
ANYHOW	HE	OCT	THROUGHOUT	
ANYONE	HE'D	OF	THRU	
ANYTHING	HE'LL	OFF	THU	
ANYWHERE	HENCE	OFTEN	THUS	
APR	HER	ON	TO	
ARE	HERE	ONCE	TOGETHER	
AREN'T	HEREAFTER	ONE	TOO	
AROUND	HEREBY	ONE'S	TOWARD	
AS	HEREIN	ONLY	TOWARDS	
AT	HERES	ONTO	TRILLION	
AUG	HEREUPON	OR	TUE	
B	HERS	OTHER	TWENTY	
BE	HERSELF	OTHERS	TWO	
BECAME	HE'S	OTHERWISE	U	
BECAUSE	HIM	OUR	UNDER	
BECOME	HIMSELF	OURS	UNLESS	
BECOMES	HIS	OURSELVES	UNLIKE	
BECOMING	HOW	OUT	ÚNLIKELY	
BEEN	HOWEVER	OVER	UNTIL	
BEFORE	HUNDRED	OVERALL	UP	
BEFOREHAND	I	OWN	UPON	
BEGIN	I'D	P	USE	
BEGINNING	IE	PER	USED	
BEHIND	IF	PERHAPS	USING	
BEING	I'LL	Q	V	

BELOW	I'M	R	VERY
BESIDE	IN	RATHER	VIA
BESIDES	INC.	RECENT	W
BETWEEN	INDEED	RECENTLY	WAS
BEYOND	INSTEAD	S	WASN'T
BILLION	INTO	SAME	WE
BOTH	IS	SAT	WED
BUT	ISN'T	SEEM	WE'D
BY	IT	SEEMED	WELL
C	ITS	SEEMING	WE'LL
CAN	IT'S	SEEMS	WERE
CANNOT	ITSELF	SEP	WE'RE
CAN'T	I'VE	SEVEN	WEREN'T
CAPTION	J	SEVENTY	WE'VE
CO	JAN	SEVERAL	WHAT
CO.	JUL	SHE	WHATEVER
COULD	JUN	SHE'D	WHAT'LL
COULDN'T	K	SHE'LL	WHAT'S
D	L	SHE'S	WHAT'VE
DE	LAST	SHOULD	WHEN
DEC	LATER	SHOULDN'T	WHENCE
DID	LATTER	SINCE	WHENEVER
DIDN'T	LATTERLY	SIX	WHERE
DO	LEAST	SIXTY	WHERAFTER
DOES	LESS	SO	WHEREAS
DOESN'T	LET	SOME	WHEREBY
DON'T	LET'S	SOMEBODY	WHEREIN
DOWN	LIKE	SOMEONE	WHERE'S
DST	LIKELY	SOMETHING	WHEREUPON
DU	LTD	SOMETIME	WHEREVER
DURING	M	SOMETIMES	WHETHER
E	MADE	SOMEWHERE	WHICH
EACH	MAKE	STILL	WHILE
EET	MAKES	STOP	WHITHER
EG	MANY	SUCH	WHO
EIGHT	MAR	SUN	WHO'D
EIGHTY	MAY	T	WHOEVER
EITHER	MAYBE	TAKING	WHOLE
ELSE	ME	TEN	WHO'LL
ELSEWHERE	MEANTIME	THAN	WHOM
END	MEANWHILE	THAT	WHOMEVER
ENDING	MIGHT	THAT'LL	WHO'S
ENOUGH	MILLION	THAT'S	WHOSE
ETC	MISS	THAT'VE	WHY
EVEN	MON	THE	WILL
EVER	MORE	THEIR	WITH
EVERY	MOREOVER	THEM	WITHIN
EVERYONE	MOST	THEMSELVES	WITHOUT

Appendix A.2 – *Texts Used in Print Analysis*

Name	Texts	Dates	KB	Words	Unique Words	Unique Word %	Mean Ratio %
P1.txt	Application Annex Deliverable 1: Design Periodic Report (6 mo)	01 / 97 01 / 97 05 / 98 08 / 98	117 KB 51 KB 270 KB 34 KB				
Total	P-1.txt	1/97 – 08/98	488 KB	70638	2396	3.39	51.12
P2.txt	Deliverable – Task 2.1 Deliverable – Task 2.2 Deliverable – Task 2.3 Deliverable – Task 3 Deliverable – Task 4 Deliverable – Task 5.1 Deliverable – Task 5.2 Deliverable – Task 5.2b Deliverable – Task 7.1 Deliverable – Task 7.2	12 / 98 12 / 98 12 / 98 01 / 99 12 / 98 12 / 98 12 / 98 12 / 98 12 / 98 12 / 98	21 KB 134 KB 46 KB 249 KB 173 KB 55 KB 242 KB 4 KB 4 KB 8 KB				
Total	P-2.txt	08/98 – 1/99	954 KB	145582	4467	3.07	50.64
P3.txt	Periodic Report (12 mo) Deliverable – Task 1.2 Deliverable – Task 2.1 Deliverable – Task 2.1b Deliverable – Task 2.1c Deliverable – Task 3 Deliverable – Task 3b Deliverable – Task 7.2	3 / 99 11 / 99 8 / 99 8 / 99 6 / 99 8 / 99 8 / 99 6 / 99	113 KB 15 KB 14 KB 19 KB 45 KB 8 KB 6 KB 7 KB				
Total	P-3.txt	01/99 – 11/99	228 KB	34560	1397	4.04	50.34
P4.txt	Final Report – Task 1.2 Final Report – Task 2.1 Final Report – Task 2.2 Final Report – Task 2.3 Final Report – Task 3 Final Report – Task 4 Final Report – Task 5.1 Final Report – Task 5.2 Final Report – Task 6 Periodic Report (18 mo)	11 / 99 6 / 99 11 / 99 6 / 99 9 / 99 5 / 00 11 / 99 11 / 99 5 / 00 11 / 99	67 KB 63 KB 177 KB 51 KB 332 KB 264 KB 356 KB 381 KB 412 KB 119 KB				
Total	P-4.txt	6/99 – 5/00	2271 KB	350524	6496	1.85	50.56
All	Print-Documents.txt	1/97 – 5/00	3914 KB	601273	9142	1.52	50.56

Appendix A.3 – *Top 50 Keywords in Print Consistency Analysis*

WORD	P1	P2	P3	P4	TOTAL
RESEARCH	371	808	142	2268	3589
SYSTEM	219	369	115	1319	2022
NETWORK	217	489	87	1033	1826
SCIENCE	272	387	74	1008	1741
EUROPEAN	**319**	**441**	**117**	**841**	**1718**
POLICY	322	290	106	888	1606
SELF	225	227	220	843	1515
INFORMATION	**284**	**266**	**131**	**790**	**1471**
NETWORKS	**428**	**191**	**82**	**737**	**1438**
ANALYSIS	**180**	**333**	**163**	**695**	**1371**
SOCIAL	175	232	108	852	1367
TECHNOLOGY	163	340	45	749	1297
NEW	233	255	55	731	1274
SYSTEMS	**280**	**174**	**87**	**700**	**1241**
LEVEL	159	235	55	756	1205
ORGANIZATION	**142**	**134**	**126**	**497**	**899**
COMMUNICATION	190	89	61	555	895
KNOWLEDGE	163	133	50	546	892
DEVELOPMENT	125	219	57	475	876
EU	101	175	52	525	853
TASK	**310**	**84**	**158**	**282**	**834**
DYNAMICS	161	137	83	441	822
DATA	**189**	**167**	**108**	**347**	**811**
SCIENTIFIC	82	163	60	496	801
IDENTITY	71	214	18	491	794
ORDER	91	172	45	475	783
DIFFERENT	82	176	43	479	780
CASE	90	172	54	456	772
INNOVATION	164	157	30	393	744
RTD	154	89	37	446	726
RESULTS	165	166	62	330	723
MODEL	91	160	31	432	714
PRODUCTION	73	173	40	409	695
THEORY	107	140	43	389	679
TIME	67	153	49	408	677
WORDS	39	212	39	384	674
PROJECT	**271**	**99**	**90**	**206**	**666**
SOCIETY	144	103	68	349	664
GOVERNMENT	54	122	18	469	663
PROCESS	54	121	38	443	656
SET	21	237	38	359	655
ECONOMIC	68	172	21	380	641
FIRMS	**15**	**253**	**9**	**364**	**641**
BASED	102	133	38	360	633

NATIONAL	144	115	21	334	614
LOCAL	40	136	30	400	606
STUDY	132	97	44	328	601
TERMS	95	168	42	296	601
FACTOR	25	213	20	342	600
INSTITUTIONS	41	157	29	371	598

Appendix A.4 – *Top Keywords Print x All Analysis*

P1xPall	**FREQ.**	**P2xAll**	**FREQ.**	**P3xPall**	**FREQ.**	**P4xPall**	**FREQ.**
ALGORITHMS	50	ALTRI	27	ALTA	15	*ALGORITHMS*	*8*
AMSTERDAM	76	ANCHE	57	AMSTERDAM	35	*CHE*	*5*
APPENDIX	20	ANNI	44	ANALYSIS	163	*DA*	*12*
APPLICATION	69	ATTORI	88	ARCHIVES	17	*DEI*	*11*
AVAILABLE	53	CHE	312	AXIS	25	*DELLA*	*4*
BESSELAAR	61	CI	35	BIBLIOMETRICS	14	*DELLE*	*4*
BIELEFELD	47	*COGNITIVE*	*26*	BIELEFELD	23	*DI*	*22*
BIOTECHNOLOGY	*15*	COME	111	COCITATION	22	**DISCOURSE**	**182**
CHAOS	29	***COMMUNICATION***	***89***	COMMUNICATIONA+	21	*DUTH*	*12*
CMC	28	COMUNE	33	CONFERENCE	28	*GR*	*26*
COMMUNICATION	**190**	CON	76	CONGESTION	12	*GRANDI*	*3*
COMPANY	*4*	CONOSCENZE	39	COURSE	44	*IL*	*18*
COMPLEX	97	COSTRUZIONE	39	**DATA**	**108**	SE	*7*
COMPLEXITY	54	CUI	28	DESIGN	29	*LA*	*56*
COMPUTER	90	DA	74	*DISTRICT*	*3*	*LE*	*14*
CONCEPTUAL	19	DEGLI	58	DOCUMENTS	36	LEYDESDORFF	***132***
CONFERENCE	55	DEI	90	DUTH	37	*MA*	*24*
COORDINATOR	27	DEL	135	EE	25	***MODELS***	***135***
COUNCIL	*6*	DELLA	82	EMPIRICAL	40	*PROCESSI*	*4*
DATA	**189**	DELLE	123	***FIRMS***	***9***	*PROJECT*	*206*
DELIVERABLE	25	DI	690	GR	44	*SI*	*3*
DEN	60	***DISCOURSE***	***4***	HELIX	54	*TASK*	*282*
DESIGNS	21	DISTRETTO	133	HOST	13	*UN*	*16*
DI	*15*	È	133	HTTP	40		
DISSEMINATION	43	*ENTREPRENEURS*	*22*	INCOMING	12		
DISTRICT	*8*	**FIRMS**	**253**	INFORMETRIC	11		
DR	37	GLI	87	INGWERSEN	16		
DUTH	42	GRANDI	45	INTERNET	45		
DYNAMIC	66	HA	42	INTERVIEWS	27		
DYNAMICS	161	HANNO	39	KUEPPERS	17		
EAS	30	*HELIX*	*15*	LINK	22		
ECONOMY	58	IDENTIFICAZION+	31	LINKS	71		
ED	52	IDENTITÀ	36	LIST	43		
EDS	59	IL	195	LISTS	45		
ELECTRONIC	37	IMPRENDITORIAL+	28	LITERATURE	29		
EMERGING	76	IMPRESE	142	MAILING	63		
ENERGY	*7*	*KNOWLEDGE*	*133*	MATERIAL	23		
ESS	18	LA	195	MEETING	35		
EUROPEAN	319	LE	225	METHODS	38		
EVOLUTION	71	LIVELLO	49	ONLINE	15		
EVOLUTIONARY	103	MA	75	**ORGANIZATION**	**126**		
FACTOR	*25*	*MEANING*	*10*	ORGANIZED	23		
FAX	23	MIRANDOLA	96	OVERVIEW	29		
FEDERAL	*5*	MULTINAZIONALI	26	PAGE	28		
FIGURE	*7*	NEL	81	PAGES	30		

FIRMS	***15***	***NETWORKS***	***191***	PERIOD	40
GAS	46	*OPPORTUNITY*	*6*	PING	21
GENETIC	43	***ORGANIZATION***	***134***	PLATON	13
GROUPS	*8*	PICCOLE	28	PLOT	12
HELIX	59	PIÙ	53	PRESENTED	23
INFORMATION	284	PROCESSI	65	PROGRESS	31
INNOVATION	164	PROCESSO	40	**PROJECT**	**90**
INTERVIEWS	43	PRODOTTI	49	ROME	19
KNOWLEDGE	163	PROGETTI	36	SDWS	45
LEYDESDORFF	**115**	QUESTO	57	**SELF**	**220**
LOET	58	QUINDI	30	SIGNIFIES	12
LONDON	77	*RECOGNITION*	*4*	SOEIS	49
MAIL	26	REGRESSION	47	SURREY	21
MANIEZZO	13	*RTD*	*89*	**TASK**	**158**
METHODS	69	RUOLO	38	THREADS	19
MODELING	40	SCM	29	TRIPLE	61
MODELS	**152**	***SELF***	***227***	VIRTUAL	20
MONTHS	28	SET	237	VISTA	14
MUTATION	16	SI	197	WEB	123
NATIONAL	144	*SOCIAL*	*232*	WEBOMETRIC	15
NETWORKS	**428**	SONO	130	WEBOMETRICS	29
NEURAL	40	STORIA	28	WORK	51
NEW	233	*SYSTEM*	*369*	WORKSHOP	17
NEWMETROPOLIS	20	***SYSTEMS***	***174***		
NIJKAMP	51	**TASK**	**84**		
OPTIMIZATION	24	TRA	77		
OPTIONS	39	*TRIPLE*	*16*		
PARADIGM	22	UN	179		
PARTICIPANTS	26	UNA	127		
PARTNER	34	UNO	28		
PARTNERS	42	XXX	31		
PETER	47				
PHASE	66				
POLICY	322				
POLITICAL	*15*				
POPULATION	35				
POWER	*7*				
PP	63				
PRELIMINARY	23				
PRESS	68				
PROF	24				
PROJECT	**271**				
REGGIANI	50				
REGIONAL	75				
REPORTS	36				
RESULTS	165				
RTD	154				
SECTOR	*3*				

SELFORGANIZATI+	22
SELFORGANIZING	24
SELFREFERENCE	13
SET	*21*
SOCIETY	144
SPATIAL	57
STI	54
STUDIES	103
STUDY	132
SYSTEMS	**280**
TASK	**310**
TASKS	66
TEAM	29
TEL	29
THEORETICAL	93
THRACE	32
TRIPLE	62
TSER	19
UNDERSTANDING	62
UNIVERSITY	166
USA	*3*
UVA	22
VAN	73
VIRTUAL	34
VR	13
WORD	*7*
WORKPACKAGE	62
YEAR	*3*
YORK	46

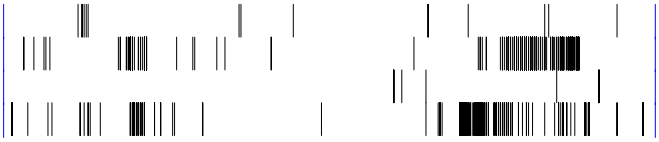
Appendix A.5 – *Top Keywords in Print x Each Analysis*

P1xP2	FREQ.	P2xP3	FREQ.	P3xP4	FREQ.
AMSTERDAM	**76**	*ACTIVITY*	*18*	ACTIVITY	26
COMMISSION	*15*	***AMSTERDAM***	***23***	**AMSTERDAM**	**35**
COMMUNICATION	190	***ANALYSIS***	***333***	**ANALYSIS**	**163**
CONFERENCE	55	*BIBLIOMETRICS*	*3*	BIBLIOMETRICS	14
COUNCIL	*6*	*BOUDOURIDES*	*5*	BOUDOURIDES	16
DATA	189	COMMISSION	105	COMMUNICATIONA+	21
DEVELOPED	67	*COMMUNICATION*	*89*	CONFERENCE	28
DISSEMINATION	43	*COMMUNICATIONA+*	*9*	COURSE	44
DISTRICT	*8*	*CONFERENCE*	*24*	DATA	108
DYNAMICS	161	COUNCIL	112	DESIGN	29
EMPIRICAL	**56**	*COURSE*	*56*	DISSEMINATION	17
FEDERAL	*5*	*DATA*	*167*	*DISTRICT*	*3*
FIRMS	***15***	*DESIGN*	*19*	DUTH	37
FUJIGAKI	11	DISTRICT	159	DYNAMICS	83
FUNDING	*21*	*DUTH*	*33*	**EMPIRICAL**	**40**
HELIX	59	*DYNAMICS*	*137*	***FIRMS***	***9***
IMPRESE	*	EMPIRICAL	***40***	HELIX	54
INFORMATION	*5*	FEDERAL	66	HTTP	40
INTERNET	284	**FIRMS**	**253**	INCOMING	12
INTERVIEWS	*	*HELIX*	*15*	INFORMATION	131
MANIEZZO	*	*HTTP*	*39*	INTERNET	45
MEDIATED	*	IDENTITY	214	INTERVIEWS	27
MEETING	115	IMPRESE	142	KUEPPERS	17
MEETINGS	15	*INFORMATION*	*266*	MAILLIST	6
METHODS	**26**	*INTERNET*	*23*	MATERIAL	23
MODELING	13	*INTERVIEWS*	*27*	MEETING	35
MODELS	**24**	*KUEPPERS*	*4*	**METHODS**	**38**
MONITORING	38	*MATERIAL*	*21*	MODELING	18
MONTHS	13	*MEDIA*	*9*	**MODELS**	**39**
MUTATION	69	*MEETING*	*11*	NISTEP	5
NATIONAL	40	***METHODS***	***31***	ONLINE	15
NETWORKS	152	MIRANDOLA	96	ORGANISATION	41
NEURAL	11	*MODELING*	*6*	**ORGANIZATION**	**126**
NEW	28	***MODELS***	***54***	ORGANIZED	23
NEWMETROPOLIS	16	NEL	81	OVERVIEW	29
NIJKAMP	144	*ONLINE*	*7*	PAGE	28
NISTEP	428	ORGANISATIONS	79	PAGES	30
OBJECTIVE	40	***ORGANIZATION***	***134***	**PARTNERS**	**19**
OBJECTIVES	233	*ORGANIZED*	*15*	PERIOD	40
OPERATOR	20	*OVERVIEW*	*16*	PERIODIC	7
OPTIMIZATION	51	*PAGE*	*23*	PING	21
OPTIONS	11	*PAGES*	*10*	PLATON	13
ORGANIZATION	**34**	***PARTNERS***	***10***	PLOT	12
OVERLAY	37	*PATTERNS*	*47*	POLICIES	48
PARTICIPANTS	12	*PING*	*11*	PRESENTED	23

PARTNER	24	*POLICIES*	*78*	PROGRESS	31
PARTNERS	**39**	*PRESENTED*	*18*	**PROJECT**	**90**
PETER	142	PROCESSI	65	REPORT	31
PHASE	11	***PROGRESS***	***18***	*RESEARCH*	*142*
POLICY	26	***PROJECT***	***99***	ROME	19
POPULATION	34	QUESTO	57	SCHEDULE	5
PRESS	42	*SEARCH*	*16*	SDWS	45
PROF	47	*SELF*	*227*	SEARCH	21
PROJECT	**66**	SI	197	SELF	220
QUESTIONNAIRE	322	*SOCIAL*	*232*	SIGNIFIES	12
REGGIANI	35	*SOCIETY*	*103*	SOEIS	49
REGIONAL	68	*SOEIS*	*33*	SURREY	21
REPORTS	24	SONO	130	**TASK**	**158**
RESULTS	271	*SURREY*	*6*	TASKS	26
ROME	14	*SYSTEMS*	*174*	TECHNIQUES	17
RTD	50	***TASK***	***84***	THEORIES	24
SECONDORDER	75	*TASKS*	*21*	THRACE	19
SECTOR	36	*THEORIES*	*20*	THREADS	19
SELF	165	*THRACE*	*13*	TRAFFIC	12
SELFORGANIZATI+	25	*THREADS*	*12*	TRANSCRIBED	5
SELFORGANIZING	154	*TRIPLE*	*16*	TRIPLE	61
SELFREFERENCE	11	*VIRTUAL*	*8*	VARIABLES	32
SET	*3*	*VISTA*	*6*	VIRTUAL	20
SOCIETY	225	*WEB*	*41*	VISTA	14
SPATIAL	22	***WORK***	***56***	WEB	123
STI	24	*WORKSHOP*	*5*	WEBOMETRIC	15
STUDIED	13			WEBOMETRICS	29
STUDIES	*21*			**WORK**	**51**
STUDY	144			WORKSHOP	17
SYSTEMS	57				
TASK	**37**				
TASKS	103				
THEORETICAL	*17*				
THRACE	310				
TRIPLE	66				
TSER	29				
VIRTUAL	62				
WORD	73				
WORK	**13**				

Appendix A.6 – *Collocate Analysis: Figure 1 -> Firms*

Distribution of 'Firms'

N	File	Words	Hits	per 1,000	Plot
1	p1.txt	69,859	15	0.21	
2	p2.txt	143,716	253	1.76	
3	p3.txt	33,947	9	0.27	
4	p4.txt	347,511	364	1.05	

Keyword: Firms

WORD	TOTAL	LEFT	RIGHT
FIRMS	720	41	38
SMALL	82	72	10
LARGE	55	42	13
INSTITUTIONS	*40*	*5*	*35*
LOCAL	39	22	17
NEW	33	15	18
NETWORK	*32*	*26*	*6*
ITALIAN	30	26	4
NETWORKS	*28*	*13*	*15*
PRODUCTION	27	14	13
DISTRICT	25	12	13
FOREIGN	24	14	10
MIRANDOLA	21	6	15
NUMBER	20	18	2
INNOVATIVE	19	19	0
MCA	19	19	0
ANALYSIS	18	4	14
CASE	18	12	6
DUTCH	18	14	4
MAIN	18	2	16
INNOVATION	17	11	6
ENGLISH	16	14	2

Keywords: Firms x Institutions

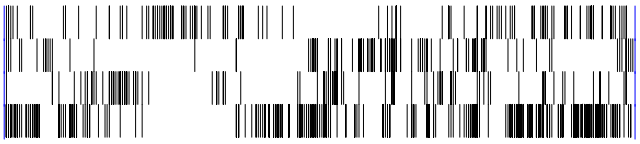
WORD	**TOTAL**	**LEFT**	**RIGHT**
FIRMS	45	5	2
INSTITUTIONS	*39*	*4*	*35*
NETWORK	10	8	2
NETWORKS	6	6	0

Keywords: Firms x Network(s)

WORD	**TOTAL**	**LEFT**	**RIGHT**
FIRMS	63	4	6
NETWORK	*32*	*26*	*6*
NETWORKS	*28*	*13*	*15*
SMALL	16	14	2
INSTITUTIONS	14	2	12
LARGE	8	4	4
TYPES	6	3	3
DISTRICT	5	5	0

Appendix A.7 – *Collocate Analysis: Figure 2 -> Organization*

Distribution of 'Organization'

N	File	Words	Hits	per 1,000	Plot
1	p1.txt	69,866	142	2.03	
2	p2.txt	143,720	134	0.93	
3	p3.txt	33,951	126	3.71	
4	p4.txt	347,525	498	1.43	

Keyword: Organization

WORD	TOTAL	LEFT	RIGHT
ORGANIZATION	960	34	27
SELF	667	648	19
INFORMATION	149	9	140
SOCIETY	125	10	115
EUROPEAN	110	2	108
ORDER	66	37	29
NETWORK	49	19	30
SOCIAL	49	18	31
SYSTEM	47	9	38
NETWORKS	45	7	38
PROJECT	*41*	*29*	*12*
THEORY	35	21	14
TASK	*34*	*13*	*21*
RESEARCH	31	8	23
SYSTEMS	31	12	19
DYNAMICS	27	15	12
SCIENCE	27	2	25
COMPLEX	26	5	21
INTELLECTUAL	26	23	3
TERMS	23	12	11
PROCESSES	22	19	3
STUDY	22	19	3
THEORIES	21	20	1
COMMUNICATION	20	0	20
MAILING	19	16	3
MODELING	19	16	3

Keyword: Organization x Project

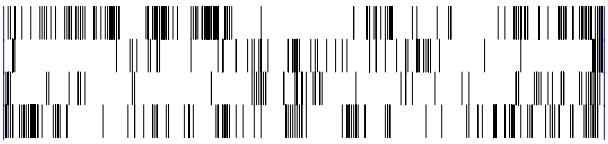
WORD	**TOTAL**	**LEFT**	**RIGHT**
ORGANIZATION	32	0	0
PROJECT	*32*	*24*	*8*
SELF	29	29	0
INFORMATION	16	0	16
SOCIETY	15	0	15
EUROPEAN	10	0	10
JAPANESE	8	2	6
SOEIS	6	3	3
THEORY	5	1	4

Keyword: Organization x Task

WORD	**TOTAL**	**LEFT**	**RIGHT**
TASK	*27*	*13*	*14*
ORGANIZATION	25	0	0
SELF	24	24	0
MODELING	8	8	0

Appendix A.8 – *Collocate Analysis: Figure 3 -> Project*

Distribution of 'Project'

N	File	Words	Hits	per 1,000	Plot
1	p1.txt	69,866	273	3.91	
2	p2.txt	143,720	99	0.69	
3	p3.txt	33,951	91	2.68	
4	p4.txt	347,520	209	0.60	

Keyword: Project

WORD	TOTAL	LEFT	RIGHT
PROJECT	743	38	39
SOEIS	*87*	*80*	*7*
RESEARCH	59	46	13
TASK	56	26	30
SELF	42	8	34
RESULTS	*36*	*28*	*8*
WITHIN	34	22	12
EUROPEAN	33	19	14
ORGANIZATION	32	8	24
COMMUNICATION	28	17	11
WEB	27	4	23
INFORMATION	24	20	4
STUDY	21	15	6
WORK	21	16	5
DESIGN	20	11	9
HTTP	20	13	7
TASKS	20	14	6
THEORETICAL	20	16	4
PROGRESS	19	11	8
RELEVANT	19	11	8
SOCIETY	19	17	2
MEETING	18	3	15
PARTNERS	17	8	9
EMPIRICAL	16	11	5
FUNDED	16	4	12

Keywords: Project x Task

WORD	**TOTAL**	**LEFT**	**RIGHT**
PROJECT	40	1	4
RESULTS	*36*	*28*	*8*
ENTIRE	7	7	0
RESEARCH	7	7	0
DISSEMINATION	5	3	2

Keywords: Project x SOEIS

WORD	**TOTAL**	**LEFT**	**RIGHT**
PROJECT	100	8	8
SOEIS	*83*	*76*	*7*
ORGANIZATION	18	6	12
TASK	18	14	4
HTTP	13	4	9
WEB	12	2	10
PAGE	9	3	6
ARCHIVES	8	8	0
RESEARCH	7	5	2
SISTER	7	7	0
OVERALL	6	6	0
ORGANIZING	5	0	5
SURVEY	5	0	5

Appendix A.9 – *Collocate Analysis: Figure 4 -> Task*

Distribution of 'Task'

N	File	Words	Hits	per 1,000	Plot
1	p1.txt	69,865	310	4.44	
2	p2.txt	143,714	84	0.58	
3	p3.txt	33,951	158	4.65	
4	p4.txt	347,517	282	0.81	

Keyword: Task

WORD	TOTAL	LEFT	RIGHT
TASK	1072	114	124
PROJECT	*60*	*34*	*26*
RESEARCH	60	46	14
POLICY	*53*	*26*	*27*
SOEIS	49	21	28
DEVIATIONS	39	22	17
SELF	38	15	23
WORK	38	33	5
NETWORKS	36	22	14
EUROPEAN	35	18	17
MODELING	33	16	17
REPORT	32	20	12
FORCES	31	0	31
MEETING	29	12	17
ORGANIZATION	29	16	13
TASKS	27	27	0
OBJECTIVE	25	24	1
INNOVATION	24	10	14
INPUT	24	20	4
RESULTS	24	16	8
RTD	24	6	18
INFORMATION	23	23	0
SYSTEMS	23	13	10
THEORETICAL	22	14	8
DELIVERABLE	21	10	11
ARCHIVES	20	20	0
DEVELOP	20	0	20
IMPLICATIONS	20	11	9
TEAM	20	4	16
DESIGN	19	12	7
DYNAMICS	19	7	12
SOCIAL	19	3	16
IT	18	5	13
MODELS	18	8	10

PART	18	17	1
DEVELOPED	17	15	2
SOCIETY	17	17	0
ACCOUNTABILITY	16	1	15
INTEGRATION	16	6	10
PROGRESS	16	13	3
EMPIRICAL	15	11	4
SCIENTIFIC	15	13	2
ACTIVITIES	14	5	9
AMSTERDAM	14	8	6

Keywords: Task x Project

WORD	**TOTAL**	**LEFT**	**RIGHT**
TASK	68	2	6
PROJECT	*60*	*34*	*26*
SOEIS	17	3	14
WORK	10	9	1
DELIVERABLE	5	1	4

Keywords: Task x Policy

WORD	**TOTAL**	**LEFT**	**RIGHT**
TASK	59	2	7
POLICY	*51*	*24*	*27*
IMPLICATIONS	18	9	9
RESEARCH	8	3	5
EUROPEAN	6	2	4
INTEGRATION	6	2	4
NETWORKS	5	3	2
RESULTS	5	2	3

Appendix B: Archive of Electronic Communications Analysis

Appendix B.1 – *Stop-List used for Electronic Analysis*

A	EVERYTHING	MOSTLY	THEN	WON'T
ABOUT	EVERYWHERE	MR	THENCE	WOULD
ABOVE	EXCEPT	MRS	THERE	WOULDN'T
ACCORDING	F	MUCH	THEREAFTER	X
ACROSS	FEB	MUST	THEREBY	Y
ACTUALLY	FEW	MY	THERE'D	YES
ADJ	FIFTY	MYSELF	THEREFORE	YET
AFTER	FIRST	N	THEREIN	YOU
AFTERWARDS	FIVE	NAMELY	THERE'LL	YOU'D
AGAIN	FOR	NEITHER	THERE'RE	YOU'LL
AGAINST	FORMER	NEVER	THERE'S	YOUR
ALL	FORMERLY	NEVERTHELESS	THEREUPON	YOU'RE
ALMOST	FORTY	NINE	THERE'VE	YOURS
ALONE	FOUND	NINETY	THESE	YOURSELF
ALONG	FOUR	NO	THEY	YOURSELVES
ALREADY	FRI	NOBODY	THEY'D	YOU'VE
ALSO	FROM	NONE	THEY'LL	Z
ALTHOUGH	FROM	NONETHELESS	THEY'RE	
ALWAYS	FURTHER	NOONE	THEY'VE	
AM	G	NOR	THIRTY	
AMONG	H	NOT	THIS	
AMONGST	HAD	NOTHING	THOSE	
AN	HAS	NOV	THOUGH	
AND	HASN'T	NOW	THOUSAND	
ANOTHER	HAVE	NOWHERE	THREE	
ANY	HAVEN'T	O	THROUGH	
ANYHOW	HE	OCT	THROUGHOUT	
ANYONE	HE'D	OF	THRU	
ANYTHING	HE'LL	OFF	THU	
ANYWHERE	HENCE	OFTEN	THUS	
APR	HER	ON	TO	
ARE	HERE	ONCE	TOGETHER	
AREN'T	HEREAFTER	ONE	TOO	
AROUND	HEREBY	ONE'S	TOWARD	
AS	HEREIN	ONLY	TOWARDS	
AT	HERES	ONTO	TRILLION	
AUG	HEREUPON	OR	TUE	
B	HERS	OTHER	TWENTY	
BE	HERSELF	OTHERS	TWO	
BECAME	HE'S	OTHERWISE	U	
BECAUSE	HIM	OUR	UNDER	
BECOME	HIMSELF	OURS	UNLESS	
BECOMES	HIS	OURSELVES	UNLIKE	
BECOMING	HOW	OUT	ÚNLIKELY	
BEEN	HOWEVER	OVER	UNTIL	
BEFORE	HUNDRED	OVERALL	UP	
BEFOREHAND	I	OWN	UPON	
BEGIN	I'D	P	USE	
BEGINNING	IE	PER	USED	
BEHIND	IF	PERHAPS	USING	
BEING	I'LL	Q	V	

BELOW	I'M	R	VERY
BESIDE	IN	RATHER	VIA
BESIDES	INC.	RECENT	W
BETWEEN	INDEED	RECENTLY	WAS
BEYOND	INSTEAD	S	WASN'T
BILLION	INTO	SAME	WE
BOTH	IS	SAT	WED
BUT	ISN'T	SEEM	WE'D
BY	IT	SEEMED	WELL
C	ITS	SEEMING	WE'LL
CAN	IT'S	SEEMS	WERE
CANNOT	ITSELF	SEP	WE'RE
CAN'T	I'VE	SEVEN	WEREN'T
CAPTION	J	SEVENTY	WE'VE
CO	JAN	SEVERAL	WHAT
CO.	JUL	SHE	WHATEVER
COULD	JUN	SHE'D	WHAT'LL
COULDN'T	K	SHE'LL	WHAT'S
D	L	SHE'S	WHAT'VE
DE	LAST	SHOULD	WHEN
DEC	LATER	SHOULDN'T	WHENCE
DID	LATTER	SINCE	WHENEVER
DIDN'T	LATTERLY	SIX	WHERE
DO	LEAST	SIXTY	WHERAFTER
DOES	LESS	SO	WHEREAS
DOESN'T	LET	SOME	WHEREBY
DON'T	LET'S	SOMEBODY	WHEREIN
DOWN	LIKE	SOMEONE	WHERE'S
DST	LIKELY	SOMETHING	WHEREUPON
DU	LTD	SOMETIME	WHEREVER
DURING	M	SOMETIMES	WHETHER
E	MADE	SOMEWHERE	WHICH
EACH	MAKE	STILL	WHILE
EET	MAKES	STOP	WHITHER
EG	MANY	SUCH	WHO
EIGHT	MAR	SUN	WHO'D
EIGHTY	MAY	T	WHOEVER
EITHER	MAYBE	TAKING	WHOLE
ELSE	ME	TEN	WHO'LL
ELSEWHERE	MEANTIME	THAN	WHOM
END	MEANWHILE	THAT	WHOMEVER
ENDING	MIGHT	THAT'LL	WHO'S
ENOUGH	MILLION	THAT'S	WHOSE
ETC	MISS	THAT'VE	WHY
EVEN	MON	THE	WILL
EVER	MORE	THEIR	WITH
EVERY	MOREOVER	THEM	WITHIN
EVERYONE	MOST	THEMSELVES	WITHOUT

Appendix B.2 – *Texts Used in Electronic Analysis*

Name	Dates	# Emails	KB	Word Occurrences	Unique Words	Unique Word %	Mean Ratio %
E1.txt	10/97 – 05/98	350	807	120113	3604	2.88	54.29
E2.txt	06/98 – 12/98	357	980	140125	4498	3.21	58.61
E3.txt	01/99 – 07/99	293	660	97552	3247	3.33	57.09
E4.txt	08/99 – 12/99	261	991	142228	4859	3.42	60.14
All.txt	10/97 – 12/99	1261	3438	500183	9679	1.94	57.67

Appendix B.3 – *EuroCon-Knowflow (SOEIS) Member & Associates List* [10]

1	J.W. Abraham	**26**	Koen Frenken	**51**	Juergen Roth *
2	Isidro F. Aguillo	**27**	*Christian Fuchs*	**52**	Beatriz Ruivo
3	Petra Ahrweiler *	**28**	Yuko Fujigaki	**53**	**Christian Salzmann**
4	James Amend	**29**	Nigel Gilbert *	**54**	Luis Sanz-Menendez
5	*Ben Andrews*	**30**	Henk Goorhuis *	**55**	*Frank Sbresny*
6	Sveva Avveduto	**31**	Heide Hackmann	**56**	Andrea Scharnhorst
7	Katalin Balazs	**32**	Takayuki Hayashi	**57**	Helmut Schauer
8	Paolo Barbesino	**33**	Peter Healey	**58**	Christof Schiene
9	Kate Barker	**34**	Gaston Heimeriks *	**59**	*Corinna Schlombs*
10	Andrea Belliger	**35**	Philippe Hert	**60**	Eric Schwarz
11	Peter Van Den Besselaar *	**36**	Wolfgang Hofkirchner	**61**	*Efisio Serra*
12	Lucio Biggiero *	**37**	Annamaria Inzelt	**62**	Masashi Shirabe
13	**Gertrude Blauwhof**	**38**	David Krieger *	**63**	Beatrice Sigrist *
14	Manfred Bonitz	**39**	Janis Kristapsons	**64**	Daniel Stoller-Schai
15	Moses Boudourides *	**40**	Guenter Kueppers *	**65**	Edwina Taborsky
16	*Alex Coltro*	**41**	Loet Leydesdorff *	**66**	*Laure Thomas*
17	Michele Courant	**42**	Sinisa Maricic	**67**	Jesus Vega
18	Alcino Couto	**43**	**Michael Murtaugh**	**68**	Costas Vorlow
19	*Abel Covarrubias*	**44**	*Sabine Paul*	**69**	Caroline Wagner
20	*Ireneu Dias*	**45**	*Meier Peter*	**70**	Gerald Wagner
21	Vinck Dominique	**46**	Lars Qvortrup	**71**	Shyh-Rong Wang
22	Simon Dresner *	**47**	Aura Reggiani *	**72**	Connie Wilson
23	Henry Etzkowitz	**48**	Marta Riba *	**73**	Gerard De Zeeuw *
24	*Charles Evans*	**49**	*Carlos Rodrigues*	**74**	Andrés Zelman
25	Peter Fleissner	**50**	*T Rogers*		

[10] *Italics* = Joined later, **Bold** = No longer in list, * = SOEIS-Core (15), Total Members = 74.

Appendix B.4 – *Top 50 Keywords in Electronic Consistency Analysis*

WORD	FILES	TOTAL	E1	E2	E3	E4
SYSTEM	4	1738	397	446	621	274
UNIVERSITY	4	1632	291	556	263	522
SYSTEMS	4	1591	417	379	370	425
INFORMATION	**4**	**1560**	**381**	**478**	**278**	**423**
RESEARCH	**4**	**1443**	**451**	**328**	**304**	**360**
SELF	4	1335	531	331	277	196
SOCIAL	4	1225	266	253	338	368
SCIENCE	4	1188	251	266	334	337
CONFERENCE	**4**	**1169**	**172**	**356**	**214**	**427**
NEW	4	1036	282	261	175	318
KNOWLEDGE	**4**	**836**	**346**	**137**	**122**	**231**
PROJECT	**4**	**818**	**406**	**141**	**157**	**114**
ORGANIZATION	**4**	**808**	**314**	**190**	**150**	**154**
SOCIETY	4	783	155	164	183	281
LOET	4	782	279	176	224	103
TECHNOLOGY	4	732	145	177	109	301
PAPERS	4	698	131	224	122	221
MEETING	**4**	**659**	**274**	**184**	**160**	**41**
EUROPEAN	4	656	263	127	122	144
THEORY	4	651	173	197	145	136
COMMUNICATION	4	638	221	156	172	89
TASK	**4**	**617**	**387**	**90**	**93**	**47**
RE	4	610	178	156	164	112
WORK	4	598	170	135	139	154
ORDER	4	586	176	91	122	197
WORLD	4	561	53	138	134	236
DEAR	4	554	166	140	174	74
DIFFERENT	4	539	109	155	168	107
LEYDESDORFF	4	527	249	126	98	54
TIME	4	523	107	157	87	172
POLICY	**4**	**522**	**202**	**54**	**135**	**131**
PLEASE	4	521	108	166	124	123
COMPLEX	4	502	131	179	59	133
PETER	4	493	186	135	90	82
NETWORKS	**4**	**490**	**316**	**80**	**50**	**44**
DATA	4	462	222	139	43	58
INTERNATIONAL	4	441	57	106	103	175
DYNAMICS	4	441	163	128	53	97
PAPER	4	437	95	161	76	105
BASED	4	426	126	86	78	136
HUMAN	4	424	31	112	113	168
SEE	4	423	85	145	80	113
KIND	4	422	122	112	110	78
DEVELOPMENT	4	402	107	102	67	126
MANAGEMENT	4	401	86	111	69	135

NETWORK	4	399	211	71	63	54
MAIL	4	398	83	116	80	119
SCIENTIFIC	4	389	106	86	97	100
HENK	4	388	99	92	137	60
RESULTS	4	384	115	95	98	76

Appendix B.5 – *Top Keywords in Electronic x All Analysis*

E1xEall	**FREQ.**	**E2xEall**	**FREQ.**	**E3xEall**	**FREQ.**	**E4xEall**	**FREQ.**
AGENT	*10*	***AGREEMENT***	***5***	AGENT	76	***AMSTERDAM***	***23***
AGENTS	*10*	***BIELEFELD***	***26***	**AGREEMENT**	**69**	***BIELEFELD***	***5***
AHRWEILER	41	*ECONOMIC*	*39*	***ANALYSIS***	***33***	*CH*	*13*
AMSTERDAM	**153**	**EVOLUTIONARY**	**200**	APRIL	68	*CLOSURE*	*8*
ANALYSIS	**155**	FILM	56	BILBAO	27	*COMMUNICATION*	*89*
ANNEX	65	GENETIC	97	BST	81	CYBER	49
BIELEFELD	215	***INDUSTRIAL***	***14***	CLOSED	71	DATA	***58***
CONFERENCE	*172*	*INNOVATION*	*39*	CLOSURE	64	*DATE*	*21*
CULTURE	*10*	***KNOWLEDGE***	***137***	*COMPUTER*	*28*	*DEAR*	*74*
DATA	**222**	*ORDER*	*91*	DATA	***43***	*DUTH*	*3*
DELIVERABLE	35	*POLICY*	*54*	DEAR	174	*EMERGENCE*	*20*
DISSEMINATION	46	***PROJECT***	***141***	DIFFERENT	168	*EMPIRICAL*	*20*
DISTRICTS	63	*RELEVANCE*	*10*	ENVIRONMENT	123	*ENTROPY*	*3*
DISTRICTUAL	32	RORTY	68	***EVOLUTIONARY***	***14***	*IDENTITY*	*29*
DUTH	54	SEPT	52	HENK	137	*KRIEGER*	*3*
EMERGING	74	***TASK***	***90***	*HISTORY*	*13*	LANDSCAPE	44
ENDOWMENT	41			KOBE	23	*LEYDESDORFF*	*54*
ENTREPRENEURIA+	63			LOET	224	*LOET*	*103*
ENTREPRENEURS	60			MANUFACTURING	42	***MEANING***	***27***
ENTREPRENEURSH+	53			**MEANING**	**158**	*MEETING*	*41*
EU	90			*MODELS*	*28*	*MET*	*4*
EUROPEAN	263			OPERATIONALLY	54	*MOSES*	*11*
FAX	*30*			PERCENTAGE	163	***NETWORK***	***54***
FIRM	41			PROBLEMS	94	***NETWORKS***	***44***
FUJIGAKI	57			*PROPOSAL*	*3*	*NIGEL*	*5*
GILBERT	51			PUBLIC	148	*NL*	*16*
GREECE	56			RELEVANCE	73	PHOTONS	42
GUENTER	115			*RESOURCES*	*14*	***PROJECT***	***114***
HISTORY	*17*			SCIENCE	334	*REGARDS*	*49*
HUMAN	*31*			SOCIAL	338	*REMOTE*	*5*
INDUSTRIAL	**86**			*SPSG*	*35*	RIGHTS	50
INTERVIEWS	39			STATEMENTS	38	*SELF*	*196*
KNOWLEDGE	**346**			**SYSTEM**	**621**	*SURREY*	*3*
KUEPPERS	78			TRANSDISCIPLIN+	58	*SWITZERLAND*	*6*
LARS	32			UNDERSTANDING	139	SYMPOSIUM	97
LEYDESDORFF	249					***SYSTEM***	***274***
LOET	279					***TASK***	***47***
MEETING	274					*TASKS*	*8*
MET	128					TECHNOLOGY	301
MONTHS	60					***THEORETICAL***	***34***
NETWORK	**211**					TOULOUSE	36
NETWORKS	**316**					TRADE	57
NIGEL	65					*UNI*	*3*
NL	173					UNIVERSITÄT	46
NONAKA	32					*UVA*	*14*
ORGANIZATION	314					WORLD	236
ORGANIZATIONAL	90					WTO	75
ORGANIZING	114						
PARTNERS	57						
PETER	186						

PETRA	68
POLICY	202
POLITICAL	*16*
PROJECT	**406**
PROPOSAL	73
PUBLIC	*45*
REMOTE	88
RESOURCES	159
RTD	80
SELF	531
STI	63
SUB	64
SURREY	52
TASK	**387**
TASKS	122
THEORETICAL	**144**
TSER	39
UNI	52
UVA	159
WORKPACKAGE	73
WORLD	*53*
WP	30
YUKO	44

Appendix B.6 – *Top Keywords in Electronic x Each Analysis*

E1xE2	**FREQ.**	**E2xE3**	**FREQ.**	**E3xE4**	**FREQ.**
AGENTS	*10*	*AGENCY*	*5*	ACTOR	14
AHRWEILER	41	*AGREEMENT*	*5*	ACTORS	36
AIM	39	ALGORITHMS	52	AGENT	76
AMSTERDAM	153	ANALYSIS	120	AGENTS	83
ANNEX	65	*APRIL*	*28*	APRIL	68
ANT	21	AUTOMATA	37	BIELEFELD	28
AUTONOMY	24	*AUTOPOIETIC*	*8*	BILBAO	27
BEATRICE	33	BIOLOGY	67	BST	81
BIELEFELD	215	BOOK	92	CH	65
BOUNDARY	26	CELLULAR	52	*CHAIR*	*24*
BUDGET	25	CHAT	24	CHEM	41
COMMISSION	28	*CHEM*	*12*	CLOSED	71
COMMITMENT	21	*CLOSURE*	*19*	CLOSURE	64
CONDUCTED	22	*COMMUNICATIONS*	*12*	COMMUNICATION	172
CONFERENCE	*172*	COMPLEX	179	COMMUNICATIVE	25
CULTURE	*10*	COMPUTATION	69	*COMPUTER*	*28*
DATA	**222**	**DATA**	**139**	CONSTRUCTIVIST	16
DELIVERABLE	35	*DEAR*	*140*	COUPLING	27
DESIGNS	27	DER	67	*CYBER*	*4*
DIMENSION	45	DETERMINISTIC	23	CYBERCONFERENC+	19
DIS	17	DIGITAL	47	DEAR	174
DISSEMINATION	46	EIGEN	32	DIFFERENT	168
DISTRICT	23	*ENVIRONMENT*	*82*	DISTINCTION	46
DISTRICTS	63	EVOLUTION	162	DONOSTIA	20
DISTRICTUAL	32	**EVOLUTIONARY**	**200**	DURHAM	15
ECOLOGY	*4*	FILM	56	EMPIRICAL	58
EDUCATIONAL	42	GENETIC	97	ENTROPY	35
ELEMENTS	56	HEARING	39	***EVOLUTIONARY***	***14***
EMERGING	74	*HENK*	*92*	EXIST	41
ENDOWMENT	41	**HISTORY**	**106**	GMT	59
ENTREPRENEURIA+	63	*IDENTITY*	*35*	GOORHUIS	79
ENTREPRENEURS	60	ILLIGAL	23	GREETINGS	23
ENTREPRENEURSH+	53	***INNOVATION***	***39***	HENK	137
EU	90	***INTEGRATION***	***17***	***HISTORY***	***13***
EUROCON	25	KDD	26	IDENTITIES	20
EUROPEAN	263	*LOET*	*176*	IDENTITY	89
EVOLUTIONARY	***80***	*MANUFACTURING*	*6*	INSTITUTES	14
FALSE	26	MEANING	***71***	**INTEGRATION**	**53**
FEMALE	24	MET	56	INTEND	19
FIRM	41	MINING	40	*INTERESTS*	*6*
FIRMS	38	MODELS	143	JAPAN	57
FRAMEWORK	65	*MODES*	*4*	KIND	110
FUJIGAKI	57	MOLECULAR	41	KOBE	23
GERALD	16	*MONETARY*	*3*	KOSOVO	17
GILBERT	51	NEUCHATEL	36	KRIEGER	30
GOVERNMENT	72	NUCLEAR	27	**LEYDESDORFF**	**98**
GREECE	56	ONLINE	70	*LIGHT*	*5*
GUENTER	115	*OPERATIONS*	*18*	*LIVING*	*9*
HISTORY	***17***	PHILOSOPHICAL	30	LOET	224
HUMAN	*31*	PHILOSOPHY	66	LUCIO	44

IDENTITY	103	*POLICY*	*54*	LUNCH	42
INDUSTRIAL	86	*PROBLEMS*	*50*	**MEANING**	**158**
INDUSTRY	86	PROGRAM	101	**MEETING**	**160**
INNOVATION	**138**	*PUBLIC*	*69*	MEME	15
INTEGRATION	**57**	*RELEVANCE*	*10*	MIKEL	14
INTERVIEWS	39	*ROME*	*4*	NL	78
INVITED	*14*	RORTY	68	OPERATIONALLY	54
IWT	17	*SCIENCE*	*266*	OPTION	24
KNOWFLOW	22	SEPT	52	PERCENTAGE	163
KNOWLEDGE	346	SEPTEMBER	89	PRICING	25
KRIEGER	50	SESSION	137	PROBLEMS	94
KUEPPERS	78	*SOCIAL*	*253*	**PROJECT**	**157**
LARS	32	*SOIS*	*3*	*PROPOSALS*	*10*
LEYDESDORFF	**249**	*SPSG*	*9*	QUESTIONAIR	14
LOET	279	SYMBOLIC	32	RADICAL	33
MALE	17	*SYSTEM*	*446*	RE	164
MEETING	**274**	TOFTS	26	REGARDS	84
MET	128	*TRANSDISCIPLIN+*	*6*	REMINDINGS	16
MINING	*3*	***UNDERSTANDING***	***73***	ROME	41
MOLECULAR	*4*	UNIVERSITY	556	SELF	277
MONEY	37			*SPECIES*	*4*
MONTHS	60			SPSG	35
NATIONAL	142			STATEMENTS	38
NETWORK	211			SUBSYSTEMS	32
NETWORKS	316			*SYMPOSIUM*	*20*
NEWMETROPOLIS	27			SYSTEM	621
NIGEL	65			**TASK**	**93**
NIJKAMP	17			TASKS	34
NISTEP	25			*TECHNOLOGY*	*109*
NL	173			*TRADE*	*6*
NONAKA	32			TRANSDISCIPLIN+	58
OBJECTIVES	31			UNCERTAINTY	44
ONLINE	*9*			**UNDERSTANDING**	**139**
ORDER	176			UNIV	16
ORGANIZATION	314			UNIZH	32
ORGANIZATIONAL	90			UVA	72
ORGANIZATIONS	82			WB	29
ORGANIZING	114			WELLCOME	15
PARTICULAR	*33*			*YORK*	*4*
PARTNER	23				
PARTNERS	57				
PETRA	68				
PHILOSOPHY	*9*				
PING	22				
POLICIES	58				
POLICY	202				
PRECONDITIONS	23				
PROGRAMMES	20				
PROJECT	**406**				
PROPOSAL	73				
RELATEDNESS	22				
RELATING	16				
RESEARCH	451				

RESOURCES	159
RESPONDENTS	19
REVIEWED	*5*
REWRITE	17
RISK	54
ROME	32
RORTY	*5*
ROTH	21
RTD	80
SELF	531
SESSION	*41*
SIGRIST	23
SOC	20
STI	63
STRATEGIC	26
STUDY	113
SUB	64
SURREY	52
TASK	**387**
TASKS	122
TEAM	37
TECHNIQUE	23
THEORETICAL	144
TRANSFER	28
TRUTH	*8*
TSER	39
UNIVERSITY	*291*
UVA	159
WOMEN	23
WORKPACKAGE	73
WORLD	*53*
WP	30
YUKO	44

Appendix B.7 – *Collocate Analysis: Figure 1 -> Evolutionary*

Distribution of 'Evolutionary'

N	File	Words	Hits	per 1,000	Plot
1	e1.txt	117,595	80	0.68	
2	e2.txt	137,822	200	1.45	
3	e3.txt	96,062	14	0.15	
4	e4.txt	140,894	82	0.58	

Keyword: Evolutionary

WORD	TOTAL	LEFT	RIGHT
EVOLUTIONARY	414	19	19
COMPUTATION	89	7	82
GENETIC	35	19	16
THEORY	30	2	28
ECONOMICS	28	4	24
SYSTEMS	*27*	*7*	*20*
BIOLOGY	25	3	22
PROGRAMMING	25	6	19
EVOLUTION	24	11	13
ALGORITHMS	21	5	16
UNIVERSITY	21	9	12
MODEL	20	1	19
NEURAL	*19*	*10*	*9*
CONFERENCE	16	9	7
PROCESS	16	4	12
DESIGN	14	1	13
MODELS	14	6	8
ECOLOGY	13	7	6
DEVELOPMENT	12	7	5
EUROPEAN	12	8	4
FIRST	12	6	6
NETWORKS	12	8	4
PAPERS	12	11	1
ARTIFICIAL	10	6	4
CO	10	7	3
JOURNAL	10	5	5
STRATEGIES	10	4	6
LEARNING	9	4	5

Keywords: Evolutionary x Systems

WORD	TOTAL	LEFT	RIGHT
EVOLUTIONARY	28	1	2
SYSTEMS	*27*	*7*	*20*
CO	6	3	3
EVOLUTION	6	3	3
FUZZY	5	2	3
NEURAL	5	4	1

Keywords: Evolutionary x Neural

WORD	TOTAL	LEFT	RIGHT
EVOLUTIONARY	26	5	2
NEURAL	*19*	*10*	*9*
PROGRAMMING	12	6	6
NETWORKS	11	8	3
EVOLUTION	9	3	6
CO	6	3	3
GENETIC	6	6	0
ARTIFICIAL	5	1	4
SYSTEMS	5	1	4

Appendix B.8 – *Collocate Analysis: Figure 2 -> Meaning*

Distribution of 'Meaning'

N	File	Words	Hits	per 1,000	Plot
1	e1.txt	117,584	30	0.26	
2	e2.txt	137,812	71	0.52	
3	e3.txt	96,063	158	1.64	
4	e4.txt	140,889	27	0.19	

Keyword: Meaning

WORD	TOTAL	LEFT	RIGHT
MEANING	332	14	32
INFORMATION	*44*	*29*	*15*
SYSTEM	42	19	23
UNCERTAINTY	28	19	9
LOET	26	9	17
SYSTEMS	21	6	15
PROVIDED	19	10	9
WORDS	*16*	*0*	*16*
PROVIDING	14	12	2
SELF	14	10	4
ABOUT	13	10	3
HENK	12	4	8
LEYDESDORFF	12	0	12
PETER	12	7	5
PREVIOUS	10	8	2
SOCIAL	10	5	5
TERMS	10	7	3
THERE	10	5	5
DIFFERENT	9	6	3

Keyword: Meaning x Information

WORD	**TOTAL**	**LEFT**	**RIGHT**
MEANING	43	2	5
INFORMATION	*40*	*28*	*12*

Keyword: Meaning x Words

WORD	**TOTAL**	**LEFT**	**RIGHT**
MEANING	16	0	0
WORDS	*16*	*0*	*16*
HENK	10	4	6
LOET	8	3	5
PETER	7	4	3
GOORHUIS	6	0	6
LEYDESDORFF	5	0	5

Appendix B.9 – *Collocate Analysis: Figure 3 -> Project*

Distribution of 'Project'

N	File	Words	Hits	per 1,000	Plot
1	e1.txt	117,599	409	3.48	
2	e2.txt	137,817	141	1.02	
3	e3.txt	96,069	157	1.63	
4	e4.txt	140,895	114	0.81	

Keyword: Project

WORD	TOTAL	LEFT	RIGHT
PROJECT	839	11	14
MEETING	*77*	*28*	*49*
SOEIS	66	60	6
RESEARCH	63	46	17
MEMBERS	41	10	31
MANAGEMENT	*40*	*7*	*33*
TASK	39	21	18
MEETINGS	*34*	*13*	*21*
SELF	30	5	25
WORK	28	16	12
ORGANIZATION	22	6	16
INFORMATION	21	9	12
EUROPEAN	20	12	8
LOET	20	3	17
PETER	20	5	15
RE	19	16	3
RESULTS	19	13	6
TSER	19	18	1
REGARDS	17	3	14
THEORETICAL	17	10	7
COURSE	16	2	14
COMMUNICATION	15	6	9
EU	15	12	3
SOIS	15	14	1
AMSTERDAM	14	7	7
CASE	14	6	8
POLICY	14	6	8
ROME	14	12	2
TASKS	14	8	6
UNIVERSITY	13	3	10
COMMITTEE	12	3	9
FUNDED	12	6	6
GROUP	12	5	7
LEVEL	12	9	3

ORDER	12	7	5
PARTNERS	12	6	6
SYSTEMS	12	6	6
BEST	11	2	9
DIFFERENT	11	8	3
MOSES	11	3	8
OVERALL	11	11	0
PART	11	9	2
BASED	10	2	8

Keywords: Project x Meeting

WORD	**TOTAL**	**LEFT**	**RIGHT**
PROJECT	104	3	2
MEETING	*49*	*28*	*21*
MEETINGS	*22*	*13*	*9*
SOEIS	14	14	0
ROME	13	12	1
RE	11	8	3
PURPOSE	10	10	0
MANAGEMENT	*9*	*6*	*3*
LOET	7	0	7
SWITZERLAND	7	0	7
BIELEFELD	6	1	5
DATE	6	0	6
FULL	6	6	0
LOCATION	6	6	0
PERCENTAGE	6	3	3
REGARDS	6	1	5
SEPT	6	1	5
AMSTERDAM	5	2	3
PETER	5	0	5

Keywords: Project x Management

WORD	**TOTAL**	**LEFT**	**RIGHT**
PROJECT	43	3	3
MANAGEMENT	*40*	*7*	*33*
MEETING	31	9	22

Appendix B.10 – *Collocate Analysis: Figure 4 -> Task*

Distribution of 'Task'

N	File	Words	Hits	per 1,000	Plot
1	e1.txt	117,598	387	3.29	
2	e2.txt	137,817	90	0.65	
3	e3.txt	96,066	93	0.97	
4	e4.txt	140,888	47	0.33	

Keyword: Task

WORD	TOTAL	LEFT	RIGHT
TASK	761	61	83
PROJECT	*37*	*18*	*19*
SELF	26	14	12
LOET	25	12	13
TASKS	23	21	2
MEETING	*22*	*11*	*11*
AMSTERDAM	21	10	11
DAVID	19	10	9
THEORETICAL	19	14	5
WP	19	18	1
BIELEFELD	18	13	5
INPUT	18	14	4
ORGANIZATION	18	15	3
RESEARCH	18	11	7
SYSTEMS	18	12	6
INTEGRATION	17	10	7
POLICY	17	11	6
REPORT	17	9	8
RESULTS	17	12	5
HENK	16	4	12
LEYDESDORFF	16	6	10
NETWORKS	16	13	3
PETER	16	8	8
WORKPACKAGE	16	7	9
DATA	14	10	4
SOCIAL	14	5	9
CONTRIBUTION	13	12	1
MODEL	13	11	2
MODELING	13	7	6
MODELS	13	5	8
EUROPEAN	12	4	8
INNOVATION	12	5	7
MOSES	12	7	5
OBJECTIVE	12	11	1

TEAM	12	1	11
MEMBERS	11	9	2
PART	11	8	3
REGARDS	11	6	5
STUDY	11	4	7
SYSTEM	11	5	6
ANALYSIS	10	3	7
CASE	10	4	6
KRIEGER	10	1	9
PROGRESS	10	7	3
SUB	10	9	1
ACCOUNTABILITY	9	3	6
BASED	9	3	6
BEST	9	6	3
DELIVERABLE	9	6	3
EMPIRICAL	9	6	3

Keywords: Task x Project

WORD	**TOTAL**	**LEFT**	**RIGHT**
TASK	46	5	4
PROJECT	*37*	*18*	*19*
MEMBER	6	4	2
RESPONSIBLE	6	2	4

Keywords: Task x Meeting

WORD	**TOTAL**	**LEFT**	**RIGHT**
TASK	22	0	0
MEETING	*22*	*11*	*11*
BIELEFELD	5	4	1

Appendix C-I: Archive of Journal Publication – *Referenced Journals*

Appendix C-I.1 – *All Journals Referenced in Dissertation*

ACAD MANAGE J	ACADEMY OF MANAGEMENT JOURNAL
ACAD MANAGE REV	ACADEMY OF MANAGEMENT REVIEW
ADMIN SCI QUART	ADMINISTRATIVE SCIENCE QUARTERLY
ADMIN SOC	ADMINISTRATION & SOCIETY
AM ECON REV	AMERICAN ECONOMIC REVIEW
AM J SOCIOL	AMERICAN JOURNAL OF SOCIOLOGY
AM PSYCHOL	AMERICAN PSYCHOLOGIST
AM SOCIOL REV	AMERICAN SOCIOLOGICAL REVIEW
AMER BEHAV SCI	AMERICAN BEHAVIORAL SCIENTIST
ANN N Y ACAD SCI	ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
ANN REG SCI	ANNALS OF REGIONAL SCIENCE
ANNU REV INFORM SCI	ANNUAL REVIEW OF INFORMATION SCIENCE AND TECHNOLOGY
ANNU REV SOCIOL	ANNUAL REVIEW OF SOCIOLOGY
ANTIPODE	ANTIPODE
ANXIETY STRESS COP	ANXIETY STRESS AND COPING
ARBOR-CIEN PENSAM	ARBOR-CIENCIA PENSAMIENTO Y CULTURA
ASIST MON SER	ASIST MONOGRAPH SERIES
ASIST MONOGR SER	ASIST MONOGRAPH SERIES
BIOSYSTEMS	JOURNAL OF BIOLOGICAL & INFORMATION PROCESSING
BRIT J CLIN PHARMA	BRITISH JOURNAL OF CLINICAL PHARMACOLOGY
BRIT J SOCIOL EDUC	BRITISH JOURNAL OF SOCIOLOGY OF EDUCATION
BRIT MED J	BRITISH MEDICAL JOURNAL
CALC VAR PARTIAL D	CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS
CALIF MANAGE REV	CALIFORNIA MANAGEMENT REVIEW
CAMBRIDGE J ECON	CAMBRIDGE JOURNAL OF ECONOMICS
CAN J ADM SCI	CANADIAN JOURNAL OF ADMINISTRATIVE SCIENCES-REVUE CANADIENNE
CAREER DEVELOP QUA	CAREER DEVELOPMENT QUARTERLY
COMPUTING	COMPUTING
CURR SCI	CURRENT SCIENCE
DRUSTVENA ISTRAZIV	DRUSTVENA ISTRAZIVANJA
ECON J	ECONOMIC JOURNAL
ECON LETT	ECONOMICS LETTERS
ECONOMETRICA	ECONOMETRICA
ENVIRON PLAN A	ENVIRONMENT AND PLANNING A
ENVIRON PLAN B-PLA	ENVIRONMENT AND PLANNING B-PLANNING & DESIGN
ENVIRON PLANN C	ENVIRONMENT AND PLANNING C
EUR J PHARM BIOPHA	EUROPEAN JOURNAL OF PHARMACEUTICS AND BIOPHARMACEUTICS
EUR URBAN REG STUD	EUROPEAN URBAN AND REGIONAL STUDIES
EVALUATION REV	EVALUATION REVIEW
FUSION ENG DES	FUSION ENGINEERING AND DESIGN
HARVARD BUS REV	HARVARD BUSINESS REVIEW
HIGHER EDUC	HIGHER EDUCATION
HUM COMMUN RES	HUMAN COMMUNICATION RESEARCH
HUM RELAT	HUMAN RELATIONS
IEEE T ENG MANAGE	IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT
IEEE TRANS EDUC	IEEE TRANSACTIONS ON EDUCATION

IND HEALTH	INDUSTRIAL HEALTH
IND MARKET MANAG	INDUSTRIAL MARKETING MANAGEMENT
INFORM PROCESS MANAG	INFORMATION PROCESSING & MANAGEMENT
INFORM SOC	INFORMATION SOCIETY
INT ARCH SOZIALGES	INTERNATIONALES ARCHIV FUR SOZIALGESCHICHTE DER DEUTSCHEN LIT.
INT FORUM INFORM DOC	INTERNATIONAL FORUM ON INFORMATION AND DOCUMENTATION
INT J HUMAN-COMPUT	INTERNATIONAL JOURNAL OF HUMAN-COMPUTER INTERACTION
INT J IND ORGAN	INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION
INT J MANPOWER	INTERNATIONAL JOURNAL OF MANPOWER
INT J OPER PROD MAN	INTERNATIONAL JOURNAL OF OPERATIONS & PRODUCTION MANAGEMENT
INT J SCI EDUC	INTERNATIONAL JOURNAL OF SCIENCE EDUCATION
INT J TECHNOL MANAGE	INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT
INT SOCIOL	INTERNATIONAL SOCIOLOGY
INTERLEND DOC SUPPLY	INTERLENDING & DOCUMENT SUPPLY
INVENT MATH	INVENTIONES MATHEMATICAE
J AM SOC INFORM SCI	JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
J AMER SOC INFORM	JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
J DIFFEREN GEOM	JOURNAL OF DIFFERENTIAL GEOMETRY
J DOC	JOURNAL OF DOCUMENTATION
J ECON BEHAV ORGAN	JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION
J ECON LIT	JOURNAL OF ECONOMIC LITERATURE
J EMPLOY COUNS	JOURNAL OF EMPLOYMENT COUNSELING
J GEOL SOC	JOURNAL OF THE GEOLOGICAL SOCIETY
J IND ECON	JOURNAL OF INDUSTRIAL ECONOMICS
J INFORM SCI	JOURNAL OF INFORMATION SCIENCE
J INST THEOR ECON	JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS
J INT BUS STUD	JOURNAL OF INTERNATIONAL BUSINESS STUDIES
J LAW ECON	JOURNAL OF LAW & ECONOMICS
J MANAGE	JOURNAL OF MANAGEMENT
J MENT HEALTH ADMI	JOURNAL OF MENTAL HEALTH ADMINISTRATION
J METEOROL SOC JPN	JOURNAL OF THE METEOROLOGICAL SOCIETY OF JAPAN
J OCCUP ENVIRON ME	JOURNAL OF THE SOCIETY OF OCCUPATIONAL MEDICINE
J OCCUP HEALTH	JOURNAL OF OCCUPATIONAL HEALTH
J OPER RES SOC	JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY
J PLAN EDUC RES	JOURNAL OF PLANNING EDUCATION AND RESEARCH
J POLIT ECON	JOURNAL OF POLITICAL ECONOMY
J PROD INNOVAT MANAG	JOURNAL OF PRODUCT INNOVATION MANAGEMENT
J REINE ANGEW MATH	JOURNAL FUR DIE REINE UND ANGEWANDTE MATHEMATIK
JAHRB NAT STATIST	JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
JASSS	JOURNAL OF ARTIFICIAL SOCIETIES & SOCIAL SIMULATIONS
KNOWL ORGAN	KNOWLEDGE ORGANIZATION
KOLNER Z SOZIOL SO	KOLNER ZEITSCHRIFT FUR SOZIOLOGIE UND SOZIALPSYCHOLOGIE
KYBERNETES	KYBERNETES
LANCET	JOURNAL-LANCET
LECT NOTE ARTIF IN	LARGE-SCALE PARALLEL DATA MINING
LIBR QUART	LIBRARY QUARTERLY
LIBR RESOUR TECH SER	LIBRARY RESOURCES & TECHNICAL SERVICES
LIBR TRENDS	LIBRARY TRENDS

LIBRI	LIBRI
MANAGE SCI	MANAGEMENT SCIENCE
MINERVA	MINERVA
NONLINEAR ANAL-THE	NONLINEAR ANALYSIS-THEORY METHODS & APPLICATIONS
NURS ECON	NURSING ECONOMICS
OCCUP ENVIRON MEDI	OCCUPATIONAL AND ENVIRONMENTAL MEDICINE
ONLINE INF REV	ONLINE INFORMATION REVIEW
ORGAN BEHAV HUM DE	ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES
ORGAN STUD	ORGANIZATION STUDIES
P ASIS ANNU MEET	PROCEEDINGS OF THE ASIS ANNUAL MEETING
PAC J MATH	PACIFIC JOURNAL OF MATHEMATICS
PERS REV	PERSONNEL REVIEW
PHIL SOC SCI	PHILOSOPHY OF THE SOCIAL SCIENCES
POLICY STUD J	POLICY STUDIES JOURNAL
PSYCHOL MED	PSYCHOLOGICAL MEDICINE
PUBLIC ADMIN	PUBLIC ADMINISTRATION
PUBLIC OPIN QUART	PUBLIC OPINION QUARTERLY
Q J ECON	QUARTERLY JOURNAL OF ECONOMICS
R&D MANAGE	R & D MANAGEMENT
RAND J ECON	RAND JOURNAL OF ECONOMICS
REG STUD	REGIONAL STUDIES
RENEWABLE ENERGY	RENEWABLE ENERGY
RES HIGH EDUC	RESEARCH IN HIGHER EDUCATION
RES ORGAN BEHAV	RESEARCH IN ORGANIZATIONAL BEHAVIOR
RES POLICY	RESEARCH POLICY
RES TECHNOL MANAGE	RESEARCH-TECHNOLOGY MANAGEMENT
REV ECON	REVIEW OF ECONOMICS
REV ECON STAT	REVIEW OF ECONOMICS AND STATISTICS
REV EPIDEMIOL SANT	REVUE D EPIDEMIOLOGIE ET DE SANTE PUBLIQUE
REV SAUDE PUBL	REVISTA DE SAUDE PUBLICA
REV SCI INSTR	REVIEW OF SCIENTIFIC INSTRUMENTS
SCI COMMUN	SCIENCE COMMUNICATION
SCI SOCIALES SANTE	SCIENCES SOCIALES ET SANTE
SCI TECHNOL HUM VAL	SCIENCE TECHNOLOGY & HUMAN VALUES
SCIENCE	SCIENCE
SCIENTIST	SCIENTIST
SCIENTOMETRICS	SCIENTOMETRICS
SEMIOTICA	SEMIOTICA
SERIALS LIBR	SERIALS LIBRARIAN
SLOAN MANAGE REV	SLOAN MANAGEMENT REVIEW
SMALL BUS ECON	SMALL BUSINESS ECONOMICS
SOC FORCES	SOCIAL FORCES
SOC SCI INFORM	SOCIAL SCIENCE INFORMATION STUDIES
SOC SCI MED	SOCIAL SCIENCE & MEDICINE
SOC STUD SCI	SOCIAL STUDIES OF SCIENCE
SOCIOL RES ONLINE	SOCIOLOGICAL RESEARCH ONLINE
SOCIOL TRAV	SOCIOLOGIE DU TRAVAIL
SOCIOLOGY	SOCIOLOGY-THE JOURNAL OF THE BRITISH SOCIOLOGICAL ASSOCIATION

SOZIALE WELT	SOZIALE WELT-ZEITSCHRIFT FUR SOZIALWISSENSCHAFTLICHE FORSCHUNG.
STRATEGIC MANAGE J	STRATEGIC MANAGEMENT JOURNAL
SYST RES BEHAV SCI	SYSTEMS RESEARCH AND BEHAVIORAL SCIENCE
TECHNOL ANAL STRAT	TECHNOLOGY ANALYSIS AND STRATEGIC MANAGEMENT
TECHNOL FORECAST SOC	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
TECHNOVATION	TECHNOVATION
TIJDSCHR ECON SOC	TIJDSCHRIFT VOOR ECONOMISCHE EN SOCIALE GEOGRAFIE
TRANSP RES PT D-TR	TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT
TRANSPORT RES C-EM	TRANSPORTATION RESEARCH PART C-EMERGING TECHNOLOGIES
TURK PSIKOL DERG	TURK PSIKOLOJI DERGISI
URBAN STUDIES	URBAN STUDIES
WEIMARER BEITR	WEIMARER BEITRAGE
WELTWIRTSCHAFTL AR	WELTWIRTSCHAFTLICHES ARCHIV-REVIEW OF WORLD
WORK EMPLOY SOC	WORK EMPLOYMENT AND SOCIETY
WORK OCCUPATION	WORK AND OCCUPATIONS
WORK STRESS	WORK AND STRESS
WORLD DEV	WORLD DEVELOPMENT
Z BIBL BIBLIOGR	ZEITSCHRIFT FUR BIBLIOTHEKSWESEN UND BIBLIOGRAPHIE
Z GERONTOL GERIATR	ZEITSCHRIFT FUR GERONTOLOGIE UND GERIATRIE
Z SEMIOTIK	ZEITSCHRIFT FUR SEMIOTIK
Z SOZ	ZEITSCHRIFT FUR SOZIOLOGIE

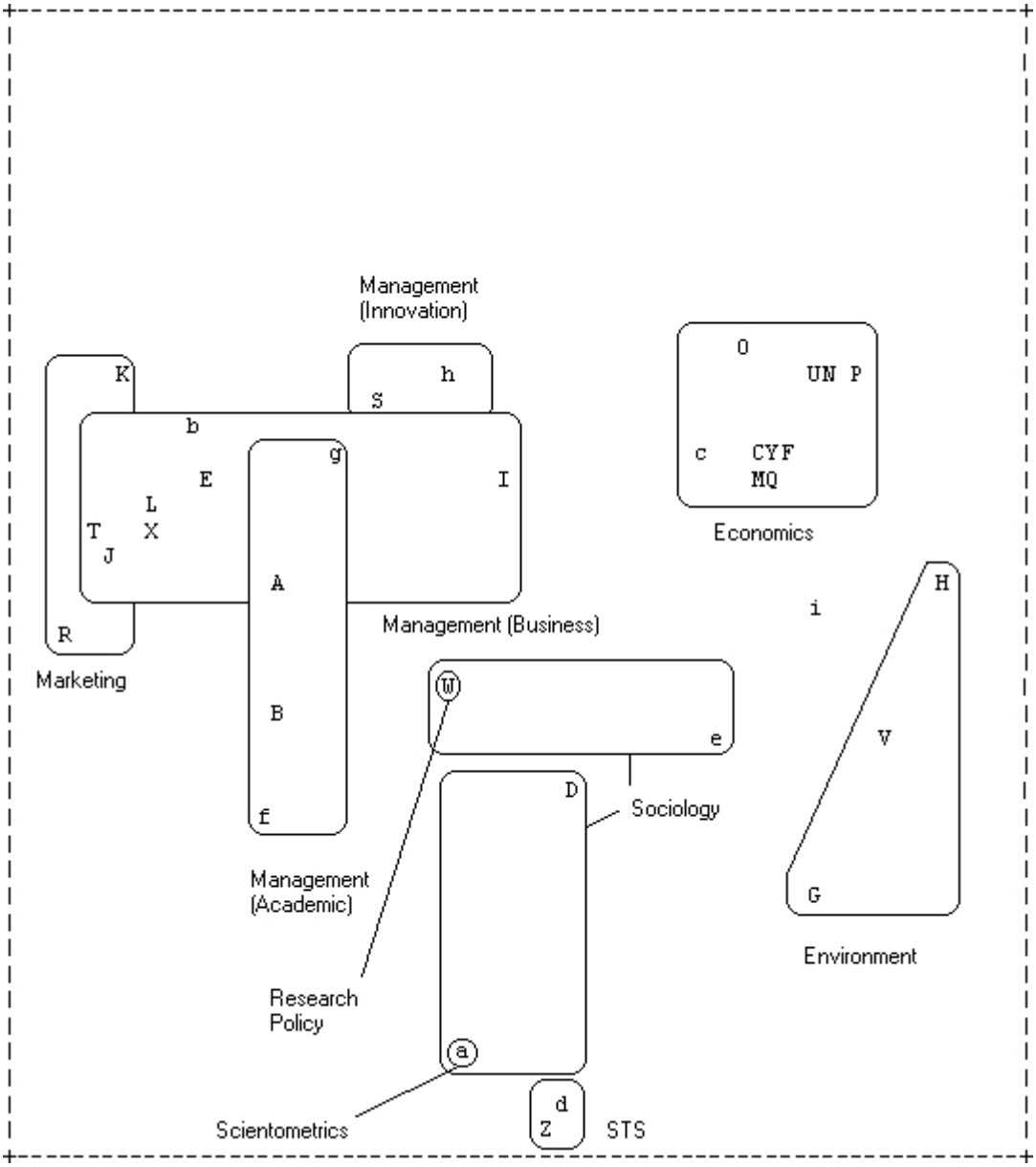
Appendix C-I.2 – *Journals in Research Policy Environment (1996 – 2000)*

ACAD MANAGE J	ACADEMY OF MANAGEMENT JOURNAL
ADMIN SCI QUART	ADMINISTRATIVE SCIENCE QUARTERLY
AM ECON REV	AMERICAN ECONOMIC REVIEW
AM J SOCIOL	AMERICAN JOURNAL OF SOCIOLOGY
CALIF MANAGE REV	CALIFORNIA MANAGEMENT REVIEW
CAMBRIDGE J ECON	CAMBRIDGE JOURNAL OF ECONOMICS
ECON J	ECONOMIC JOURNAL
ECONOMETRICA	ECONOMETRICA
ENVIRON PLANN A	ENVIRONMENT AND PLANNING A
ENVIRON PLANN C	ENVIRONMENT AND PLANNING C
HARVARD BUS REV	HARVARD BUSINESS REVIEW
IEEE T ENG MANAGE	IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT
IND MARKET MANAG	INDUSTRIAL MARKETING MANAGEMENT
INT J IND ORGAN	INTERNATIONAL JOURNAL OF INDUSTRIAL ORGANIZATION
INT J OPER PROD MAN	INTERNATIONAL JOURNAL OF OPERATIONS & PRODUCTION MANAGEMENT
INT J TECHNOL MANAGE	INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT
J AM SOC INFORM SCI	JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
J ECON BEHAV ORGAN	JOURNAL OF ECONOMIC BEHAVIOR & ORGANIZATION
J ECON LIT	JOURNAL OF ECONOMIC LITERATURE
J IND ECON	JOURNAL OF INDUSTRIAL ECONOMICS
J INST THEOR ECON	JOURNAL OF INSTITUTIONAL AND THEORETICAL ECONOMICS
J INT BUS STUD	JOURNAL OF INTERNATIONAL BUSINESS STUDIES
J LAW ECON	JOURNAL OF LAW & ECONOMICS
J POLIT ECON	JOURNAL OF POLITICAL ECONOMY
J PROD INNOVAT MANAG	JOURNAL OF PRODUCT INNOVATION MANAGEMENT
MANAGE SCI	MANAGEMENT SCIENCE
ORGAN STUD	ORGANIZATION STUDIES
POLICY STUD J	POLICY STUDIES JOURNAL
Q J ECON	QUARTERLY JOURNAL OF ECONOMICS
R&D MANAGE	R & D MANAGEMENT
RAND J ECON	RAND JOURNAL OF ECONOMICS
REG STUD	REGIONAL STUDIES
RES ORGAN BEHAV	RESEARCH IN ORGANIZATIONAL BEHAVIOR
RES POLICY	RESEARCH POLICY
RES TECHNOL MANAGE	RESEARCH-TECHNOLOGY MANAGEMENT
REV ECON STAT	REVIEW OF ECONOMICS AND STATISTICS
SCI TECHNOL HUM VAL	SCIENCE TECHNOLOGY & HUMAN VALUES
SCIENTOMETRICS	SCIENTOMETRICS
SLOAN MANAGE REV	SLOAN MANAGEMENT REVIEW
SMALL BUS ECON	SMALL BUSINESS ECONOMICS
SOC STUD SCI	SOCIAL STUDIES OF SCIENCE
SOCIOL TRAV	SOCIOLOGIE DU TRAVAIL
SOZ WELT	SOZIALE WELT-ZEITSCHRIFT FUR SOZIALWISSENSCHAFTLICHE FORSCHUNG
STRATEGIC MANAGE J	STRATEGIC MANAGEMENT JOURNAL
TECHNOL FORECAST SOC	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
WORLD DEV	WORLD DEVELOPMENT

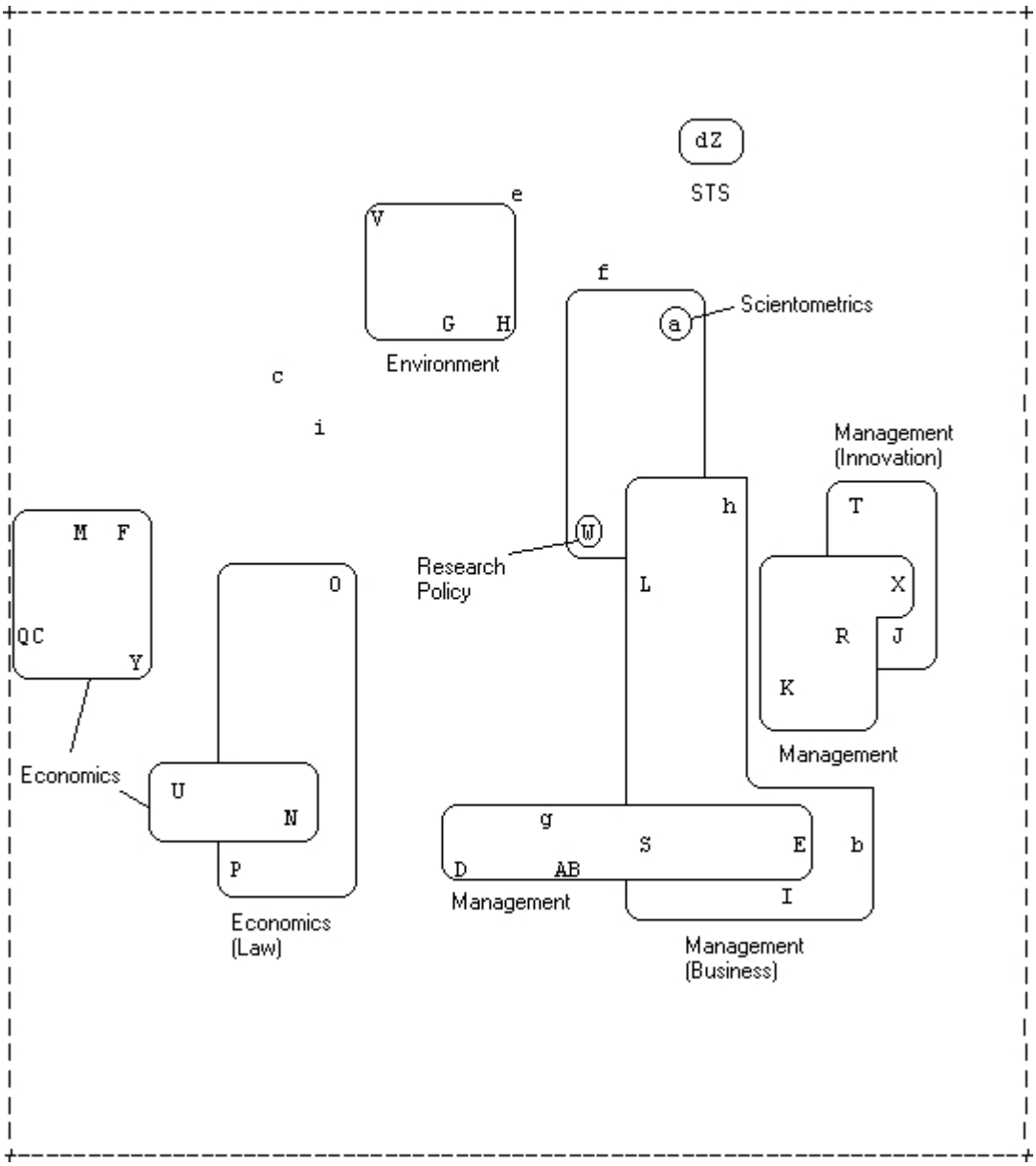
Appendix C-I.3 – *Journals in Scientometrics Environment (1996 – 2000)*

ACAD MANAGE J	ACADEMY OF MANAGEMENT JOURNAL
AM ECON REV	AMERICAN ECONOMIC REVIEW
AM J SOCIOL	AMERICAN JOURNAL OF SOCIOLOGY
AM PSYCHOL	AMERICAN PSYCHOLOGIST
AM SOCIOL REV	AMERICAN SOCIOLOGICAL REVIEW
ANNU REV INFORM SCI	ANNUAL REVIEW OF INFORMATION SCIENCE AND TECHNOLOGY
ANNU REV SOCIOL	ANNUAL REVIEW OF SOCIOLOGY
CAMBRIDGE J ECON	CAMBRIDGE JOURNAL OF ECONOMICS
DRUS ISTRAZ	DRUSTVENA ISTRAZIVANJA
EVALUATION REV	EVALUATION REVIEW
HIGH EDUC	HIGHER EDUCATION
HUM COMMUN RES	HUMAN COMMUNICATION RESEARCH
IEEE T ENG MANAGE	IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT
INFORM PROCESS MANAG	INFORMATION PROCESSING & MANAGEMENT
INT FORUM INFORM DOC	INTERNATIONAL FORUM ON INFORMATION AND DOCUMENTATION
INTERLEND DOC SUPPLY	INTERLENDING & DOCUMENT SUPPLY
J AM SOC INFORM SCI	JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
J DOC	JOURNAL OF DOCUMENTATION
J ECON LIT	JOURNAL OF ECONOMIC LITERATURE
J INFORM SCI	JOURNAL OF INFORMATION SCIENCE
J OPER RES SOC	JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY
KNOWL ORGAN	KNOWLEDGE ORGANIZATION
LIBR QUART	LIBRARY QUARTERLY
LIBR RESOUR TECH SER	LIBRARY RESOURCES & TECHNICAL SERVICES
LIBR TRENDS	LIBRARY TRENDS
LIBRI	LIBRI
MINERVA	MINERVA
P ASIS ANNU MEET	PROCEEDINGS OF THE ASIS ANNUAL MEETING
PUBLIC OPIN QUART	PUBLIC OPINION QUARTERLY
R&D MANAGE	R & D MANAGEMENT
RES HIGH EDUC	RESEARCH IN HIGHER EDUCATION
RES POLICY	RESEARCH POLICY
RES TECHNOL MANAGE	RESEARCH-TECHNOLOGY MANAGEMENT
REV ECON	REVIEW OF ECONOMICS
REV SAUDE PUBL	REVISTA DE SAUDE PUBLICA
SCI COMMUN	SCIENCE COMMUNICATION
SCI TECHNOL HUM VAL	SCIENCE TECHNOLOGY & HUMAN VALUES
SCIENTIST	SCIENTIST
SCIENTOMETRICS	SCIENTOMETRICS
SOC FORCES	SOCIAL FORCES
SOC SCI INFORM	SOCIAL SCIENCE INFORMATION STUDIES
SOC STUD SCI	SOCIAL STUDIES OF SCIENCE
TECHNOL FORECAST SOC	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
TURK PSIKOL DERG	TURK PSIKOLOJI DERGISI

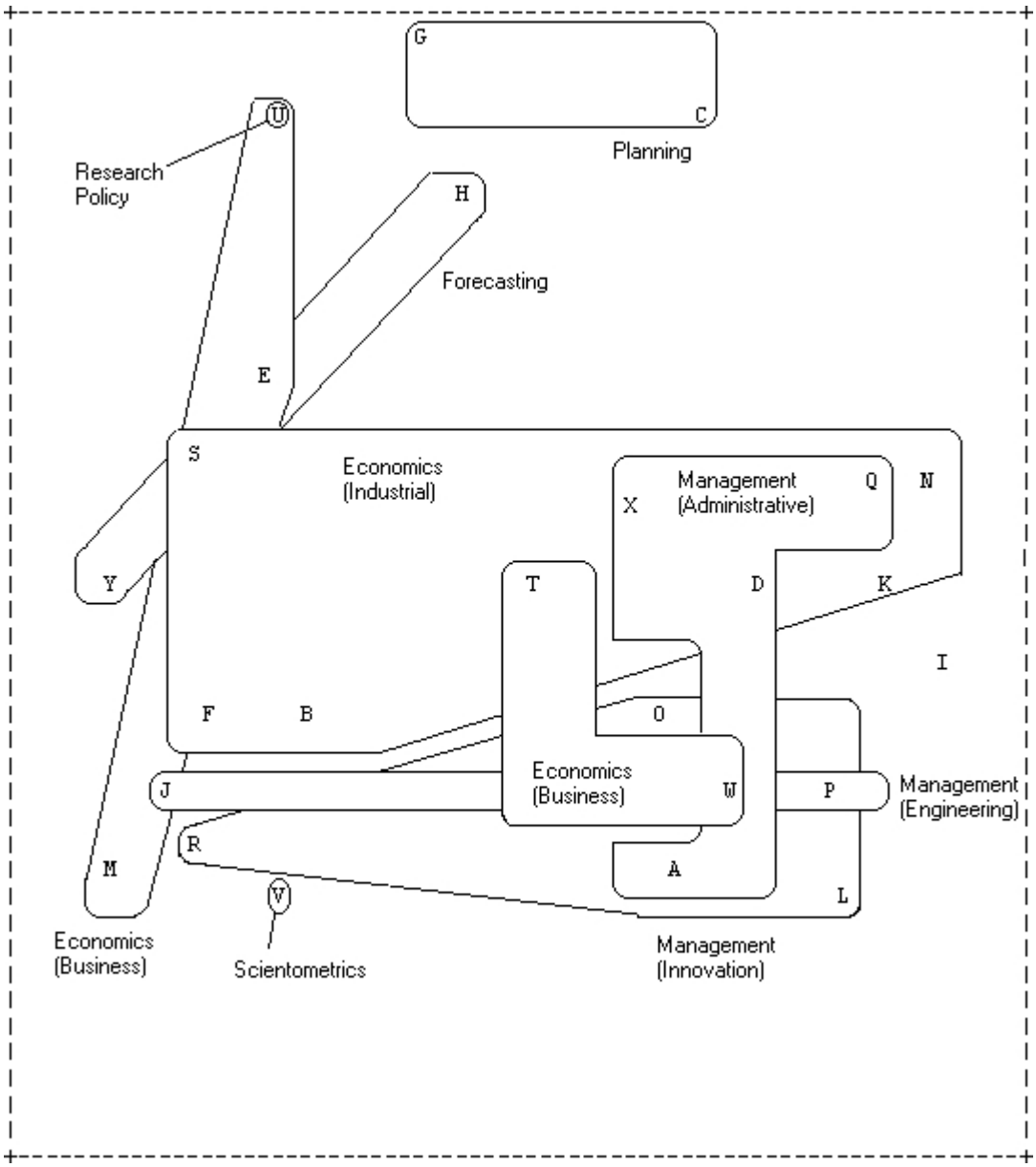
Appendix C-II: Archive of Journal Publication – *Research Policy*



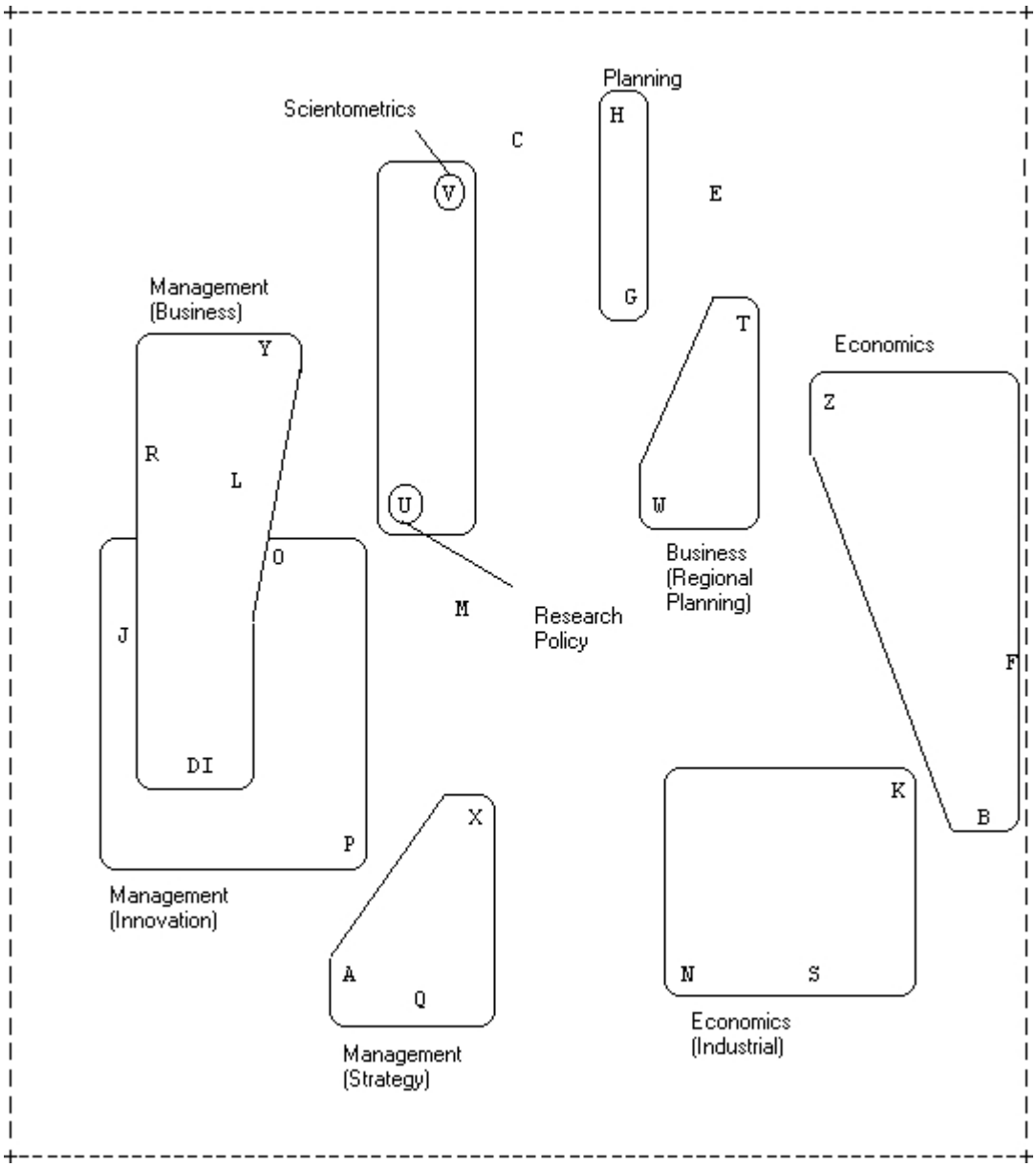
Appendix C-II.1 – *Research Policy Scaling Plot – Citing 1996*



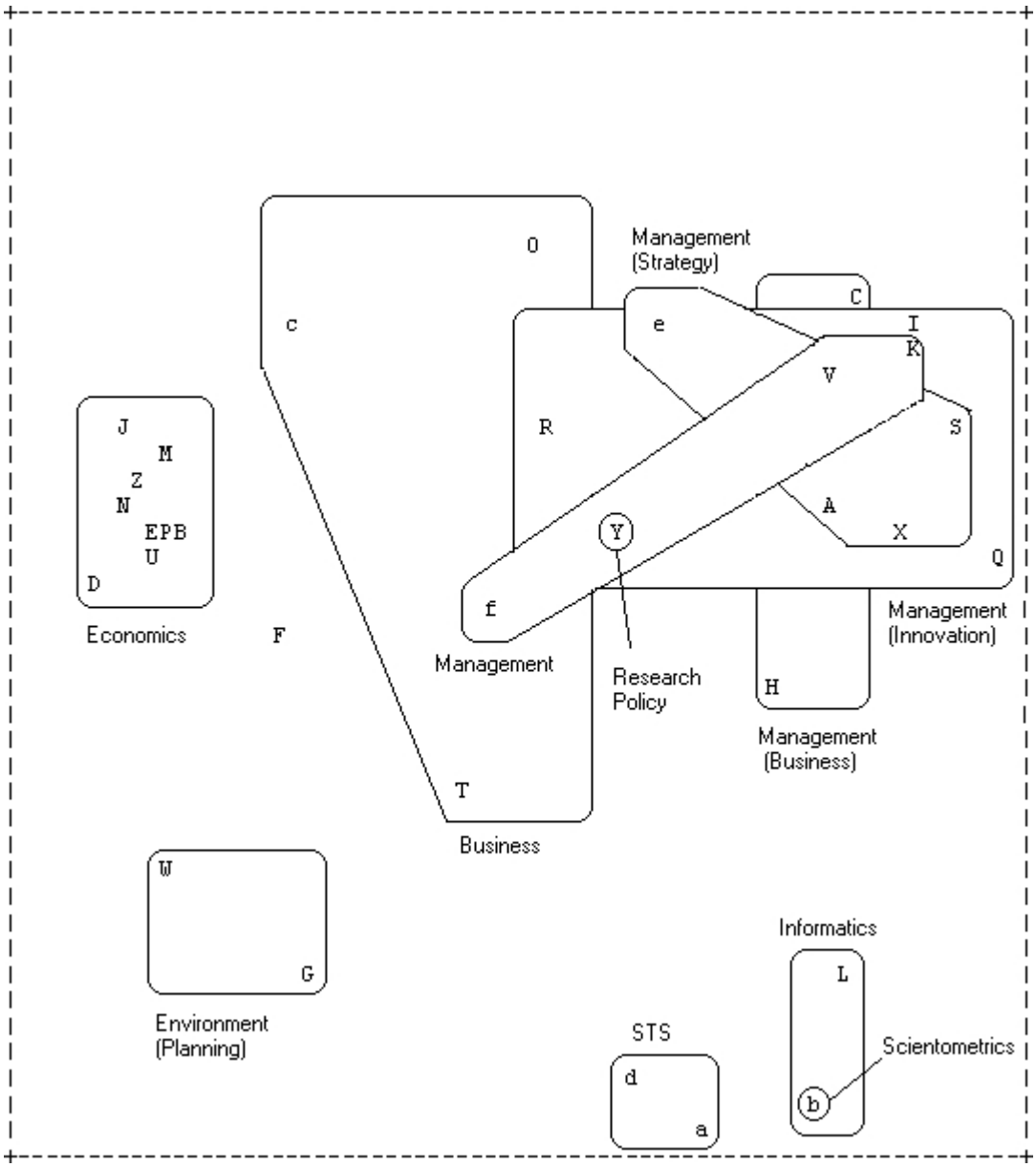
Appendix C-II.2 – *Research Policy Scaling Plot – Cited 1996*



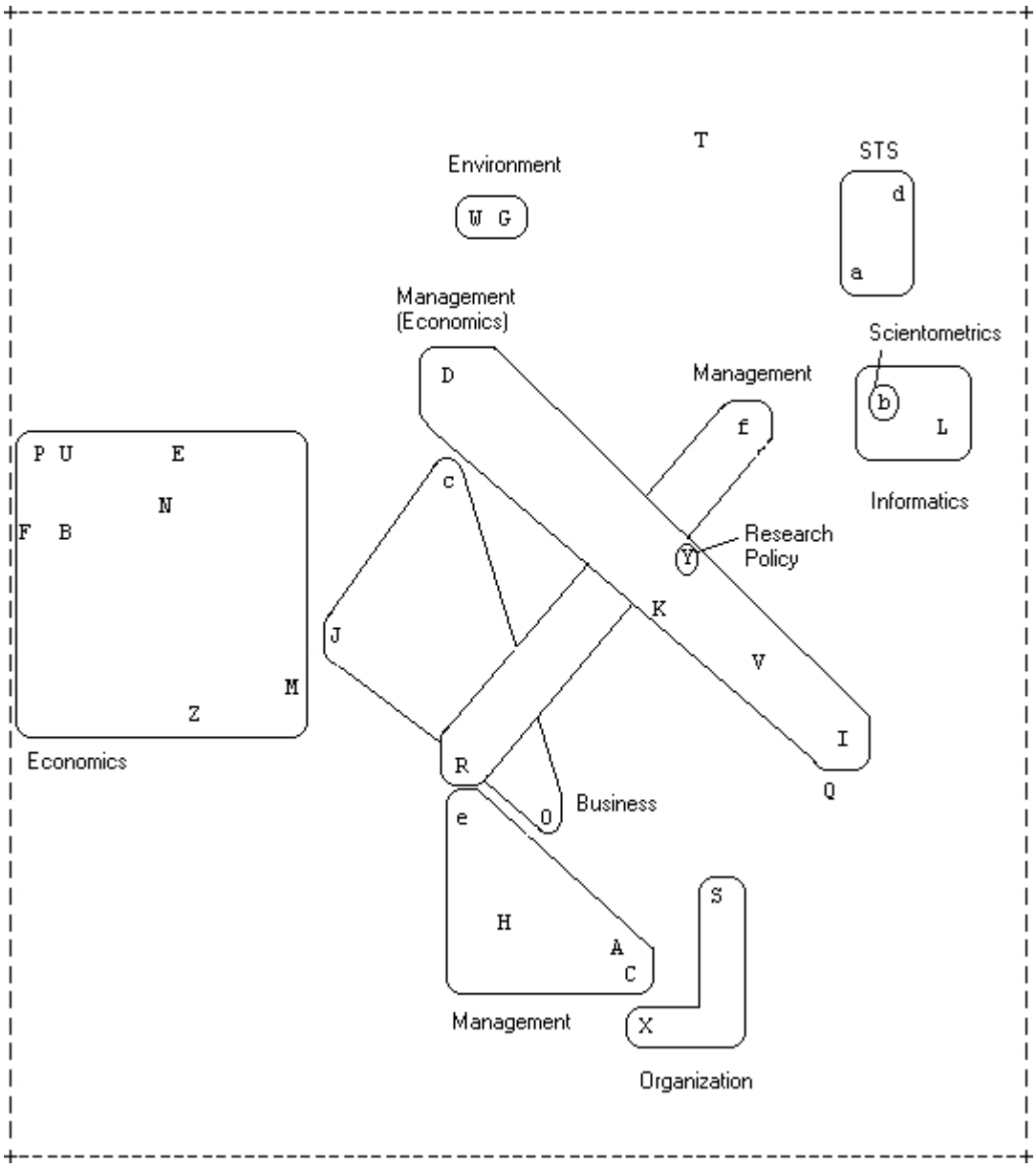
Appendix C-II.3 – *Research Policy Scaling Plot – Citing 1997*



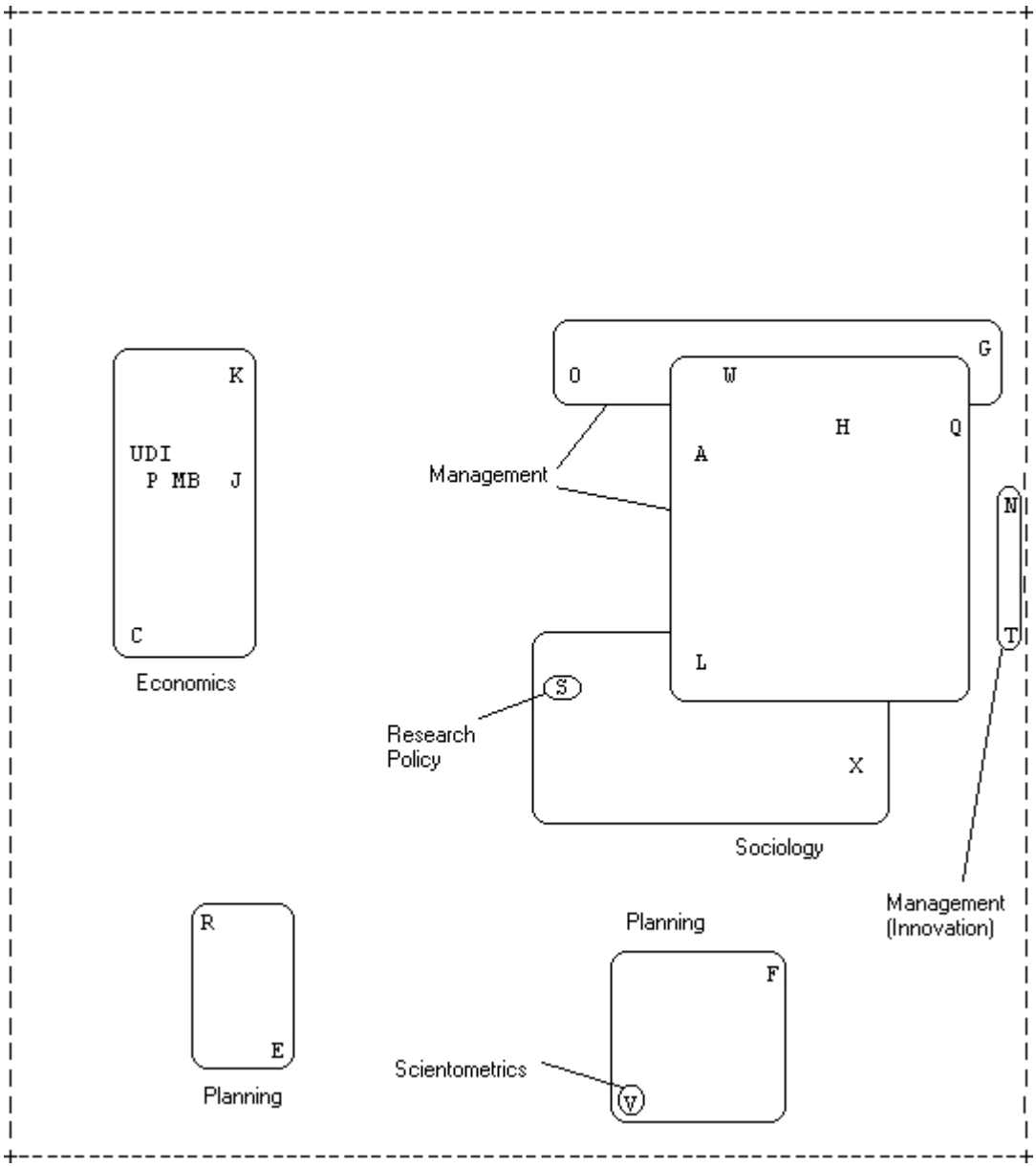
Appendix C-II.4 – *Research Policy Scaling Plot – Cited 1997*



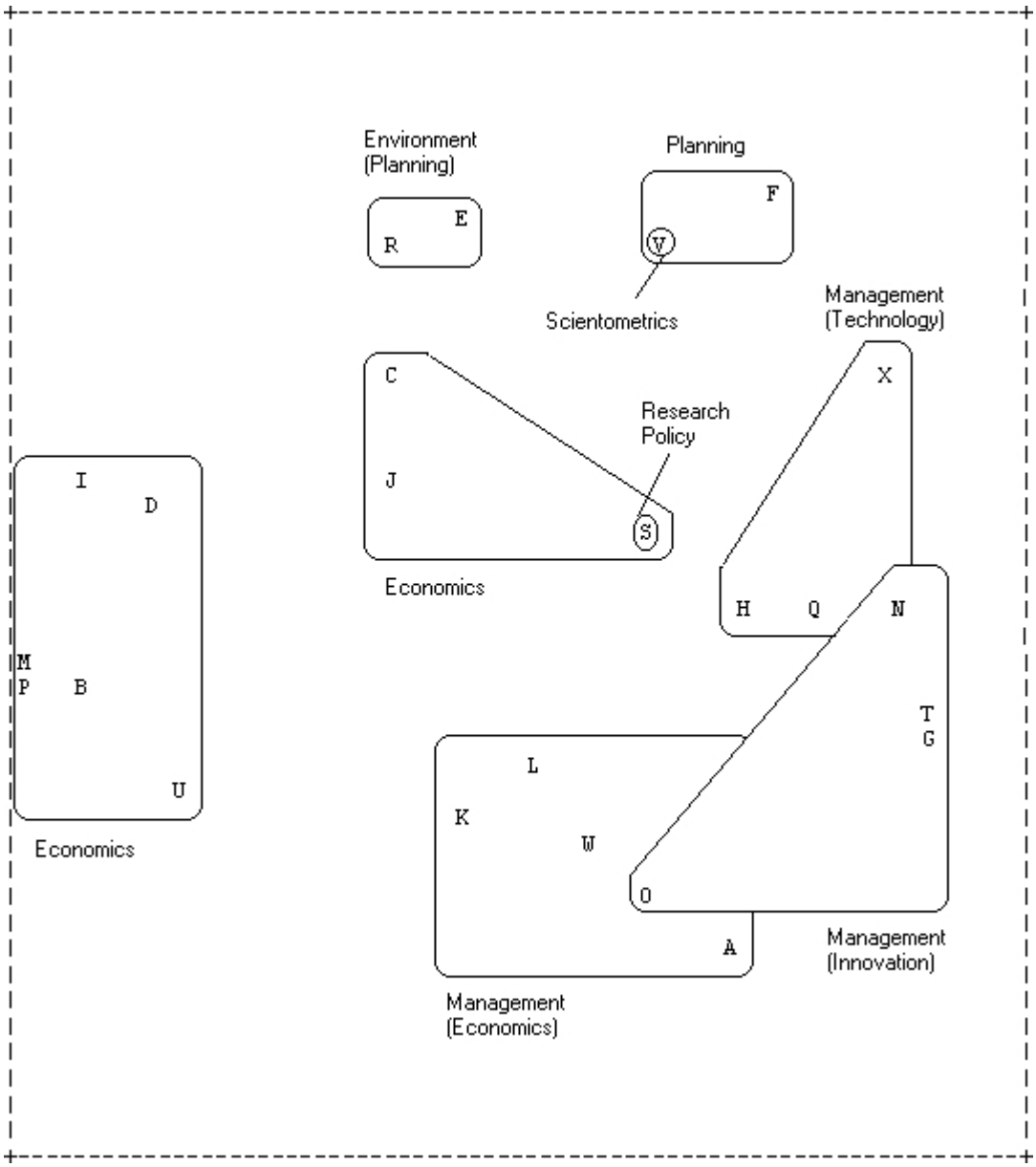
Appendix C-II.5 – *Research Policy Scaling Plot – Citing 1998*



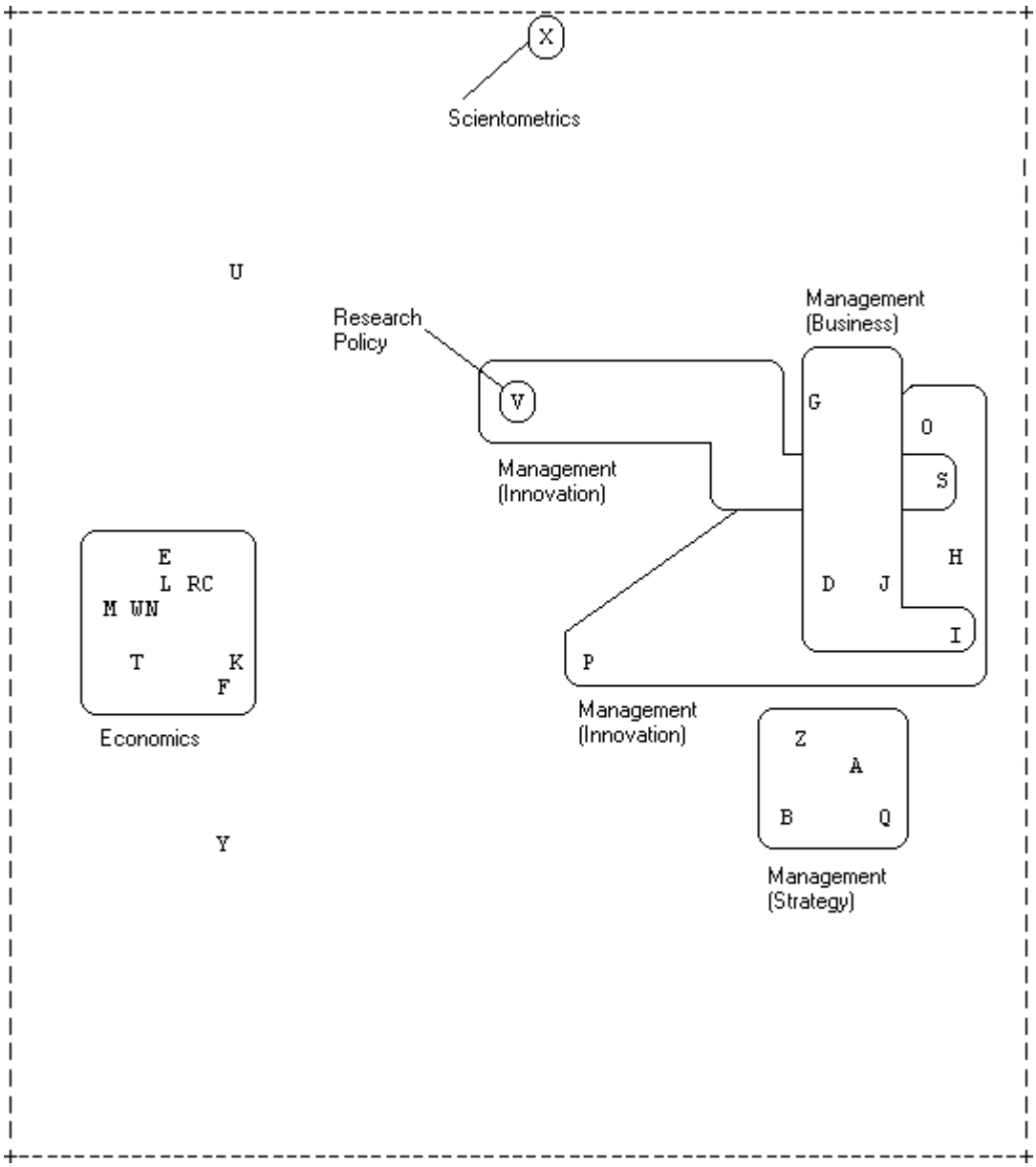
Appendix C-II.6 – *Research Policy Scaling Plot – Cited 1998*



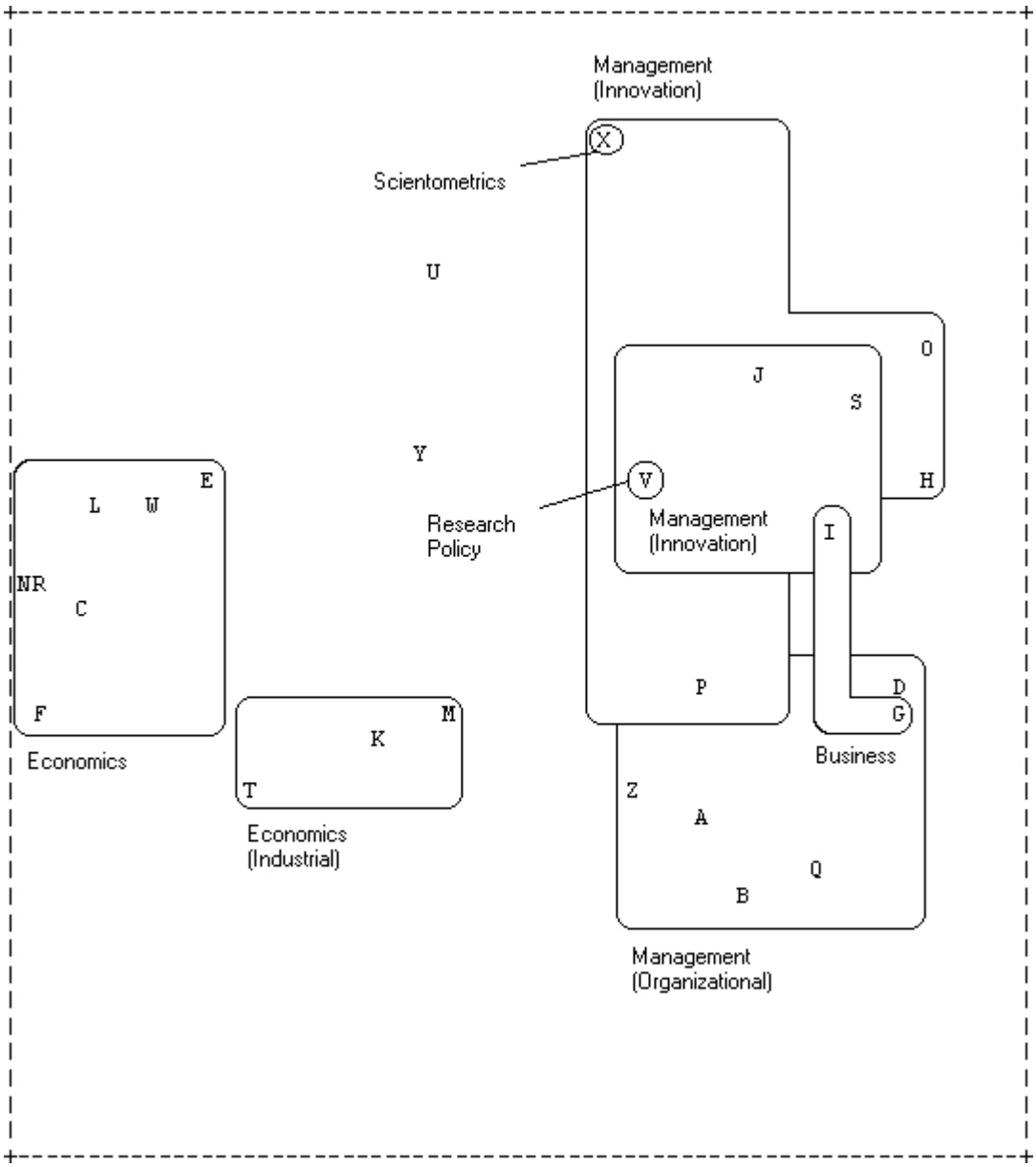
Appendix C-II.7 – *Research Policy Scaling Plot – Citing 1999*



Appendix C-II.8 – *Research Policy Scaling Plot – Cited 1999*



Appendix C-II.9 – *Research Policy Scaling Plot – Citing 2000*



Appendix C-II.10 – *Research Policy Scaling Plot – Cited 2000*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
C	AM ECON REV	**0.95**	-0.01	-0.01	0.08	0.03	0.03	0.08	0.03	0.03	0.17
M	J ECON LIT	**0.95**	-0.02	-0.02	0.09	0.06	0.07	0.06	0.05	0.05	0.19
Y	REV ECON STAT	**0.93**	-0.05	-0.02	0.09	0.01	0.02	0.07	0.02	0.00	0.13
F	ECON J	**0.89**	-0.04	-0.04	0.06	0.00	0.03	0.05	0.02	0.03	0.20
Q	J POLIT ECON	**0.89**	-0.05	-0.02	0.07	0.02	0.07	0.02	0.07	0.07	0.06
N	J IND ECON	**0.85**	-0.07	-0.05	-0.06	-0.08	-0.13	-0.01	-0.17	-0.12	-0.11
U	RAND J ECON	**0.80**	-0.09	-0.03	-0.10	-0.09	-0.13	-0.03	-0.16	-0.12	-0.25
c	SMALL BUS ECON	**0.77**	0.06	0.05	0.26	-0.05	0.12	0.06	-0.11	-0.02	0.13
P	J LAW ECON	**0.69**	-0.12	-0.07	-0.14	-0.12	-0.10	-0.14	-0.16	0.00	-0.37
O	J INST THEOR ECON	**0.61**	-0.04	-0.05	-0.07	-0.10	0.00	-0.06	-0.09	0.16	-0.06
E	CALIF MANAGE REV	-0.05	**0.90**	0.19	-0.03	-0.01	-0.11	-0.03	0.00	0.04	0.00
X	RES TECHNOL MANAGE	-0.13	**0.88**	-0.03	-0.07	-0.06	0.16	0.08	0.21	0.04	-0.04
b	SLOAN MANAGE REV	-0.07	**0.88**	-0.04	-0.05	-0.01	-0.11	0.03	0.02	0.04	-0.02
L	INT J TECHNOL MANAGE	-0.14	**0.84**	0.30	-0.03	-0.05	0.10	0.25	0.17	-0.06	-0.07
I	HARVARD BUS REV	0.39	**0.77**	-0.08	0.06	0.05	-0.07	0.00	0.05	0.06	0.19
T	R&D MANAGE	-0.17	**0.67**	0.13	-0.11	-0.13	0.22	0.08	0.12	-0.21	-0.12
J	IEEE T ENG MANAGE	-0.18	**0.55**	0.17	-0.11	-0.16	0.35	0.26	0.21	-0.24	-0.14
A	ACAD MANAGE J	-0.03	0.16	**0.93**	-0.06	-0.02	-0.09	0.12	0.01	0.00	-0.04
B	ADMIN SCI QUART	-0.08	0.00	**0.90**	-0.05	-0.04	0.13	0.00	0.01	0.21	0.03
g	STRATEGIC MANAGE J	0.04	0.31	**0.75**	-0.06	-0.01	-0.16	0.19	-0.04	-0.10	-0.09
f	SOZ WELT	-0.11	-0.07	**0.62**	-0.04	-0.10	0.45	-0.10	0.00	0.12	0.04
V	REG STUD	0.03	-0.02	-0.06	**0.87**	-0.04	-0.01	-0.06	-0.07	-0.03	-0.01
H	ENVIRON PLANN C	0.29	-0.13	-0.10	**0.84**	-0.06	-0.01	-0.01	-0.07	-0.02	0.00
G	ENVIRON PLANN A	-0.09	-0.06	-0.02	**0.83**	-0.04	-0.05	-0.05	-0.05	0.01	-0.05
Z	SCI TECHNOL HUM VAL	-0.10	-0.93	-0.06	-0.09	**0.96**	0.03	-0.06	-0.08	0.00	-0.02
d	SOC STUD SCI	-0.08	-0.07	-0.04	-0.06	**0.96**	0.01	-0.04	-0.04	-0.01	-0.06
W	RES POLICY	0.02	0.15	0.07	-0.01	0.03	**0.88**	0.04	-0.07	-0.11	0.00
e	SOCIOL TRAV	0.26	-0.07	-0.14	-0.08	0.09	**0.58**	-0.08	-0.07	0.47	-0.14
h	TECHNOL FORECAST SOC	0.10	0.14	-0.02	-0.06	-0.08	0.05	**0.85**	-0.05	0.03	0.06
S	MANAGE SCI	0.01	0.11	0.18	-0.06	-0.01	-0.06	**0.78**	0.12	-0.03	-0.09
R	J PROD INNOVAT MANAG	-0.12	0.12	-0.05	-0.11	-0.08	0.02	0.12	**0.82**	-0.09	-0.08
K	IND MARKET MANAG	-0.11	0.30	0.04	-0.10	-0.04	-0.15	-0.05	**0.72**	0.02	0.00
D	AM J SOCIOL	-0.03	-0.05	0.18	-0.06	0.01	0.03	-0.02	-0.10	**0.77**	0.10
a	SCIENTOMETRICS	-0.11	-0.08	-0.07	-0.14	0.13	0.27	-0.12	-0.20	**-0.41**	0.30
i.	WORLD DEV	0.24	-0.07	-0.05	-0.08	-0.11	-0.08	-0.03	-0.08	0.03	**0.73**

Appendix C-II.11 – *Research Policy Factor Loadings – Citing 1996*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
M	J ECON LIT	**0.93**	-0.12	0.03	-0.11	-0.02	-0.02	-0.04	-0.06	0.22	0.12	0.10	-0.01
C	AM ECON REV	**0.90**	-0.09	-0.12	-0.06	-0.08	-0.09	-0.07	0.11	0.05	-0.08	-0.08	0.00
Q	J POLIT ECON	**0.89**	-0.12	-0.13	-0.07	-0.08	-0.11	-0.08	0.15	0.06	-0.11	-0.15	0.01
F	ECON J	**0.77**	-0.08	-0.02	-0.07	-0.01	0.03	-0.04	-0.09	0.07	0.00	0.23	0.01
Y	REV ECON STAT	**0.75**	0.12	-0.09	-0.08	0.03	-0.09	-0.05	0.20	-0.18	-0.07	-0.07	-0.01
A	ACAD MANAGE J	-0.02	**0.93**	-0.05	-0.01	-0.04	-0.05	-0.03	0.05	-0.01	0.00	-0.01	0.00
B	ADMIN SCI QUART	-0.07	**0.93**	-0.03	-0.08	-0.03	-0.05	-0.05	0.02	0.00	0.06	-0.03	-0.05
g	STRATEGIC MANAGE J	0.02	**0.90**	0.02	-0.01	-0.04	0.11	-0.01	0.13	0.08	-0.05	0.03	0.01
E	CALIF MANAGE REV	-0.21	**0.51**	0.29	0.25	0.01	0.43	-0.06	-0.07	0.00	-0.18	0.03	-0.01
D	AM J SOCIOL	-0.13	**0.45**	-0.23	-0.09	-0.04	-0.19	-0.13	-0.23	0.02	0.24	-0.04	0.06
S	MANAGE SCI	-0.05	**0.43**	0.19	0.10	-0.07	0.08	-0.04	0.13	-0.13	-0.22	-0.13	0.00
T	R&D MANAGE	-0.13	-0.03	**0.90**	0.02	0.03	0.11	-0.04	-0.06	-0.05	0.02	-0.03	-0.02
J	IEEE T ENG MANAGE	-0.13	0.04	**0.83**	0.35	-0.07	0.06	-0.04	-0.04	-0.06	0.03	-0.04	0.00
R	J PROD INNOVAT MANAG	-0.09	-0.02	0.27	**0.89**	-0.04	-0.08	-0.06	0.00	-0.05	0.01	-0.04	0.01
X	RES TECHNOL MANAGE	-0.11	-0.05	0.42	**0.80**	-0.05	-0.05	-0.04	-0.01	-0.05	0.11	-0.04	0.01
K	IND MARKET MANAG	-0.11	0.02	-0.17	**0.67**	-0.04	0.20	-0.04	-0.06	-0.01	-0.05	0.00	-0.02
G	ENVIRON PLANN A	-0.04	-0.04	-0.07	-0.01	**0.89**	-0.03	-0.05	-0.06	-0.04	-0.12	-0.02	-0.01
V	REG STUD	-0.07	-0.08	-0.06	-0.04	**0.86**	-0.03	-0.06	-0.05	-0.06	-0.11	0.16	-0.01
H	ENVIRON PLANN C	-0.04	-0.05	0.14	-0.08	**0.81**	0.01	0.03	0.05	0.00	0.29	-0.06	0.01
L	INT J TECHNOL MANAGE	-0.02	0.01	0.07	0.03	-0.05	**0.81**	-0.02	-0.04	-0.02	-0.04	-0.01	0.00
h	TECHNOL FORECAST SOC	-0.10	-0.10	0.03	-0.06	0.06	**0.71**	-0.06	0.05	-0.09	0.28	-0.08	0.00
I	HARVARD BUS REV	-0.18	0.54	0.27	0.30	-0.10	**0.63**	-0.06	-0.03	0.00	-0.23	0.02	-0.01
b	SLOAN MANAGE REV	-0.19	0.35	0.42	0.40	-0.12	**0.43**	-0.06	-0.02	-0.05	-0.23	-0.04	0.00
Z	SCI TECHNOL HUM VAL	-0.13	-0.09	0.00	-0.08	-0.03	-0.06	**0.96**	-0.01	-0.04	0.12	-0.01	0.02
d	SOC STUD SCI	-0.12	-0.08	-0.06	-0.05	-0.06	-0.05	**0.96**	-0.05	-0.05	0.05	-0.05	-0.01
U	RAND J ECON	0.28	0.01	-0.11	-0.06	-0.11	-0.07	-0.09	**0.82**	0.05	0.03	0.03	-0.01
N	J IND ECON	0.29	0.35	-0.04	-0.12	-0.02	0.00	-0.06	**0.73**	0.10	0.14	0.38	0.00
i	WORLD DEV	0.33	0.00	-0.05	-0.04	-0.05	-0.05	-0.06	**-0.52**	-0.03	0.15	0.14	-0.01
O	J INST THEOR ECON	0.02	-0.09	-0.02	-0.03	-0.03	-0.04	-0.03	-0.06	**0.90**	-0.05	-0.03	-0.01
P	J LAW ECON	0.21	0.18	-0.10	-0.09	-0.10	-0.10	-0.08	0.38	**0.74**	0.00	-0.07	0.03
a	SCIENTOMETRICS	-0.09	-0.08	-0.04	0.04	-0.07	-0.01	0.09	-0.03	-0.07	**0.66**	-0.06	-0.03
W	RES POLICY	0.04	0.09	0.50	-0.03	0.19	0.24	0.13	0.06	0.07	**0.64**	0.07	0.04
c	SMALL BUS ECON	0.01	-0.09	-0.05	-0.05	0.08	-0.07	-0.04	0.05	-0.08	-0.06	**0.90**	0.00
e	SOCIOL TRAV	-0.18	-0.12	-0.03	-0.18	-0.12	-0.11	-0.14	-0.04	-0.08	-0.02	-0.11	**-0.76**
f	SOZ WELT	-0.21	-0.11	-0.01	-0.21	-0.13	-0.13	-0.19	-0.04	-0.11	0.01	-0.12	**-0.66**

Appendix C-II.12 *– Research Policy Factor Loadings – Cited 1996*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9
K	INT J IND ORGAN	**0.95**	-0.02	-0.06	-0.06	0.08	0.01	-0.02	-0.05	0.00
S	RAND J ECON	**0.86**	-0.02	-0.04	-0.06	-0.05	-0.09	-0.03	-0.07	-0.01
N	J IND ECON	**0.85**	-0.08	-0.08	-0.12	-0.01	-0.16	-0.07	-0.14	0.00
B	AM ECON REV	**0.84**	0.02	-0.04	0.09	0.13	0.17	0.03	0.10	-0.04
F	ECON J	**0.81**	-0.03	-0.08	0.06	0.16	0.16	0.00	0.12	-0.03
Q	ORGAN SCI	-0.04	**0.95**	0.04	0.19	-0.07	-0.05	-0.02	-0.01	-0.05
A	ADMIN SCI QUART	0.00	**0.87**	-0.04	0.01	-0.09	-0.04	-0.10	0.02	-0.04
X	STRATEGIC MANAGE J	-0.02	**0.79**	-0.03	0.14	0.01	-0.16	0.03	-0.03	-0.02
D	CALIF MANAGE REV	-0.06	**0.70**	0.37	0.01	0.05	0.30	0.11	-0.04	0.08
R	R&D MANAGE	-0.13	0.01	**0.90**	0.13	0.13	0.04	0.04	-0.02	0.02
O	J PROD INNOVAT MANAG	-0.04	-0.04	**0.74**	0.07	-0.23	-0.19	-0.20	0.10	-0.11
L	INT J TECHNOL MANAGE	-0.15	0.34	**0.58**	0.38	0.07	0.07	0.35	-0.11	0.00
P	MANAGE SCI	0.06	0.11	0.06	**0.87**	-0.08	-0.01	-0.02	-0.02	-0.03
J	IEEE T ENG MANAGE	-0.16	0.21	0.42	**0.75**	-0.13	-0.01	-0.02	-0.04	-0.04
W	SMALL BUS ECON	0.31	-0.04	0.02	-0.13	**0.76**	-0.01	-0.03	-0.16	-0.01
T	REG STUD	0.00	-0.09	-0.04	-0.05	**0.68**	0.14	-0.14	0.29	-0.11
E	ECON DEV Q	0.01	-0.08	-0.10	0.02	0.08	**0.65**	0.03	0.03	0.00
U	RES POLICY	0.06	0.29	0.33	-0.04	0.18	**0.51**	0.16	-0.13	0.42
M	J BUS VENTURING	-0.15	0.30	-0.11	0.31	0.27	**-0.35**	0.00	-0.24	0.01
Y	TECHNOL FORECAST SOC	-0.02	0.02	0.04	0.14	0.00	0.15	**0.73**	-0.14	0.00
H	FUTURES	-0.04	-0.07	-0.08	-0.20	-0.17	-0.11	**0.67**	0.11	-0.10
C	ANN ASSOC AM GEOGR	-0.20	-0.02	0.08	-0.16	0.08	-0.03	-0.05	**0.63**	-0.07
G	EVAL PROGRAM PLANN	-0.14	-0.08	-0.09	-0.19	-0.23	0.38	-0.27	**-0.50**	-0.34
Z	WORLD DEV	0.26	-0.06	-0.23	0.10	-0.14	0.30	-0.09	**0.50**	-0.06
V	SCIENTOMETRICS	-0.10	-0.10	-0.10	-0.06	-0.14	0.02	-0.13	-0.05	**0.89**

Appendix C-II.13 – *Research Policy Factor Loadings – Citing 1997*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
L	INT J TECHNOL MANAGE	**0.94**	-0.05	-0.03	-0.02	0.02	0.04	-0.06	0.02	0.08	0.00	-0.02
R	R&D MANAGE	**0.87**	-0.13	-0.08	-0.08	0.13	0.02	0.11	-0.04	-0.01	0.02	0.00
I	HARVARD BUS REV	**0.81**	0.38	-0.05	-0.10	0.29	-0.10	-0.09	0.06	0.11	0.06	0.06
D	CALIF MANAGE REV	**0.70**	0.53	-0.06	-0.13	0.18	0.00	0.01	-0.01	0.05	0.00	0.01
Y	TECHNOL FORECAST SOC	**0.52**	-0.16	-0.15	-0.14	-0.31	-0.10	-0.12	0.22	-0.18	0.12	0.16
A	ADMIN SCI QUART	-0.01	**0.91**	0.00	-0.08	-0.02	-0.01	-0.02	0.04	0.01	0.03	0.01
Q	ORGAN SCI	-0.11	**0.84**	-0.08	-0.06	0.06	-0.06	-0.05	0.06	-0.10	0.03	-0.03
X	STRATEGIC MANAGE J	0.13	**0.83**	0.13	-0.04	-0.08	0.01	-0.02	-0.01	0.09	0.03	0.04
N	J IND ECON	-0.04	0.18	**0.89**	0.01	-0.11	0.00	0.12	0.06	0.03	0.07	0.03
K	INT J IND ORGAN	-0.07	-0.14	**0.87**	0.06	-0.06	-0.01	0.02	0.02	-0.04	0.03	0.01
S	RAND J ECON	-0.11	0.01	**0.81**	0.12	0.00	-0.08	-0.16	0.03	-0.04	0.01	0.02
B	AM ECON REV	-0.17	-0.06	0.29	**0.81**	-0.06	-0.13	-0.06	0.12	-0.06	0.03	0.08
F	ECON J	-0.11	-0.12	0.17	**0.80**	-0.07	-0.06	0.09	0.10	-0.10	0.02	0.07
Z	WORLD DEV	-0.06	-0.07	-0.26	**0.55**	-0.11	0.01	-0.13	-0.11	0.05	0.10	-0.03
O	J PROD INNOVAT MANAG	0.04	-0.10	-0.10	-0.14	**0.75**	-0.03	0.04	0.00	-0.07	0.08	0.02
J	IEEE T ENG MANAGE	0.52	-0.08	-0.11	-0.11	**0.63**	-0.03	-0.08	0.07	-0.02	0.02	0.02
P	MANAGE SCI	0.10	0.35	-0.02	0.01	**0.48**	-0.08	-0.18	0.11	0.04	0.01	0.10
V	SCIENTOMETRICS	-0.16	-0.10	-0.10	-0.12	-0.04	**0.86**	-0.11	0.10	0.02	0.08	0.07
U	RES POLICY	0.48	0.03	0.00	-0.06	-0.12	**0.56**	0.10	-0.02	-0.17	-0.02	0.01
W	SMALL BUS ECON	-0.03	-0.08	0.04	-0.09	-0.05	-0.04	**0.83**	0.17	0.10	0.16	0.01
T	REG STUD	-0.03	-0.07	-0.15	0.07	-0.06	-0.03	**0.52**	-0.38	-0.19	-0.29	0.09
C	ANN ASSOC AM GEOGR	-0.07	-0.10	-0.09	-0.11	-0.08	-0.08	-0.09	**-0.88**	-0.01	0.12	0.05
M	J BUS VENTURING	0.04	0.00	-0.07	-0.08	-0.05	-0.06	0.02	0.03	**0.94**	0.02	0.05
E	ECON DEV Q	-0.10	-0.10	-0.11	-0.15	-0.11	-0.08	-0.08	0.11	-0.02	**-0.89**	0.06
G	EVAL PROGRAM PLANN	-0.11	-0.09	-0.12	-0.17	-0.14	-0.13	-0.08	0.11	-0.10	0.12	**-0.88**
H	FUTURES	-0.13	-0.16	-0.20	-0.31	-0.27	-0.29	-0.15	0.17	-0.22	0.33	**0.48**

Appendix C-II.14 – *Research Policy Factor Loadings – Cited 1997*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
B	AM ECON REV	**0.98**	-0.04	0.01	0.00	-0.02	-0.01	0.01	0.03	-0.02	0.07
N	J ECON LIT	**0.96**	-0.07	-0.03	-0.05	-0.05	-0.02	0.02	0.06	0.01	0.17
E	ECON J	**0.96**	-0.04	0.02	-0.03	-0.03	-0.03	0.02	0.03	0.00	-0.02
P	J POLIT ECON	**0.93**	-0.04	0.00	-0.02	-0.02	-0.01	-0.01	0.03	-0.04	0.09
U	Q J ECON	**0.91**	-0.04	-0.01	-0.01	-0.02	-0.02	0.03	0.03	-0.03	-0.07
M	J ECON LIT	**0.90**	-0.02	-0.01	-0.01	-0.04	0.01	-0.02	0.04	0.01	0.20
J	INT J IND ORGAN	**0.88**	-0.07	-0.05	-0.08	-0.07	-0.03	-0.05	0.08	0.15	0.10
Z	REV ECON STAT	**0.88**	-0.05	-0.05	-0.03	-0.04	0.00	-0.02	0.05	-0.01	0.41
D	CAMBRIDGE J ECON	**0.81**	-0.08	0.01	-0.07	-0.05	-0.09	0.03	0.04	-0.04	-0.31
A	ADMIN SCI QUART	-0.05	**0.97**	0.01	0.07	-0.01	0.04	-0.02	0.01	-0.02	0.00
X	RES ORGAN BEHAV	-0.11	**0.90**	0.25	0.03	-0.01	0.01	0.00	0.00	-0.10	0.00
S	ORGAN STUD	-0.12	**0.88**	-0.01	0.00	-0.05	0.07	-0.08	0.06	0.13	-0.03
e	STRATEGIC MANAGE J	0.03	**0.57**	0.18	0.24	-0.03	0.18	-0.07	0.05	0.41	-0.03
Y	RES POLICY	0.06	0.12	**0.91**	-0.02	0.07	-0.05	0.00	-0.08	0.04	-0.05
V	R&D MANAGE	-0.11	0.12	**0.78**	0.01	-0.05	0.24	-0.06	0.01	0.06	-0.08
K	INT J TECHNOL MANAGE	-0.20	0.43	**0.70**	0.37	-0.08	0.23	-0.11	0.06	-0.01	-0.02
f	TECHNOL FORECAST SOC	0.07	-0.12	**0.45**	0.05	-0.10	-0.11	-0.08	0.14	-0.32	0.12
H	HARVARD BUS REV	-0.06	-0.03	-0.04	**0.93**	-0.03	-0.03	-0.03	0.04	-0.02	-0.01
C	CALIF MANAGE REV	-0.10	0.30	0.21	**0.83**	-0.06	0.15	-0.07	0.07	0.05	-0.01
d	SOC STUD SCI	-0.08	-0.08	0.01	-0.02	**0.89**	-0.03	-0.02	-0.07	0.00	-0.01
a	SCI TECHNOL HUM VAL	-0.12	0.00	-0.08	-0.06	**0.87**	-0.08	-0.08	0.06	-0.09	-0.01
R	MANAGE SCI	0.08	0.05	0.14	-0.07	-0.03	**0.79**	-0.02	0.06	0.03	0.16
I	IEEE T ENG MANAGE	-0.14	0.32	0.37	0.27	-0.06	**0.63**	-0.05	0.06	-0.09	-0.01
Q	J PROD INNOVAT MANAG	-0.14	0.02	-0.09	0.09	-0.14	**0.48**	-0.20	0.16	-0.08	-0.26
W	REG STUD	0.06	-0.08	-0.02	-0.07	-0.07	-0.09	**0.86**	0.08	0.03	-0.06
G	ENVIRON PLANN A	-0.08	-0.04	-0.10	-0.02	-0.04	-0.03	**0.85**	0.06	-0.06	0.03
b	SCIENTOMETRICS	-0.12	-0.11	0.08	-0.06	0.13	-0.10	-0.07	**-0.81**	-0.03	-0.01
L	J AM SOC INFORM SCI	-0.10	0.00	-0.10	-0.04	-0.11	-0.05	-0.07	**-0.81**	-0.07	0.00
O	J INT BUS STUD	-0.03	0.10	-0.02	-0.03	-0.08	-0.10	-0.13	0.14	**0.80**	-0.03
T	POLICY STUD J	0.05	0.01	0.18	-0.14	-0.06	-0.35	-0.22	0.25	**-0.45**	-0.08
c	SMALL BUS ECON	0.19	-0.12	0.23	-0.09	-0.18	-0.24	0.17	0.21	**0.38**	0.12
F	ECONOMETRICA	0.37	-0.03	-0.08	-0.01	-0.03	0.06	-0.03	0.03	-0.01	**0.85**

Appendix C-II.15 – *Research Policy Factor Loadings – Citing 1998*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
B	AM ECON REV	**0.95**	-0.08	-0.10	-0.06	-0.08	-0.08	-0.06	-0.04	-0.06	0.02
P	J POLIT ECON	**0.90**	-0.16	-0.15	-0.08	-0.10	-0.10	-0.06	-0.05	-0.04	0.02
N	J ECON LIT	**0.89**	-0.04	0.12	-0.05	0.02	-0.07	-0.06	0.17	-0.05	-0.02
U	Q J ECON	**0.87**	-0.10	-0.17	-0.09	-0.02	-0.11	-0.05	-0.04	-0.01	0.03
E	ECON J	**0.81**	-0.11	0.22	0.02	0.07	-0.06	-0.07	0.04	-0.15	-0.11
F	ECONOMETRICA	**0.69**	-0.12	-0.24	-0.12	-0.09	-0.07	-0.07	-0.03	0.11	0.14
Z	REV ECON STAT	**0.65**	0.30	-0.18	-0.07	0.02	-0.08	-0.04	0.37	0.15	0.02
M	J ECON BEHAV ORGAN	**0.58**	0.27	0.04	0.08	-0.03	0.06	0.00	-0.02	-0.02	-0.03
H	HARVARD BUS REV	0.01	**0.94**	0.06	0.01	-0.02	-0.06	-0.06	0.01	0.07	0.06
e	STRATEGIC MANAGE J	0.11	**0.92**	0.00	0.18	0.01	0.04	0.04	0.11	0.08	-0.10
C	CALIF MANAGE REV	-0.20	**0.79**	0.22	0.04	-0.04	-0.15	-0.15	-0.06	-0.07	0.17
A	ADMIN SCI QUART	-0.10	**0.68**	-0.02	0.65	-0.08	-0.05	-0.01	-0.01	0.06	0.04
Y	RES POLICY	-0.02	0.08	**0.89**	0.03	0.05	0.17	0.14	0.11	0.09	-0.08
K	INT J TECHNOL MANAGE	-0.02	0.01	**0.86**	0.02	-0.02	0.05	-0.08	0.20	0.10	-0.02
V	R&D MANAGE	-0.12	0.08	**0.76**	-0.08	-0.09	-0.03	0.08	-0.01	0.00	0.11
I	IEEE T ENG MANAGE	-0.23	0.13	**0.70**	-0.18	-0.16	-0.15	-0.13	-0.14	0.00	0.39
D	CAMBRIDGE J ECON	0.17	-0.20	**0.43**	0.28	0.16	-0.07	0.00	-0.08	-0.24	-0.26
S	ORGAN STUD	-0.14	0.09	-0.03	**0.83**	-0.10	-0.07	-0.08	-0.02	-0.05	0.03
X	RES ORGAN BEHAV	-0.21	0.56	-0.05	**0.68**	-0.04	-0.13	-0.07	-0.05	-0.04	0.13
W	REG STUD	-0.09	-0.06	-0.01	-0.05	**0.89**	-0.06	-0.06	0.07	-0.06	0.02
G	ENVIRON PLANN A	-0.07	0.00	-0.07	-0.07	**0.89**	-0.04	-0.04	-0.07	-0.02	0.03
a	SCI TECHNOL HUM VAL	-0.17	-0.09	0.09	-0.07	-0.08	**0.84**	-0.09	-0.05	-0.04	-0.08
d	SOC STUD SCI	-0.17	-0.09	-0.03	-0.07	-0.03	**0.81**	0.22	-0.06	-0.09	0.10
b	SCIENTOMETRICS	-0.11	-0.05	0.13	-0.06	-0.04	0.15	**0.81**	-0.06	-0.08	0.04
L	J AM SOC INFORM SCI	-0.16	-0.07	-0.05	-0.04	-0.06	-0.04	**0.81**	-0.04	0.00	0.00
c	SMALL BUS ECON	-0.03	-0.15	0.11	-0.03	0.04	-0.09	-0.08	**0.78**	-0.04	0.11
J	INT J IND ORGAN	0.38	0.13	0.19	-0.03	-0.08	0.06	-0.04	**0.54**	0.03	0.01
O	J INT BUS STUD	-0.11	0.37	-0.06	0.02	0.01	-0.08	-0.01	**0.46**	-0.13	-0.15
f	TECHNOL FORECAST SOC	-0.14	-0.14	0.07	-0.05	-0.05	-0.09	-0.03	0.00	**0.78**	-0.10
R	MANAGE SCI	0.03	0.31	0.06	-0.01	-0.05	-0.06	-0.06	-0.11	**0.60**	0.18
T	POLICY STUD J	-0.20	0.00	-0.07	-0.25	-0.17	-0.09	-0.16	-0.15	-0.11	**-0.74**
Q	J PROD INNOVAT MANAG	-0.21	0.20	0.10	-0.28	-0.17	-0.22	-0.19	-0.22	-0.29	**0.50**

Appendix C-II.16 – *Research Policy Factor Loadings – Cited 1998*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7
I	J ECON LIT	**0.97**	-0.04	-0.08	-0.07	0.00	-0.01	0.00
D	ECON J	**0.97**	-0.05	-0.07	-0.05	-0.03	0.01	-0.01
B	AM ECON REV	**0.96**	-0.03	-0.04	-0.03	0.00	0.00	-0.01
P	Q J ECON	**0.94**	-0.05	-0.07	-0.10	-0.03	-0.03	-0.01
U	REV ECON STAT	**0.93**	-0.04	-0.06	-0.09	-0.04	-0.03	-0.02
M	J POLIT ECON	**0.90**	-0.04	-0.07	-0.11	-0.01	-0.05	0.00
J	J EVOL ECON	**0.89**	-0.04	-0.03	0.31	-0.09	0.02	0.03
K	J IND ECON	**0.80**	0.01	-0.08	-0.02	0.06	-0.06	-0.04
C	CAMBRIDGE J ECON	**0.62**	-0.13	-0.05	0.31	-0.14	0.28	0.02
W	STRATEGIC MANAGE J	-0.03	**0.89**	0.04	0.04	0.09	-0.03	-0.06
H	INT J TECHNOL MANAGE	-0.06	**0.71**	0.46	0.38	0.14	-0.13	0.09
A	ADMIN SCI QUART	-0.05	**0.68**	-0.14	-0.05	0.15	-0.09	0.27
Q	R&D MANAGE	-0.13	**0.63**	0.63	0.21	0.21	-0.15	-0.01
L	J INT BUS STUD	-0.09	**0.54**	-0.04	-0.09	-0.20	0.01	-0.27
T	RES TECHNOL MANAGE	-0.22	0.04	**0.82**	0.21	-0.05	-0.15	-0.03
N	J PROD INNOVAT MANAG	-0.14	-0.09	**0.66**	-0.20	0.35	-0.11	0.01
S	RES POLICY	0.08	0.08	0.25	**0.87**	-0.18	0.00	-0.06
X	TECHNOL SOC	-0.16	0.02	-0.10	**0.74**	0.26	-0.09	0.12
O	MANAGE SCI	0.09	0.12	0.01	0.13	**0.83**	-0.03	-0.10
G	IEEE T ENG MANAGE	-0.18	0.05	0.22	-0.08	**0.79**	-0.13	0.05
R	REG STUD	0.00	-0.11	-0.11	0.05	-0.10	**0.80**	-0.03
E	ENVIRON PLANN A	-0.11	-0.07	-0.14	-0.10	-0.06	**0.75**	-0.03
F	EVAL PROGRAM PLANN	-0.16	-0.10	-0.17	0.17	-0.19	-0.27	**0.71**
V	SCIENTOMETRICS	-0.17	-0.16	-0.29	0.15	-0.12	-0.39	**-0.60**

Appendix C-II.17 – *Research Policy Factor Loadings – Citing 1999*

Tag	Journal	F 1	F2	F3	F4	F5	F6	F7
B	AM ECON REV	**0.94**	-0.09	-0.07	-0.04	-0.06	-0.08	-0.05
P	Q J ECON	**0.92**	-0.11	-0.13	-0.13	-0.13	-0.08	-0.05
M	J POLIT ECON	**0.87**	-0.15	-0.13	-0.16	-0.09	-0.11	-0.04
I	J ECON LIT	**0.85**	-0.22	-0.19	0.37	-0.05	-0.03	-0.06
U	REV ECON STAT	**0.78**	0.26	-0.01	-0.09	-0.12	-0.07	0.07
D	ECON J	**0.70**	-0.12	-0.19	0.39	-0.04	0.13	-0.18
W	STRATEGIC MANAGE J	0.00	**0.87**	0.04	-0.07	0.03	-0.05	-0.05
K	J IND ECON	0.05	**0.81**	-0.06	0.15	0.15	-0.08	0.08
A	ADMIN SCI QUART	-0.17	**0.64**	0.03	-0.17	-0.01	-0.09	-0.16
L	J INT BUS STUD	-0.12	**0.57**	-0.10	0.02	-0.09	0.05	0.03
G	IEEE T ENG MANAGE	-0.22	-0.09	**0.76**	-0.01	0.10	-0.07	-0.05
N	J PROD INNOVAT MANAG	-0.16	-0.14	**0.76**	-0.09	0.02	-0.04	-0.08
T	RES TECHNOL MANAGE	-0.24	0.11	**0.68**	0.15	0.54	-0.11	-0.01
O	MANAGE SCI	0.02	0.34	**0.50**	-0.16	-0.10	-0.04	0.08
C	CAMBRIDGE J ECON	0.03	-0.07	-0.05	**0.78**	-0.04	0.39	-0.01
J	J EVOL ECON	0.02	-0.08	-0.14	**0.72**	0.02	-0.09	-0.12
S	RES POLICY	-0.16	0.14	0.15	**0.70**	0.33	-0.05	0.35
H	INT J TECHNOL MANAGE	-0.10	0.07	0.04	0.05	**0.81**	-0.09	-0.11
Q	R&D MANAGE	-0.19	0.03	0.38	0.41	**0.70**	-0.12	0.07
X	TECHNOL SOC	-0.24	-0.17	-0.34	-0.29	**0.50**	-0.04	-0.05
E	ENVIRON PLANN A	-0.12	-0.05	-0.08	-0.04	-0.08	**0.81**	-0.04
R	REG STUD	-0.11	-0.09	-0.10	0.14	-0.11	**0.79**	-0.07
V	SCIENTOMETRICS	-0.20	-0.14	-0.14	-0.01	-0.15	-0.13	**0.86**
F	EVAL PROGRAM PLANN	-0.36	-0.16	-0.18	0.05	-0.35	-0.37	**-0.38**

Appendix C-II.18 – *Research Policy Factor Loadings – Cited 1999*

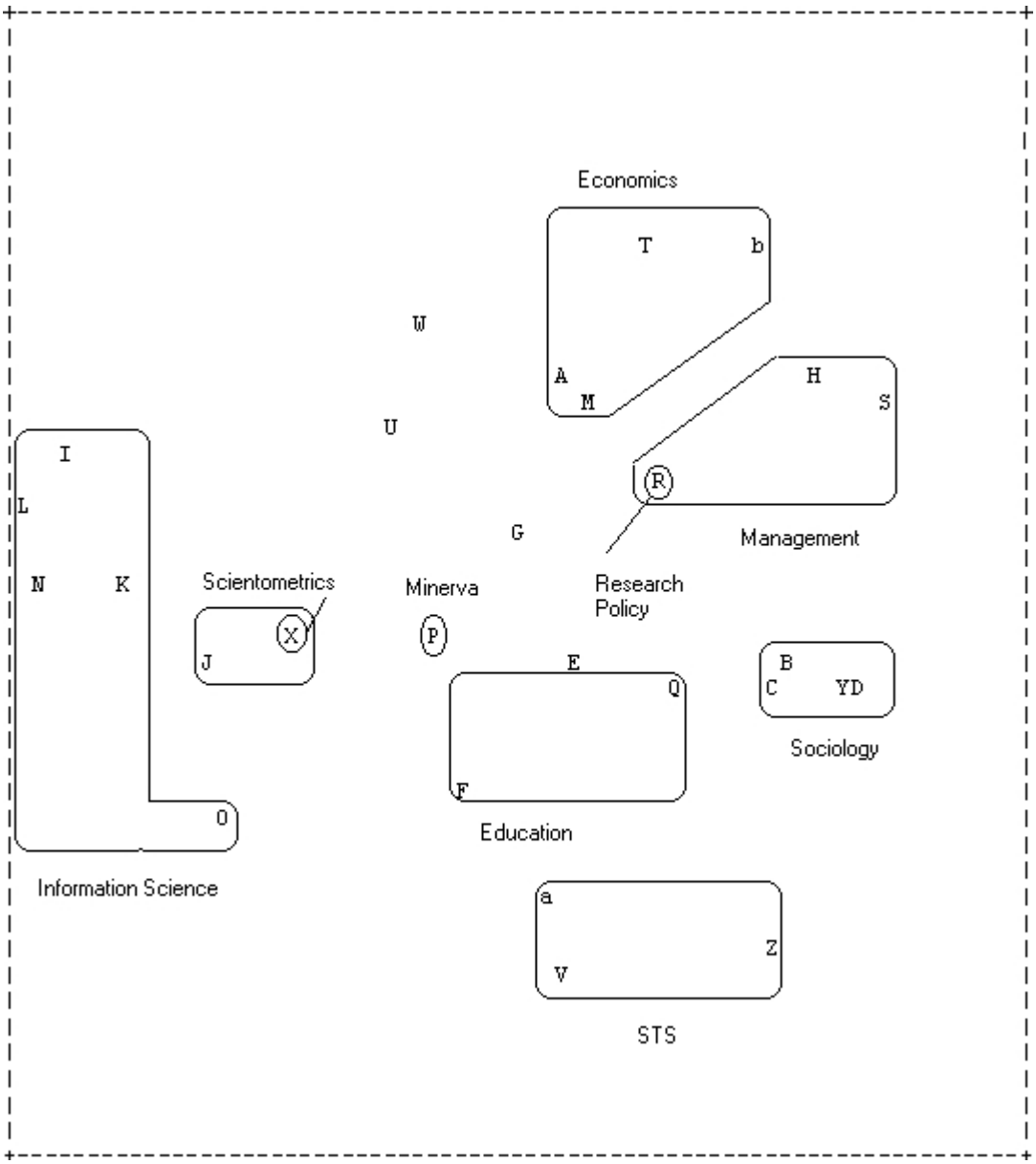
Tag	Journal	F1	F2	F3	F4	F5	F6	F7
N	J POLIT ECON	**0.94**	-0.08	-0.07	-0.02	-0.05	0.04	0.03
C	AM ECON REV	**0.94**	-0.04	0.00	0.00	0.02	0.17	0.03
L	J ECON LIT	**0.93**	-0.07	-0.04	0.01	-0.02	0.19	0.03
R	Q J ECON	**0.93**	-0.06	-0.01	-0.01	0.00	0.14	0.03
W	REV ECON STAT	**0.89**	-0.10	-0.09	-0.04	-0.12	0.04	0.05
E	ECON J	**0.88**	-0.09	-0.06	-0.05	-0.01	0.20	0.02
K	J ECON BEHAV ORGAN	**0.86**	0.08	-0.09	0.01	-0.03	0.05	0.03
T	RAND J ECON	**0.79**	-0.12	-0.13	-0.17	-0.07	-0.23	0.04
M	J IND ECON	**0.68**	-0.15	-0.17	-0.25	-0.06	-0.16	0.06
F	ECONOMETRICA	**0.58**	-0.06	-0.09	0.07	-0.16	-0.22	-0.01
B	ADMIN SCI QUART	-0.05	**0.91**	0.02	0.03	-0.02	-0.01	-0.04
A	ACAD MANAGE J	-0.11	**0.88**	0.13	0.07	0.07	-0.09	0.11
Q	ORGAN STUD	-0.17	**0.85**	0.10	0.00	-0.05	-0.01	-0.09
Z	STRATEGIC MANAGE J	-0.04	**0.76**	0.16	0.06	0.22	-0.08	0.14
G	HARVARD BUS REV	-0.05	-0.09	**0.93**	-0.09	-0.02	-0.03	0.00
D	CALIF MANAGE REV	-0.03	0.26	**0.86**	0.10	0.12	-0.05	0.06
J	INT J TECHNOL MANAGE	-0.14	0.25	**0.80**	0.20	0.33	0.04	0.02
I	INT J OPER PROD MAN	-0.22	0.11	**0.73**	0.14	-0.11	-0.11	0.02
P	MANAGE SCI	0.10	0.06	0.05	**0.88**	-0.12	0.05	-0.05
H	IEEE T ENG MANAGE	-0.30	0.14	0.23	**0.73**	0.32	-0.19	0.12
O	J PROD INNOVAT MANAG	-0.22	-0.07	0.11	**0.43**	0.42	-0.36	0.31
S	R&D MANAGE	-0.25	0.13	0.12	0.08	**0.80**	-0.17	0.10
V	RES POLICY	0.11	0.07	0.00	-0.06	**0.72**	0.33	-0.34
U	REG STUD	0.04	-0.16	-0.10	-0.04	0.02	**0.78**	0.09
X	SCIENTOMETRICS	-0.11	-0.10	-0.10	-0.07	0.01	-0.04	**-0.84**
Y	SMALL BUS ECON	0.25	0.00	-0.13	-0.28	-0.19	0.31	**0.41**

Appendix C-II.19 – *Research Policy Factor Loadings – Citing 2000*

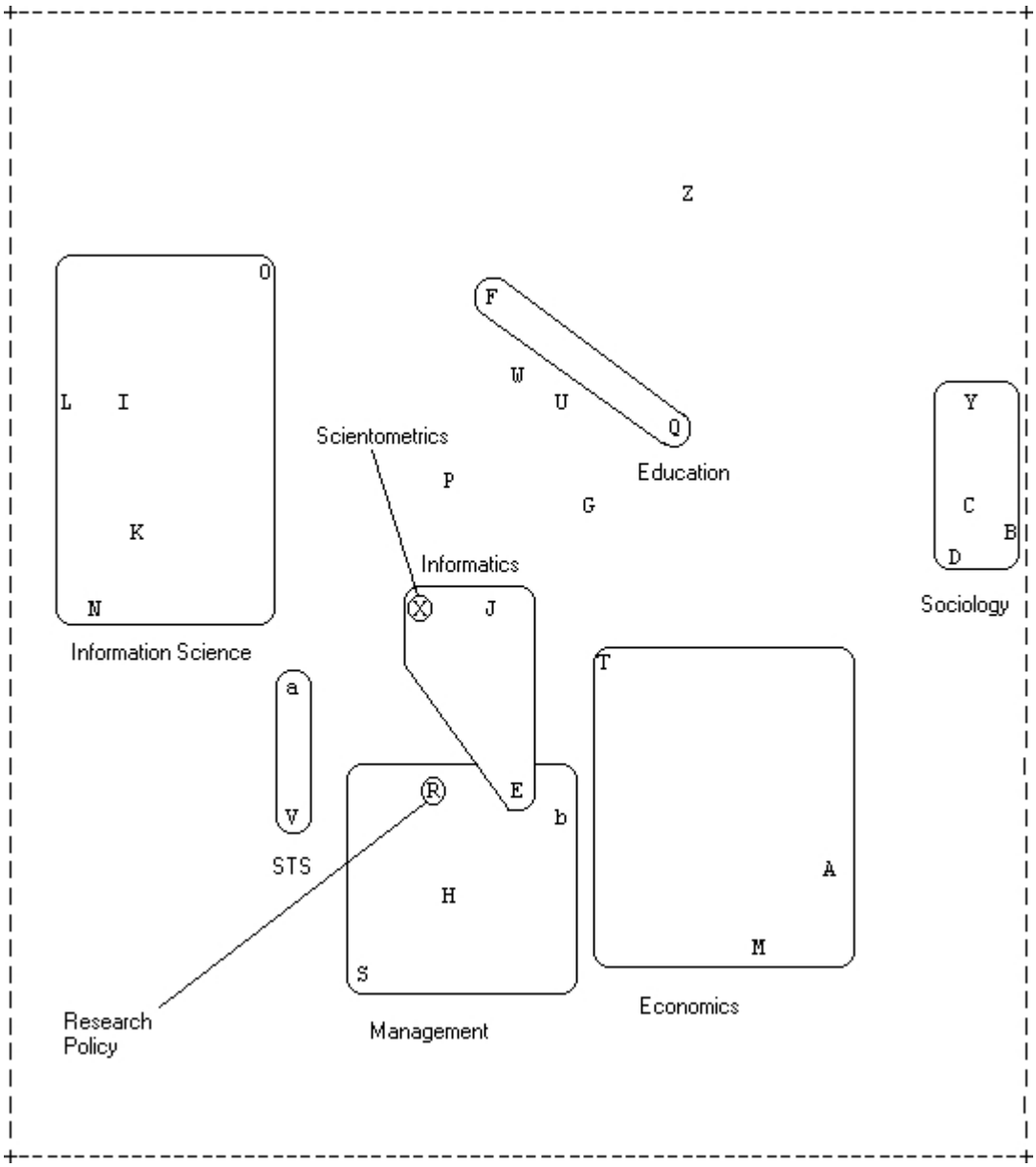
Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8
C	AM ECON REV	**0.93**	-0.08	-0.10	0.06	-0.06	-0.04	-0.07	-0.07
N	J POLIT ECON	**0.92**	-0.16	-0.19	0.09	-0.07	-0.07	-0.05	-0.11
R	Q J ECON	**0.91**	-0.11	-0.21	-0.02	-0.06	-0.06	-0.05	-0.08
L	J ECON LIT	**0.91**	-0.12	0.02	0.07	-0.15	-0.10	0.11	0.09
E	ECON J	**0.64**	-0.07	0.19	0.20	-0.15	-0.07	0.02	0.21
W	REV ECON STAT	**0.61**	-0.03	-0.06	-0.03	-0.12	-0.06	0.50	0.07
F	ECONOMETRICA	**0.57**	-0.19	-0.38	0.07	-0.02	-0.06	-0.03	-0.18
B	ADMIN SCI QUART	-0.16	**0.94**	-0.04	0.06	-0.04	-0.03	-0.05	-0.02
A	ACAD MANAGE J	-0.09	**0.90**	-0.05	0.06	0.05	0.02	0.02	-0.03
Z	STRATEGIC MANAGE J	-0.03	**0.85**	0.05	0.25	0.06	0.10	0.06	-0.03
D	CALIF MANAGE REV	-0.23	**0.60**	0.43	-0.09	0.44	0.25	0.02	-0.07
Q	ORGAN STUD	-0.18	**0.54**	-0.03	-0.27	-0.21	-0.04	-0.14	0.00
V	RES POLICY	-0.06	0.08	**0.82**	0.24	-0.09	-0.11	-0.06	0.09
J	INT J TECHNOL MANAGE	-0.09	-0.05	**0.78**	-0.09	0.16	0.34	0.06	-0.01
S	R&D MANAGE	-0.18	-0.06	**0.62**	-0.09	0.31	-0.03	-0.06	-0.11
T	RAND J ECON	0.11	-0.12	-0.04	**0.84**	-0.09	-0.08	0.04	-0.16
M	J IND ECON	-0.04	0.23	0.16	**0.80**	-0.11	-0.08	0.45	0.08
K	J ECON BEHAV ORGAN	0.28	0.19	-0.01	**0.56**	0.00	-0.04	-0.26	0.07
O	J PROD INNOVAT MANAG	-0.20	-0.05	0.17	-0.19	**0.77**	-0.13	-0.03	-0.09
H	IEEE T ENG MANAGE	-0.22	-0.06	0.30	-0.10	**0.67**	0.01	-0.09	-0.08
X	SCIENTOMETRICS	-0.22	-0.13	0.28	-0.15	**-0.48**	-0.26	-0.17	-0.29
P	MANAGE SCI	-0.15	0.15	-0.15	0.27	**0.40**	0.18	-0.27	0.00
I	INT J OPER PROD MAN	-0.15	-0.07	0.01	-0.09	-0.08	**0.89**	-0.07	-0.04
G	HARVARD BUS REV	-0.23	0.51	0.28	-0.07	0.21	**0.73**	-0.01	-0.05
Y	SMALL BUS ECON	-0.05	-0.04	-0.06	0.08	-0.04	-0.03	**0.86**	0.02
U	REG STUD	-0.07	-0.11	0.01	-0.07	-0.08	-0.07	0.03	**0.92**

Appendix C-II.20 – *Research Policy Factor Loadings – Cited 2000*

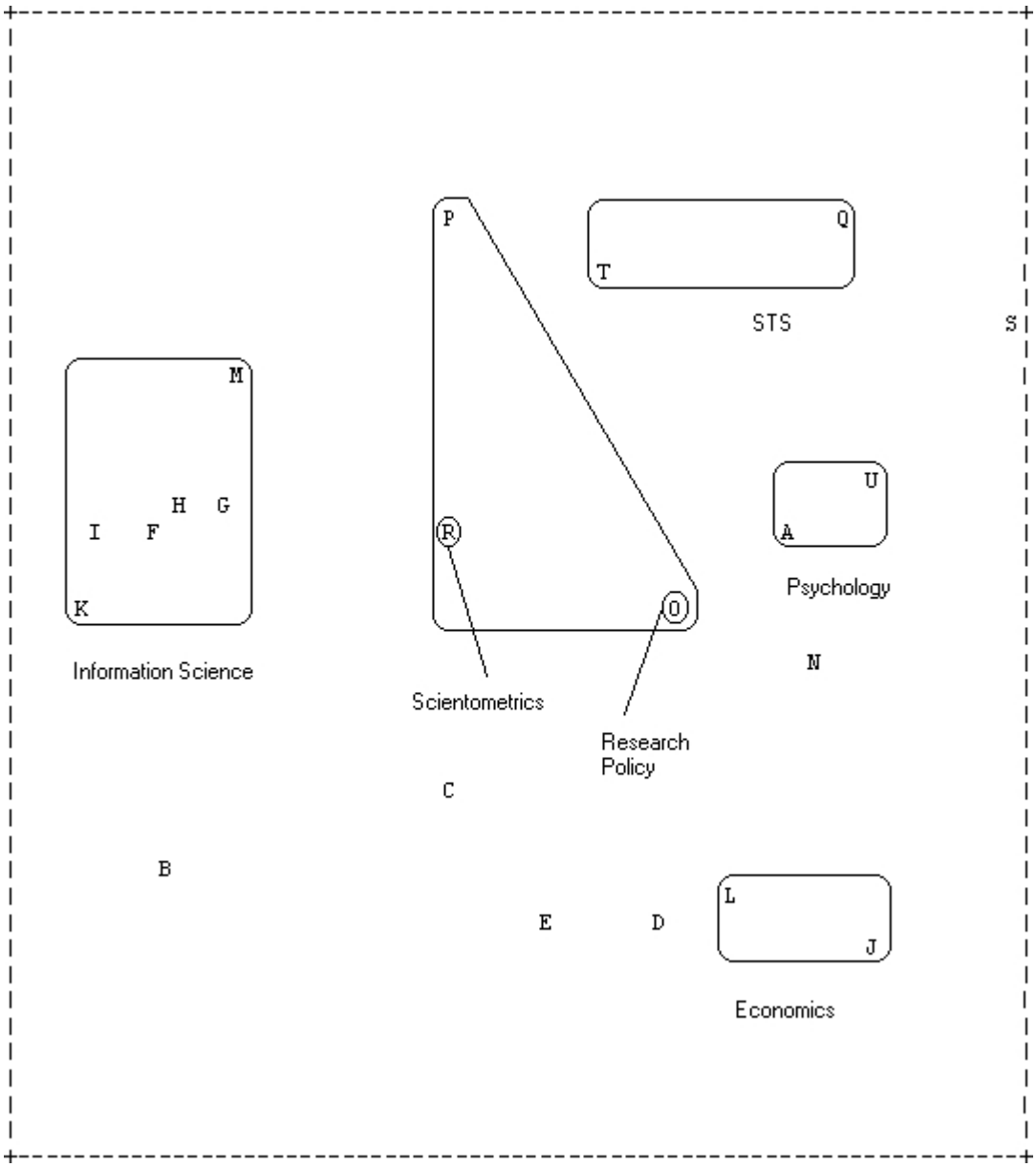
Appendix C-III: Archive of Journal Publication – *Scientometrics*



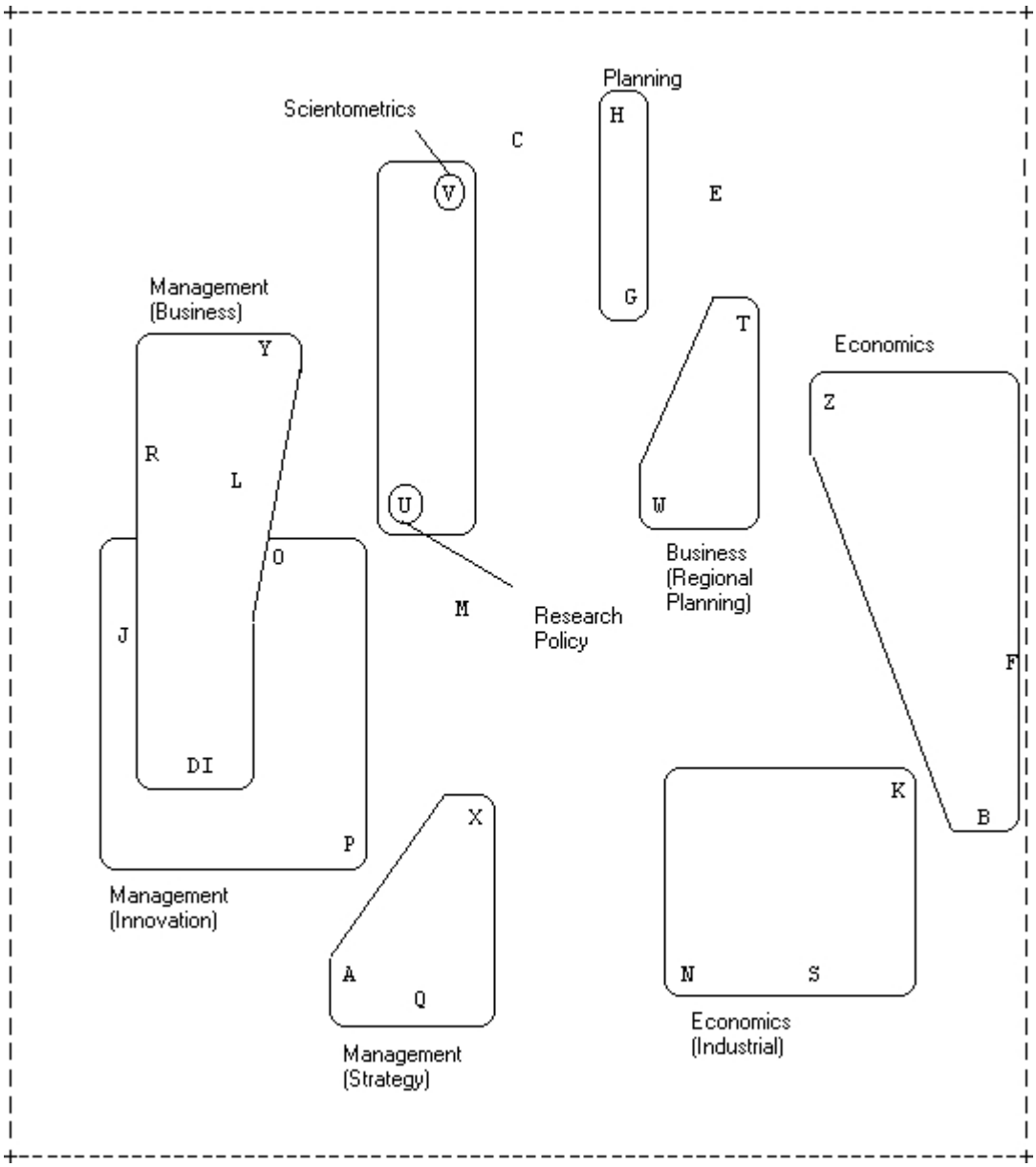
Appendix C-III.1 **–** Scientometrics Scaling Plot – Citing 1996



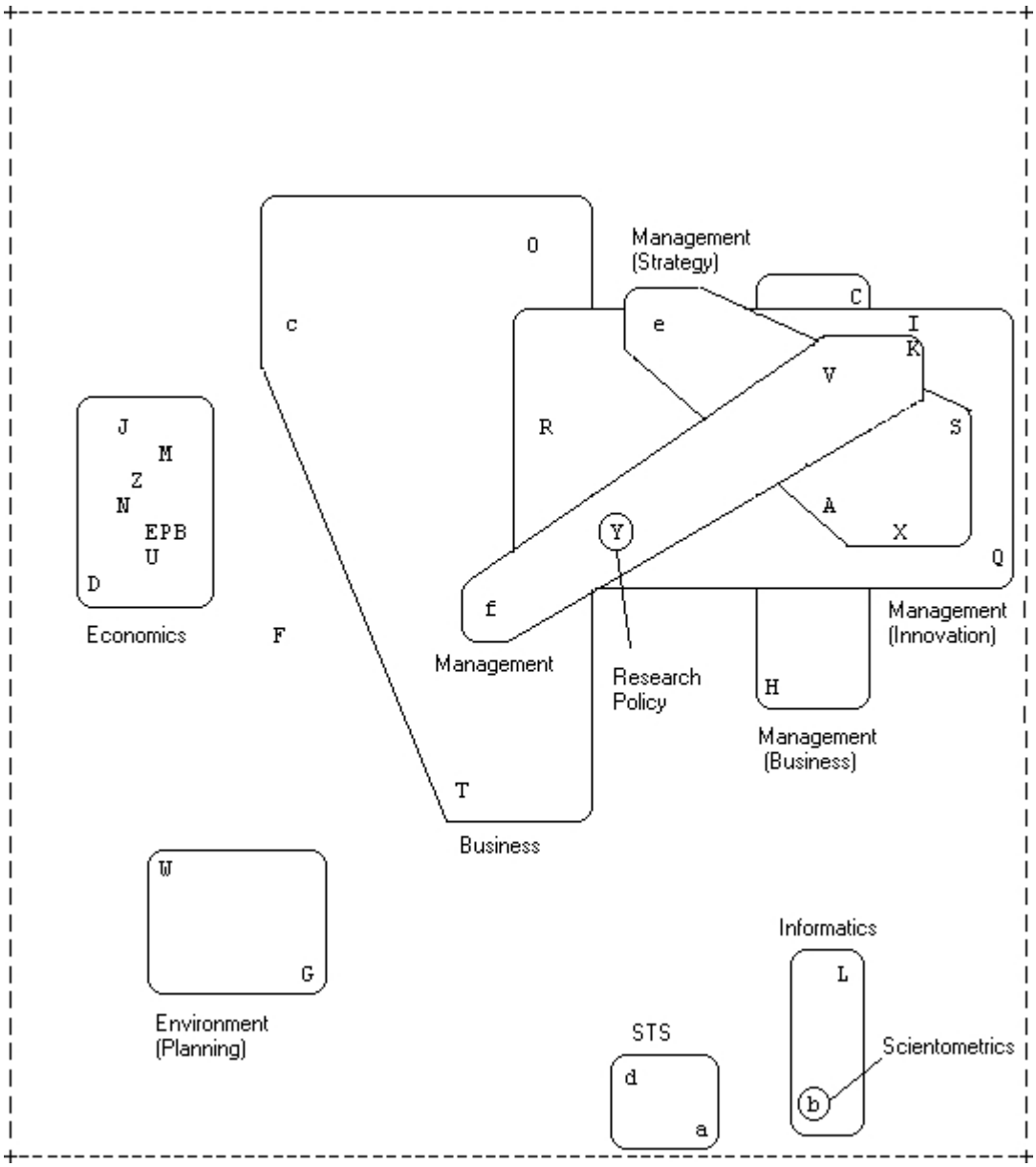
Appendix C-III.2 – *Scientometrics Scaling Plot – Cited 1996*



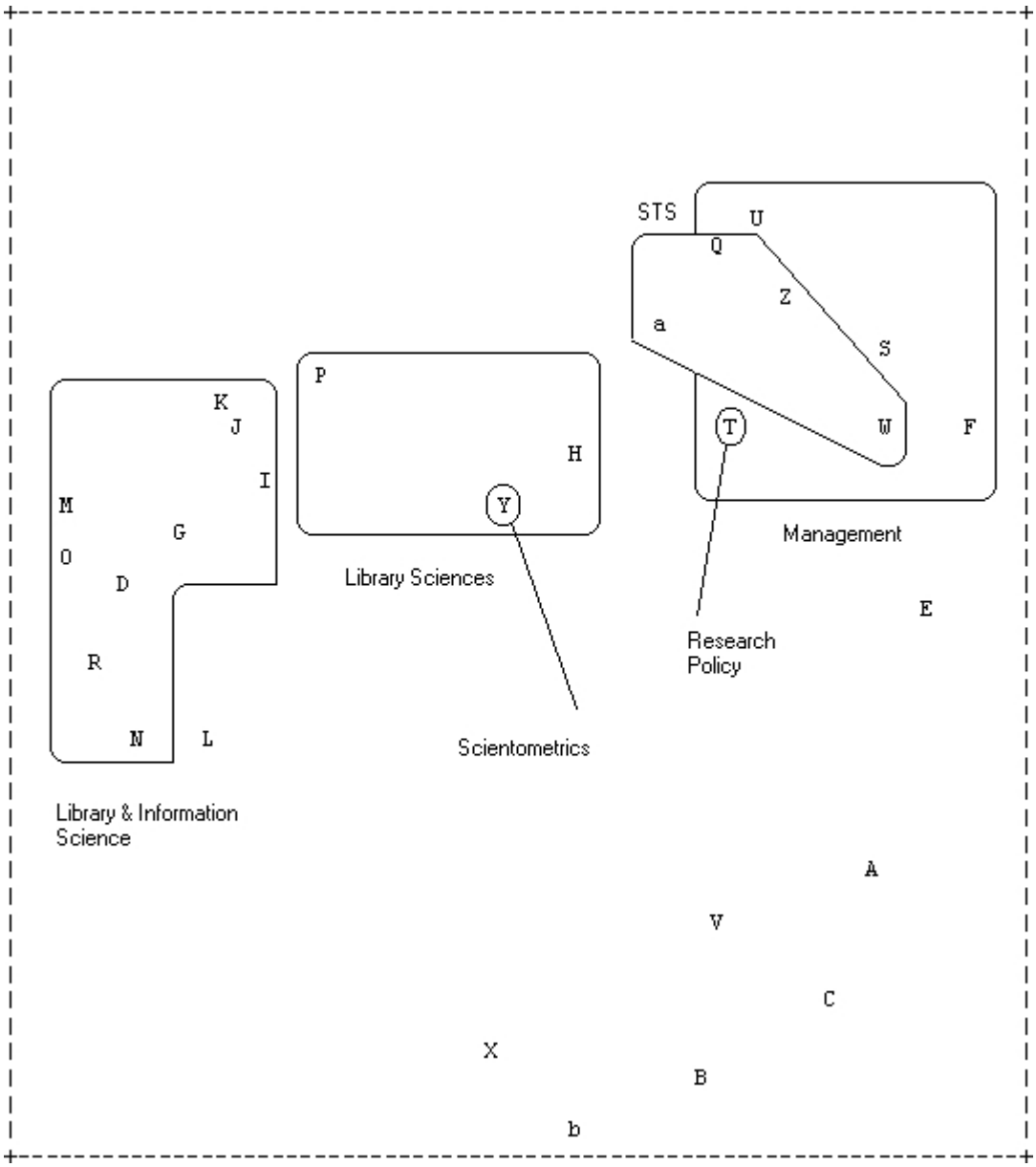
Appendix C-III.3 – *Scientometrics Scaling Plot – Citing 1997*



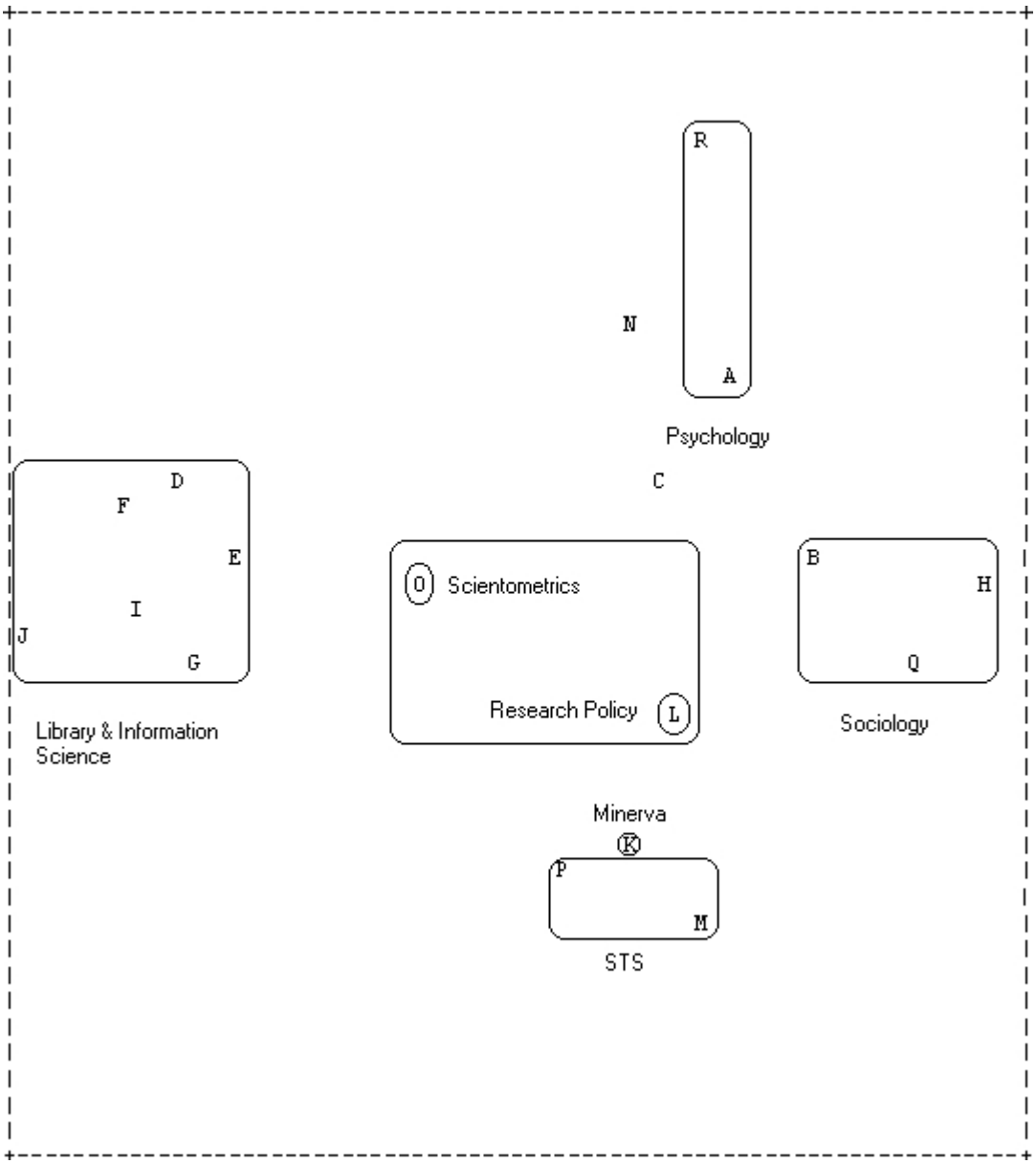
Appendix C-III.4 – *Scientometrics Scaling Plot – Cited 1997*



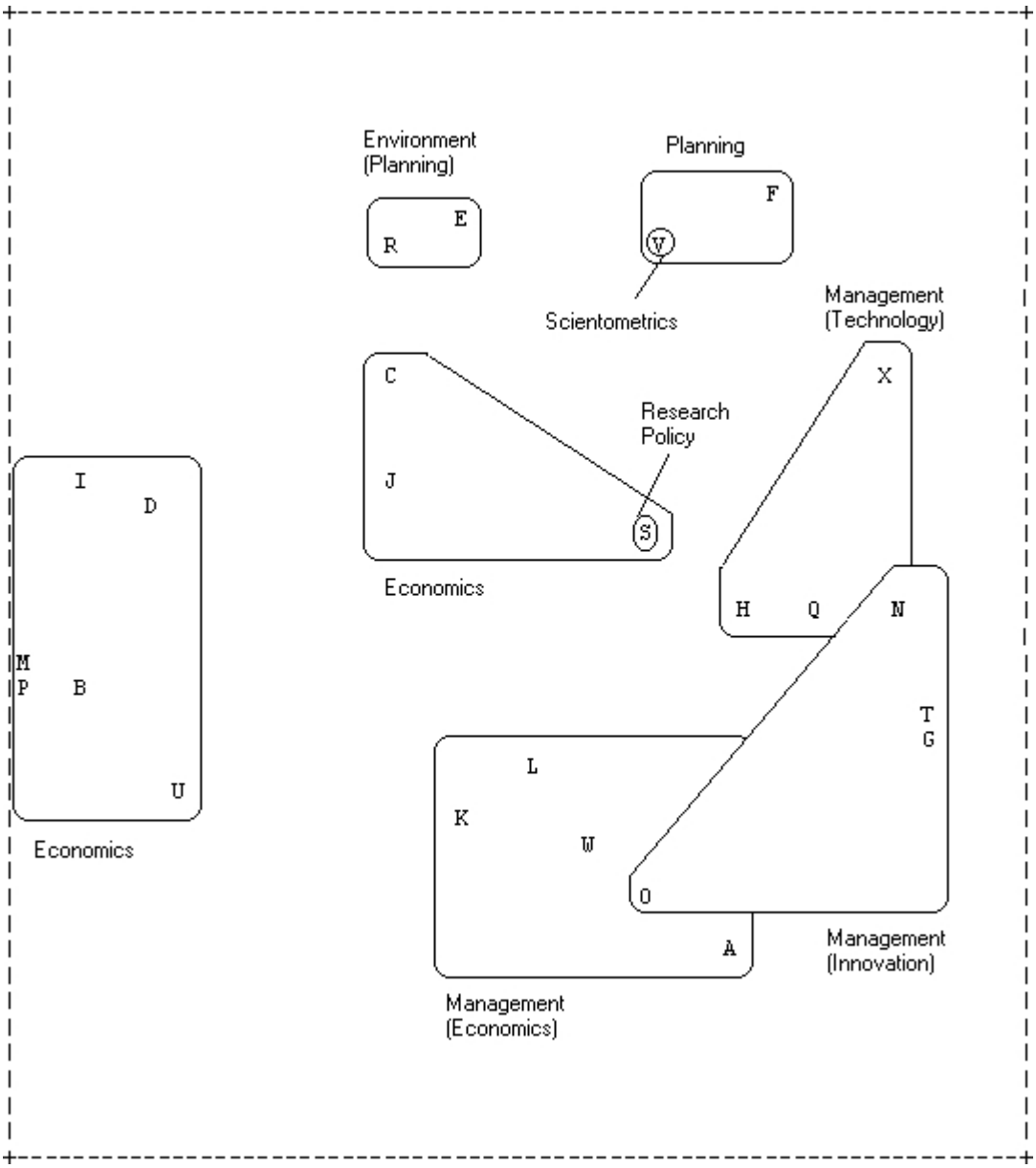
Appendix C-III.5 – *Scientometrics Scaling Plot – Citing 1998*



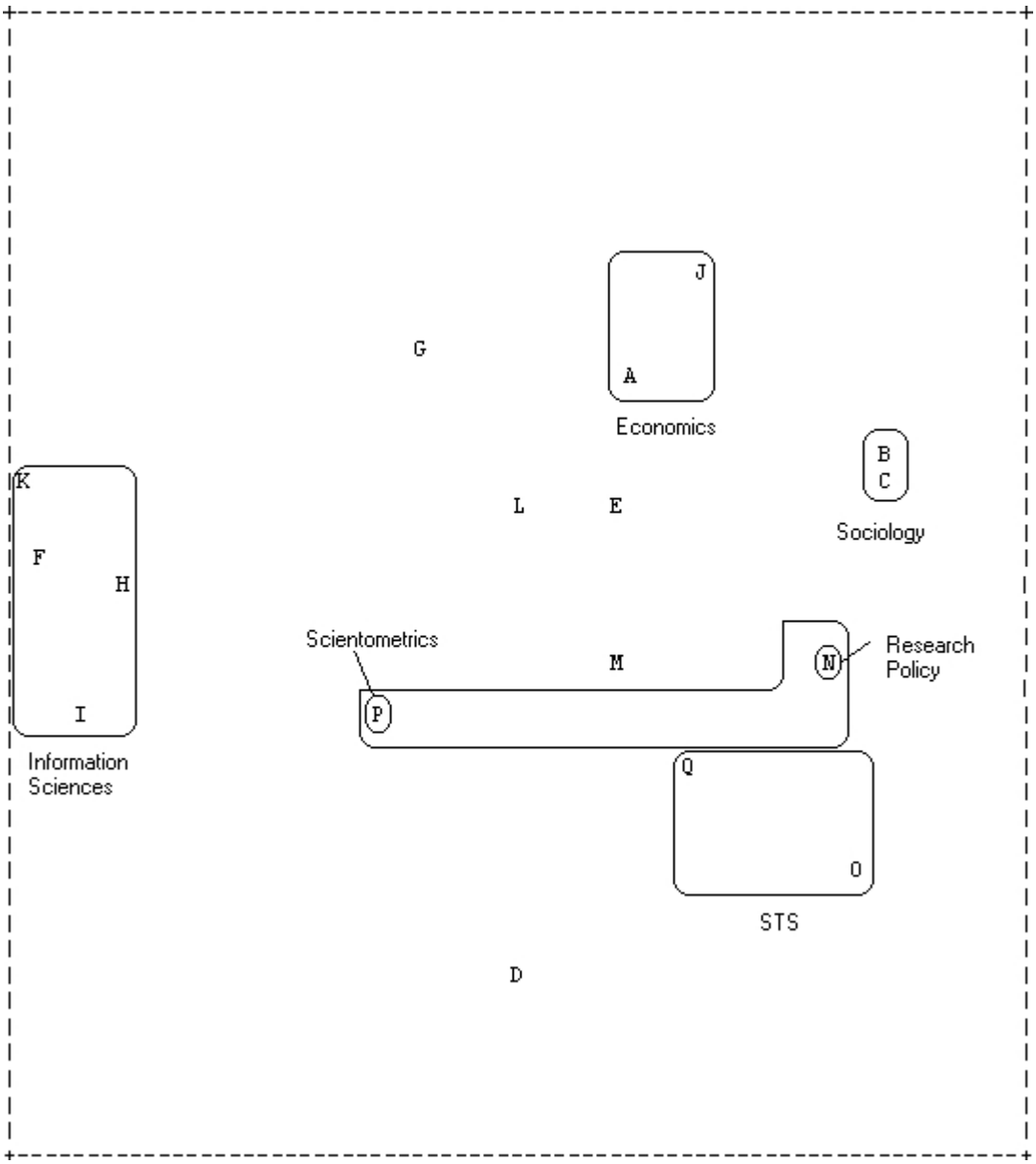
Appendix C-III.6 – *Scientometrics Scaling Plot – Cited 1998*



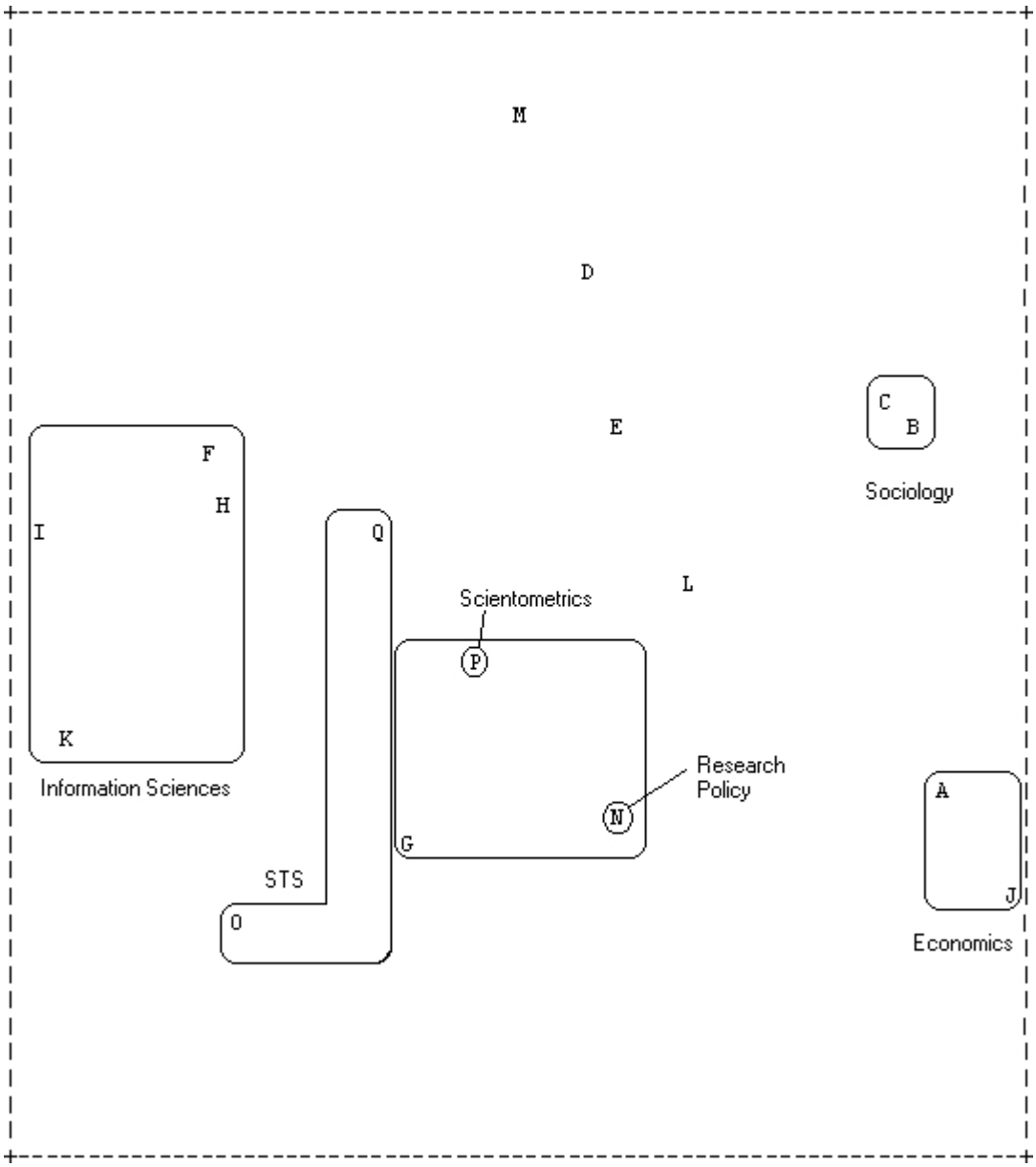
Appendix C-III.7 – *Scientometrics Scaling Plot – Citing 1999*



Appendix C-III.8 – *Scientometrics Scaling Plot – Cited 1999*



Appendix C-III.9 – *Scientometrics Scaling Plot – Citing 2000*



Appendix C-III.10 – *Scientometrics Scaling Plot – Cited 2000*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
D	ANNU REV SOCIOL	**0.99**	-0.08	-0.02	-0.03	0.00	-0.05	-0.02	0.02	-0.05	-0.01	0.02
Y	SOC FORCES	**0.99**	-0.07	-0.03	-0.03	0.01	-0.04	0.00	0.02	0.01	0.00	0.01
B	AM J SOCIOL	**0.98**	-0.06	0.00	-0.01	0.03	-0.03	0.00	0.01	0.01	0.00	0.01
C	AM SOCIOL REV	**0.97**	-0.05	-0.01	-0.02	0.01	-0.04	-0.02	0.01	-0.04	0.01	0.02
K	J AM SOC INFORM SCI	-0.04	**0.94**	-0.05	-0.04	-0.04	0.07	0.06	0.00	0.03	0.03	0.03
I	INFORM PROCESS MANAG	-0.06	**0.92**	-0.06	-0.05	-0.10	-0.01	0.07	-0.03	0.03	0.03	0.02
L	J DOC	-0.08	**0.87**	-0.07	-0.04	-0.10	0.19	0.06	0.01	0.03	0.03	0.02
N	J INFORM SCI	-0.08	**0.58**	-0.08	-0.10	-0.12	0.39	0.06	0.00	0.18	0.01	0.01
O	LIBR TRENDS	-0.07	**0.44**	-0.03	-0.15	0.13	-0.05	0.00	0.29	0.00	0.02	0.00
M	J ECON LIT	0.00	-0.04	**0.97**	-0.03	0.00	0.00	0.02	0.01	0.01	0.02	0.02
A	AM ECON REV	0.00	-0.03	**0.97**	-0.04	-0.03	-0.01	0.02	0.02	0.01	0.02	0.02
T	REV ECON	-0.02	-0.07	**0.92**	-0.09	-0.06	-0.04	0.03	0.02	0.00	0.01	0.01
b.	TECHNOL FORECAST SOC	-0.05	-0.10	**0.43**	0.24	-0.11	-0.08	0.07	-0.01	0.06	0.00	0.00
S	RES TECHNOL MANAGE	-0.01	-0.09	-0.08	**0.84**	-0.08	-0.07	0.05	0.02	0.07	0.02	0.01
R	RES POLICY	-0.04	-0.07	0.07	**0.82**	0.12	0.18	0.05	0.05	0.03	0.04	0.03
H	IEEE T ENG MANAGE	-0.02	-0.08	0.00	**0.79**	-0.10	-0.08	0.05	0.01	-0.04	0.03	0.03
V	SCI TECHNOL HUM VAL	0.01	-0.08	-0.07	-0.09	**0.94**	0.02	0.02	-0.11	0.01	0.04	0.04
a.	SOC STUD SCI	-0.09	-0.04	-0.04	-0.06	**0.92**	-0.06	0.05	-0.03	0.00	0.04	0.04
Z	SOC SCI INFORM	0.25	-0.14	-0.11	0.09	**0.52**	0.07	0.10	0.23	0.12	0.01	-0.01
J	INT FORUM INFORM DOC	-0.06	0.18	-0.06	-0.05	-0.04	**0.96**	0.01	0.02	0.02	0.02	0.02
X	SCIENTOMETRICS	-0.06	0.11	-0.04	0.06	0.07	**0.96**	0.01	0.02	0.01	0.02	0.01
F	HIGH EDUC	-0.04	-0.09	-0.07	-0.10	-0.05	0.02	**-0.73**	0.06	0.03	0.04	0.02
Q	RES HIGH EDUC	0.06	-0.09	-0.04	-0.03	-0.07	-0.05	**-0.72**	0.00	0.05	0.05	0.05
P	MINERVA	-0.07	-0.09	-0.06	-0.09	0.04	-0.04	0.08	**-0.92**	0.05	0.05	0.04
E	EVALUATION REV	0.05	-0.11	-0.08	-0.07	-0.09	-0.03	0.10	0.05	**-0.94**	0.08	0.07
G	HUM COMMUN RES	-0.03	-0.14	-0.08	-0.13	-0.12	-0.04	0.15	0.07	0.11	**-0.89**	0.12
W	SCIENTIST	-0.08	-0.15	-0.09	-0.14	-0.14	-0.05	0.17	0.08	0.13	0.16	**-0.86**
V	SCI TECHNOL HUM VAL	-0.11	-0.23	-0.14	-0.22	-0.22	-0.04	0.30	0.19	0.31	0.45	**0.52**

Appendix C-III.11 – *Scientometrics Factor Loadings – Citing 1996*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
D	ANNU REV SOCIOL	**0.96**	-0.07	0.01	-0.08	-0.05	-0.05	0.05	0.05	0.02	0.02	0.02
Y	SOC FORCES	**0.96**	-0.08	-0.02	-0.09	-0.07	-0.05	0.03	0.00	0.02	0.02	0.02
B	AM J SOCIOL	**0.95**	-0.11	-0.05	-0.07	-0.03	-0.04	0.05	0.02	0.03	0.01	0.02
C	AM SOCIOL REV	**0.95**	-0.08	-0.05	-0.07	-0.02	-0.04	0.03	0.03	0.02	0.02	0.02
K	J AM SOC INFORM SCI	-0.06	**0.94**	0.06	-0.04	-0.05	0.00	0.05	0.03	0.02	0.02	0.02
L	J DOC	-0.09	**0.91**	0.03	-0.07	-0.08	-0.04	0.05	0.01	0.02	0.02	0.02
I	INFORM PROCESS MANAG	-0.07	**0.91**	-0.08	-0.06	-0.06	-0.02	0.05	0.08	0.02	0.02	0.01
N	J INFORM SCI	-0.10	**0.72**	0.41	-0.08	-0.07	-0.04	0.03	0.02	0.00	0.01	0.02
O	LIBR TRENDS	-0.10	**0.51**	-0.12	-0.06	-0.09	-0.08	0.06	-0.45	0.07	0.05	0.05
J	INT FORUM INFORM DOC	0.00	0.09	**0.97**	0.05	0.04	0.07	-0.02	0.03	-0.03	0.00	0.03
X	SCIENTOMETRICS	-0.03	0.17	**0.95**	0.12	0.04	0.09	-0.02	0.04	-0.01	0.01	0.02
E	EVALUATION REV	-0.07	-0.14	**0.30**	0.15	-0.10	-0.11	0.10	0.01	0.02	-0.02	-0.06
S	RES TECHNOL MANAGE	-0.08	-0.07	0.16	**0.82**	-0.04	-0.03	0.04	0.00	-0.02	0.05	0.05
R	RES POLICY	-0.04	-0.02	0.12	**0.77**	0.14	0.18	0.04	0.09	0.09	0.03	0.03
H	IEEE T ENG MANAGE	-0.07	-0.07	0.01	**0.75**	-0.08	-0.11	0.05	-0.02	-0.05	0.04	0.04
b.	TECHNOL FORECAST SOC	-0.09	-0.07	-0.03	**0.33**	-0.03	0.03	0.05	0.21	0.16	-0.06	-0.05
M	J ECON LIT	0.00	-0.11	0.00	0.17	**0.93**	0.01	0.08	0.12	0.04	0.04	0.03
A	AM ECON REV	-0.06	-0.08	-0.11	-0.09	**0.89**	-0.05	0.05	0.15	0.01	0.01	0.02
T	REV ECON	-0.09	-0.09	0.08	-0.09	**0.52**	-0.10	0.06	-0.22	0.03	0.04	0.03
V	SCI TECHNOL HUM VAL	-0.10	-0.08	0.01	0.06	-0.07	**0.97**	0.06	-0.07	-0.03	0.03	0.03
a.	SOC STUD SCI	-0.07	-0.04	0.06	-0.03	-0.06	**0.97**	0.04	-0.03	-0.01	0.02	0.02
Q	RES HIGH EDUC	-0.04	-0.07	-0.06	-0.05	-0.06	-0.04	**-0.75**	0.06	0.02	0.00	-0.01
F	HIGH EDUC	-0.10	-0.10	0.03	-0.10	-0.09	-0.05	**-0.71**	0.03	0.06	0.08	0.08
Z	SOC SCI INFORM	-0.08	-0.16	-0.05	-0.14	-0.05	0.15	0.11	**-0.82**	0.10	0.06	0.06
P	MINERVA	-0.12	-0.12	0.02	-0.12	-0.10	0.03	0.12	0.11	**-0.91**	0.09	0.09
G	HUM COMMUN RES	-0.11	-0.11	0.02	-0.12	-0.12	-0.08	0.13	0.12	0.11	**-0.89**	0.13
U	REV SAUDE PUBL	-0.12	-0.12	0.00	-0.13	-0.13	-0.08	0.14	0.13	0.13	0.14	**-0.88**
W	SCIENTIST	-0.19	-0.19	0.00	-0.23	-0.22	-0.13	0.26	0.34	0.36	0.44	**0.48**

Appendix C-III.12 – *Scientometrics Factor Loadings – Cited 1996*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9
H	J AM SOC INFORM SCI	**0.96**	-0.04	0.09	-0.02	-0.08	-0.04	0.05	0.01	0.01
F	INFORM PROCESS MANAG	**0.92**	-0.03	-0.02	-0.07	-0.10	-0.02	0.04	-0.01	0.01
I	J DOC	**0.85**	-0.07	0.00	-0.10	0.04	-0.06	0.05	-0.02	0.03
K	J INFORM SCI	**0.71**	-0.07	0.29	-0.13	0.50	-0.17	0.16	-0.10	-0.10
M	LIBR QUART	**0.70**	-0.02	-0.07	0.08	0.06	-0.04	0.04	0.07	0.05
G	INT FORUM INFORM DOC	**0.68**	-0.05	0.48	0.05	0.44	-0.09	0.11	0.06	0.05
U	SUBST USE MISUSE	-0.10	**0.95**	0.03	-0.01	-0.04	0.08	0.05	0.03	0.03
A	AM PSYCHOL	-0.07	**0.95**	-0.05	0.05	-0.04	0.04	0.03	0.02	0.02
R	SCIENTOMETRICS	0.16	-0.01	**0.89**	0.03	0.06	-0.09	0.07	0.02	0.02
P	SCI COMMUN	0.10	0.27	**0.59**	0.44	-0.11	-0.24	0.09	0.04	0.02
O	RES POLICY	-0.19	-0.16	**0.51**	-0.18	-0.16	0.24	-0.03	-0.01	0.04
T	SOC STUD SCI	-0.04	-0.21	0.05	**0.84**	-0.05	0.09	0.10	0.06	0.06
Q	SCI TECHNOL HUM VAL	-0.15	0.43	-0.07	**0.73**	-0.07	-0.04	0.09	0.04	0.04
B	ASLIB PROC	0.00	-0.08	-0.12	-0.10	**0.95**	-0.07	0.08	0.06	0.06
S	SOC SCI INFORM	-0.19	-0.11	-0.02	0.23	-0.11	**0.78**	0.15	0.08	0.08
N	PSYCHOL REV	-0.05	0.22	-0.05	-0.17	-0.03	**0.70**	0.12	0.07	0.05
J	J ECON EDUC	-0.11	-0.02	-0.08	-0.07	-0.05	-0.12	**-0.71**	0.06	0.06
L	J POLIT ECON	-0.09	-0.06	-0.01	-0.08	-0.05	-0.07	**-0.68**	0.06	0.06
C	B MED LIBR ASSOC	-0.07	-0.07	-0.05	-0.12	-0.08	-0.15	0.17	**-0.92**	0.11
D	COLLEGIUM ANTROPOL	-0.19	-0.13	-0.12	-0.28	-0.24	-0.39	0.42	**0.43**	0.42
E	DATABASE	-0.11	-0.07	-0.08	-0.12	-0.07	-0.14	0.16	0.11	**-0.92**

Appendix C-III.13 – *Scientometrics Factor Loadings – Citing 1997*

	Journal	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8	F 9
H	J AM SOC INFORM SCI	**0.93**	0.10	0.02	0.05	0.06	0.03	0.03	0.00	0.03
F	INFORM PROCESS MANAG	**0.92**	0.10	-0.03	0.02	0.04	0.00	0.02	0.01	0.02
I	J DOC	**0.90**	0.01	0.00	0.07	0.06	0.04	0.03	-0.04	0.03
K	J INFORM SCI	**0.83**	0.20	-0.08	0.09	0.07	-0.19	0.04	0.00	0.03
M	LIBR QUART	**0.71**	-0.22	-0.04	0.07	0.04	0.10	0.00	0.00	0.00
B	ASLIB PROC	**0.66**	0.44	-0.05	0.04	0.05	-0.19	0.03	0.04	0.03
R	SCIENTOMETRICS	0.15	**0.85**	0.14	0.05	0.06	-0.01	0.05	0.04	0.04
G	INT FORUM INFORM DOC	0.61	**0.67**	0.08	0.02	0.04	-0.06	0.05	0.05	0.04
O	RES POLICY	-0.21	**0.50**	-0.13	0.14	0.02	0.44	-0.05	-0.09	-0.01
Q	SCI TECHNOL HUM VAL	-0.13	-0.04	**0.88**	0.10	0.09	0.04	-0.04	0.03	0.04
T	SOC STUD SCI	-0.01	0.14	**0.87**	0.06	0.09	0.08	0.08	0.04	0.05
N	PSYCHOL REV	-0.11	-0.04	-0.06	**-0.76**	0.09	0.05	0.06	0.03	0.11
A	AM PSYCHOL	-0.10	-0.06	-0.07	**-0.71**	0.06	-0.01	0.02	0.04	-0.05
L	J POLIT ECON	-0.11	-0.02	-0.11	0.08	**-0.71**	0.09	0.02	0.03	0.05
J	J ECON EDUC	-0.09	-0.06	-0.04	0.07	**-0.68**	-0.08	0.07	0.05	0.05
E	DATABASE	0.16	0.20	-0.07	0.12	0.11	**-0.75**	0.11	0.00	0.05
S	SOC SCI INFORM	0.15	0.16	0.09	0.02	0.09	**0.45**	0.14	0.04	0.04
P	SCI COMMUN	-0.10	-0.06	-0.05	0.10	0.12	-0.02	**-0.94**	0.08	0.08
C	B MED LIBR ASSOC	-0.06	-0.08	-0.15	0.17	0.20	0.01	0.15	**-0.85**	0.16
D	COLLEGIUM ANTROPOL	-0.18	-0.17	-0.27	0.30	0.34	0.08	0.30	**0.55**	0.35
U	SUBST USE MISUSE	-0.11	-0.07	-0.11	0.07	0.13	0.01	0.09	0.09	**-0.93**

Appendix C-III.14 – *Scientometrics Factor Loadings – Cited 1997*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
R	P ASIS ANNU MEET	**0.97**	0.07	-0.05	-0.02	0.01	-0.02	-0.05	-0.02	0.03	0.00	0.00
I	J AM SOC INFORM SCI	**0.96**	0.08	0.01	0.03	0.01	0.00	0.04	0.00	0.03	0.02	0.01
G	INFORM PROCESS MANAG	**0.95**	0.05	-0.04	-0.03	-0.02	-0.03	-0.03	-0.03	0.03	0.00	0.00
D	ANNU REV INFORM SCI	**0.94**	0.09	-0.05	-0.03	-0.08	-0.03	0.08	-0.04	0.05	0.01	0.00
K	J INFORM SCI	**0.94**	0.09	-0.08	0.01	-0.05	-0.04	0.00	-0.03	0.03	0.00	0.00
J	J DOC	**0.88**	0.03	-0.08	-0.06	-0.03	-0.05	0.07	-0.01	0.00	0.01	0.01
N	LIBR RESOUR TECH SER	**0.83**	0.19	-0.07	-0.10	-0.05	-0.05	0.01	-0.08	-0.14	0.03	0.05
L	KNOWL ORGAN	**0.80**	0.27	-0.05	-0.10	0.12	-0.05	0.25	-0.06	0.01	0.03	0.04
O	LIBR TRENDS	0.07	**0.94**	-0.06	-0.08	0.00	0.05	-0.09	0.01	0.03	0.05	0.04
M	LIBR QUART	0.33	**0.83**	-0.04	-0.12	-0.01	-0.06	-0.11	-0.09	0.00	0.03	0.04
P	LIBRI	0.34	**0.59**	-0.19	0.19	-0.17	-0.13	0.11	-0.05	0.09	0.02	0.01
T	RES POLICY	-0.06	-0.07	**0.90**	0.04	-0.07	-0.06	0.12	0.01	0.04	0.05	-0.09
S	R&D MANAGE	-0.12	-0.08	**0.75**	-0.14	-0.10	-0.15	-0.04	0.26	0.03	-0.13	0.06
Q	MINERVA	-0.10	-0.06	**0.68**	0.24	0.06	0.18	-0.10	-0.21	-0.01	0.12	0.02
W	SCI TECHNOL HUM VAL	-0.10	-0.07	0.01	**0.87**	0.12	-0.05	-0.08	-0.05	0.02	-0.01	0.03
a.	SOC STUD SCI	-0.10	-0.01	0.05	**0.86**	-0.03	0.00	0.06	-0.03	0.03	0.04	0.03
B	AM PSYCHOL	-0.06	-0.05	-0.04	-0.14	**0.93**	-0.06	0.09	-0.05	0.01	0.00	0.02
V	SCI COMMUN	0.00	-0.06	-0.08	0.34	**0.87**	0.13	0.06	0.14	0.04	0.06	0.04
Z	SOC SCI INFORM	-0.10	-0.07	-0.06	-0.07	-0.09	**0.84**	-0.02	-0.05	0.02	-0.01	0.03
C	AM SOCIOL REV	-0.06	0.01	0.01	0.03	0.12	**0.83**	-0.04	0.09	0.03	0.05	0.00
b.	TURK PSIKOL DERG	-0.09	-0.09	-0.11	-0.17	0.29	-0.08	**0.82**	-0.09	0.03	0.03	0.04
Y	SCIENTOMETRICS	0.37	-0.05	0.12	0.16	-0.11	-0.01	**0.80**	-0.03	0.05	0.05	0.05
A	ACAD MANAGE J	-0.07	-0.03	-0.11	-0.01	0.07	0.07	-0.05	**0.86**	0.03	0.09	0.02
F	IEEE T ENG MANAGE	-0.13	-0.09	0.46	-0.13	-0.03	-0.03	-0.06	**0.67**	0.04	-0.05	0.07
X	SCIENTIST	-0.07	-0.13	-0.10	-0.09	-0.08	-0.09	-0.10	-0.10	**-0.86**	0.15	0.14
H	INT FORUM INFORM DOC	-0.11	-0.22	-0.14	-0.17	-0.12	-0.16	-0.21	-0.21	**0.50**	0.45	0.40
U	RES TECHNOL MANAGE	-0.08	-0.11	-0.05	-0.06	-0.06	-0.07	-0.09	-0.09	0.12	**-0.88**	0.12
E	CAMBRIDGE J ECON	-0.09	-0.10	0.00	-0.09	-0.06	-0.04	-0.09	-0.08	0.10	0.11	**-0.91**

Appendix C-III.15 – *Scientometrics Factor Loadings – Citing 1998*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
G	INFORM PROCESS MANAG	**0.96**	-0.03	-0.01	-0.01	0.09	0.01	-0.03	-0.01	-0.03	-0.02
I	J AM SOC INFORM SCI	**0.93**	-0.03	0.15	0.01	-0.04	0.05	0.06	-0.01	0.07	0.07
J	J DOC	**0.86**	-0.06	0.31	-0.02	0.02	0.03	0.01	0.00	0.01	0.00
K	J INFORM SCI	**0.83**	-0.05	0.31	-0.03	0.30	0.04	0.02	-0.01	0.01	0.01
D	ANNU REV INFORM SCI	**0.78**	-0.06	-0.01	-0.07	0.54	0.05	0.04	-0.02	0.03	0.04
R	P ASIS ANNU MEET	**0.78**	-0.01	-0.16	-0.03	0.18	-0.06	-0.20	-0.01	-0.20	-0.16
M	LIBR QUART	**0.76**	-0.14	-0.04	-0.14	-0.14	0.16	0.27	0.00	0.23	0.22
N	LIBR RESOUR TECH SER	**0.55**	-0.09	-0.09	-0.09	-0.03	0.10	0.21	0.02	0.17	0.11
O	LIBR TRENDS	**0.46**	-0.19	0.08	-0.19	0.26	0.25	0.40	-0.06	0.38	0.36
S	R&D MANAGE	-0.06	**0.87**	0.05	-0.01	-0.05	0.03	0.05	0.01	0.02	0.02
F	IEEE T ENG MANAGE	-0.12	**0.83**	-0.01	-0.03	-0.01	-0.01	0.03	0.02	0.01	0.01
T	RES POLICY	-0.01	**0.80**	0.07	0.28	0.01	0.09	0.00	0.26	0.07	0.07
U	RES TECHNOL MANAGE	-0.09	**0.66**	0.58	0.11	-0.07	0.00	0.00	-0.05	-0.04	-0.04
H	INT FORUM INFORM DOC	0.03	0.07	**0.92**	0.15	-0.07	-0.02	-0.06	0.01	-0.04	-0.05
Y	SCIENTOMETRICS	0.26	0.16	**0.90**	0.20	-0.02	0.01	-0.03	0.03	0.00	0.00
P	LIBRI	0.17	-0.12	**0.55**	-0.10	0.31	0.17	0.25	0.00	0.23	0.22
a.	SOC STUD SCI	-0.03	-0.08	0.23	**0.84**	-0.02	-0.03	0.06	0.04	0.01	0.01
Q	MINERVA	-0.07	0.16	0.22	**0.77**	-0.06	0.07	0.00	0.01	0.03	0.04
W	SCI TECHNOL HUM VAL	-0.07	0.07	-0.16	**0.76**	-0.04	0.08	0.06	-0.15	0.04	0.04
Z	SOC SCI INFORM	-0.10	0.33	0.32	**0.40**	0.00	0.03	-0.05	0.32	-0.01	-0.01
L	KNOWL ORGAN	0.22	-0.05	-0.03	-0.08	**0.90**	0.05	0.05	-0.01	0.04	0.03
A	ACAD MANAGE J	-0.08	0.05	-0.02	-0.12	-0.06	**-0.70**	0.15	-0.17	0.02	0.03
C	AM SOCIOL REV	-0.11	-0.14	-0.02	0.00	0.00	**-0.66**	-0.10	0.16	0.10	0.10
B	AM PSYCHOL	-0.10	-0.12	0.02	-0.16	-0.06	0.08	**-0.77**	-0.04	0.15	0.14
V	SCI COMMUN	-0.12	0.00	-0.10	0.12	-0.03	0.18	-0.22	**-0.68**	0.09	0.11
E	CAMBRIDGE J ECON	-0.12	0.21	-0.10	0.02	-0.05	0.19	-0.17	**0.64**	0.08	0.09
b.	TURK PSIKOL DERG	-0.12	-0.11	-0.01	-0.12	-0.05	0.18	0.16	0.01	**-0.85**	0.17
X	SCIENTIST	-0.10	-0.11	0.00	-0.11	-0.05	0.17	0.14	0.01	0.15	**-0.87**

Appendix C-III.16 – *Scientometrics Factor Loadings – Cited 1998*

Tag	Journal	F 1	F 2	F 3	F 4	F 5	F 6	F 7
I	LIBR TRENDS	**0.97**	-0.07	-0.04	-0.04	0.09	0.02	0.01
G	J INFORM SCI	**0.94**	-0.06	0.02	-0.01	0.12	0.02	0.01
D	INFORM PROCESS MANAG	**0.93**	-0.03	-0.06	-0.02	0.02	-0.06	-0.01
E	J AM SOC INFORM SCI	**0.92**	-0.03	-0.02	0.00	0.09	-0.03	0.00
F	J DOC	**0.80**	-0.10	-0.12	-0.12	-0.12	-0.02	-0.01
J	LIBRI	**0.69**	-0.18	-0.07	-0.18	-0.20	-0.06	-0.01
B	AM SOCIOL REV	-0.08	**0.94**	-0.01	0.00	-0.08	-0.07	-0.01
Q	SOCIOL FORSKNIN	-0.12	**0.88**	-0.08	-0.07	0.19	0.05	0.02
H	J QUANT CRIMINOL	-0.14	**0.88**	-0.05	-0.07	-0.14	-0.09	-0.02
M	SCI TECHNOL HUM VAL	-0.13	-0.06	**0.98**	-0.09	0.00	-0.02	-0.01
P	SOC STUD SCI	-0.09	-0.08	**0.97**	-0.07	-0.05	0.02	0.00
R	THEOR PSYCHOL	-0.15	-0.11	-0.10	**0.87**	-0.05	-0.05	0.00
A	AM PSYCHOL	-0.10	-0.03	-0.05	**0.85**	-0.05	-0.06	-0.01
L	RES POLICY	-0.19	-0.08	0.00	-0.11	**0.80**	-0.25	-0.05
O	SCIENTOMETRICS	0.27	0.03	-0.07	0.00	**0.66**	0.35	0.08
K	MINERVA	-0.16	-0.11	0.01	-0.11	-0.03	**0.91**	-0.02
C	COLLEGIUM ANTROPOL	-0.20	-0.17	-0.19	-0.22	-0.10	-0.18	**0.78**
N	SCIENTIST	-0.21	-0.18	-0.21	-0.24	-0.13	-0.20	**-0.67**

Appendix C-III.17 – *Scientometrics Factor Loadings – Citing 1999*

Tag	Journal	F 1	F 2	F 3	F 4	F 5	F 6	F 7	F 8
I	LIBR TRENDS	**0.92**	-0.05	-0.08	0.06	-0.06	-0.03	0.01	0.01
E	J AM SOC INFORM SCI	**0.92**	0.00	0.04	0.05	0.02	-0.04	0.04	0.03
F	J DOC	**0.89**	-0.06	0.07	0.08	0.02	0.07	0.03	0.03
G	J INFORM SCI	**0.87**	-0.01	0.24	0.08	0.12	0.09	0.05	0.04
D	INFORM PROCESS MANAG	**0.87**	-0.03	-0.03	0.04	-0.02	-0.08	0.02	0.02
J	LIBRI	**0.65**	-0.08	-0.23	0.06	-0.14	-0.04	-0.03	-0.01
P	SOC STUD SCI	-0.08	**0.98**	-0.04	0.09	-0.03	-0.02	0.04	0.04
M	SCI TECHNOL HUM VAL	-0.13	**0.98**	0.03	0.09	0.05	-0.02	0.04	0.04
H	J QUANT CRIMINOL	-0.13	-0.08	**0.79**	0.09	-0.06	-0.06	0.02	0.02
O	SCIENTOMETRICS	0.23	0.09	**0.64**	0.06	0.42	0.26	0.09	0.07
Q	SOCIOL FORSKNIN	-0.21	-0.22	**-0.39**	0.35	0.13	-0.05	0.37	0.33
A	AM PSYCHOL	-0.14	-0.09	0.03	**-0.72**	-0.08	-0.09	0.09	0.09
R	THEOR PSYCHOL	-0.12	-0.07	-0.12	**-0.71**	0.04	0.02	0.02	0.02
L	RES POLICY	-0.12	-0.02	0.05	0.06	**0.88**	-0.10	0.03	0.03
K	MINERVA	-0.13	-0.08	0.07	0.10	-0.10	**0.92**	0.08	0.08
B	AM SOCIOL REV	-0.24	-0.19	0.19	0.20	-0.37	**-0.42**	0.29	0.29
C	COLLEGIUM ANTROPOL	-0.16	-0.12	-0.06	0.15	-0.02	-0.06	**-0.91**	0.12
N	SCIENTIST	-0.15	-0.11	-0.04	0.14	-0.02	-0.06	0.10	**-0.93**

Appendix C-III.18 – *Scientometrics Factor Loadings – Cited 1999*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7	F8
H	J AM SOC INFORM SCI	**0.94**	-0.05	-0.06	-0.05	-0.06	0.01	0.03	0.03
F	INFORM PROCESS MANAG	**0.93**	-0.07	-0.03	-0.08	-0.06	-0.12	0.01	0.01
I	J DOC	**0.91**	-0.10	-0.07	-0.03	-0.07	-0.01	0.03	0.03
K	J INFORM SCI	**0.90**	-0.10	-0.11	-0.15	-0.09	0.09	0.07	0.06
B	AM J SOCIOL	-0.14	**0.98**	-0.02	-0.05	-0.04	-0.08	0.02	0.04
C	AM SOCIOL REV	-0.14	**0.98**	-0.04	0.00	-0.04	-0.08	0.02	0.04
J	J ECON LIT	-0.12	-0.03	**0.97**	-0.09	-0.08	0.00	0.04	0.03
A	AM ECON REV	-0.10	-0.03	**0.97**	-0.08	-0.07	0.00	0.04	0.04
O	SCI TECHNOL HUM VAL	-0.16	-0.09	-0.09	**0.91**	-0.03	0.01	0.05	0.07
Q	SOC STUD SCI	-0.10	0.04	-0.08	**0.89**	-0.10	-0.09	0.06	0.03
D	DRUS ISTRAZ	-0.13	-0.16	-0.10	-0.13	**0.82**	-0.02	0.07	0.03
M	PUBLIC OPIN QUART	-0.11	0.06	-0.05	0.00	**0.76**	-0.14	0.02	0.07
P	SCIENTOMETRICS	0.13	-0.07	-0.20	-0.12	-0.04	**0.76**	0.09	0.06
N	RES POLICY	-0.21	-0.09	0.20	0.03	-0.15	**0.69**	0.03	0.06
E	HUM COMMUN RES	-0.16	-0.07	-0.12	-0.14	-0.12	-0.15	**-0.92**	0.11
L	J OPER RES SOC	-0.16	-0.12	-0.10	-0.13	-0.16	-0.15	0.12	**-0.91**
G	INTERLEND DOC SUPPLY	-0.26	-0.26	-0.24	-0.32	-0.36	-0.37	0.44	**0.46**

Appendix C-III.19 – *Scientometrics Factor Loadings – Citing 2000*

Tag	Journal	F1	F2	F3	F4	F5	F6	F7
H	J AM SOC INFORM SCI	**0.96**	-0.04	-0.06	0.02	0.00	0.05	0.02
I	J DOC	**0.95**	-0.09	-0.09	-0.03	-0.03	0.05	0.02
F	INFORM PROCESS MANAG	**0.94**	-0.05	-0.06	-0.01	-0.10	0.04	0.02
K	J INFORM SCI	**0.84**	-0.09	-0.13	-0.06	0.26	0.09	0.02
C	AM SOCIOL REV	-0.11	**0.98**	-0.07	-0.04	-0.08	0.05	0.04
B	AM J SOCIOL	-0.13	**0.97**	-0.06	-0.06	-0.08	0.05	0.05
J	J ECON LIT	-0.17	-0.05	**0.94**	-0.10	-0.01	0.14	0.05
A	AM ECON REV	-0.12	-0.07	**0.88**	-0.15	-0.12	0.13	0.06
O	SCI TECHNOL HUM VAL	-0.05	-0.09	-0.06	**0.91**	0.13	0.09	0.03
Q	SOC STUD SCI	-0.01	0.00	-0.14	**0.86**	-0.05	0.09	0.04
P	SCIENTOMETRICS	0.21	-0.03	-0.03	0.16	**0.73**	0.06	-0.03
G	INTERLEND DOC SUPPLY	-0.13	-0.10	-0.23	-0.26	**0.70**	0.12	0.08
N	RES POLICY	-0.11	-0.08	0.33	0.27	**0.45**	0.04	0.01
M	PUBLIC OPIN QUART	-0.09	0.04	-0.16	-0.07	-0.11	**-0.74**	0.03
D	DRUS ISTRAZ	0.11	-0.17	-0.09	-0.12	-0.07	**-0.70**	0.09
E	HUM COMMUN RES	-0.15	-0.15	-0.18	-0.14	-0.10	0.19	**-0.89**
L	J OPER RES SOC	-0.22	-0.27	-0.33	-0.22	-0.28	0.44	**0.50**

Appendix C-III.20 – *Scientometrics Factor Loadings – Cited 2000*

Appendix D: Archive of Mailing List Analysis

Appendix D.1 – *Autopoiesis Mailing List*

List Name: autopoiesis@thinknet.orange.ca.us[11]
Listserver: listserve@thinknet.orange.ca.us

Description:

> The Autopoiesis mailing list provides an ongoing discussion about recent developments in the theory of Autopoiesis. Originally a descriptive term developed by Maturana and Varela to describe the self-organizing properties of the brain, the theory has become of increasing import to the Social Sciences, Humanities, and Science & Technology Studies. Of particular interest is the theory of autopoietic social systems developed by Niklas Luhmann through which a black-boxing of the social (the micro-action level of individuals) permits a higher order analysis of the distribution of mediated communications. The primary aim of this list is to discuss these and other important aspects of Autopoietic Theory for both the natural and social sciences.

Web Archives: http://www.webconn.com/mail/autopoiesis/
Period of Observation: 9 / 5 / 96 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
551	300	653	1.19	39.33	66.92	26.67

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
7.78	2.22	75.56	14.44	0	0

Topic Distribution of Total Messages (%)

[11] In many cases the urls provided for each listserver (and their respective archives) have expired. This is often due to a change of listserver hosts, or in the case of the Greeks lists, the lists themselves have become obsolete. The Autopoiesis list has continued at autopoiesis@dialogue.net / listserv@dialog.net.

Appendix D.2 – *CYBERURBANITY Mailing List*

List Name: cyberurbanity@demokritos.cc.duth.gr
Listserver: listproc@demokritos.cc.duth.gr

Description:

> CYBERURBANITY is a discussion mailing list about the interaction of the cyber-spatial perspective (as Net Culture, Virtual Communities, Digital Politics, Medialogy, Hypertextuality, etc.) with classical space concepts (Urban Space Syntax, Critical Theory and Late/Post-Modernism, Environmental Studies, etc.).

Web Archives: http://platon.ee.duth.gr/data/maillist-archives/cyberurbanity/
Period of Observation: 30 / 5 / 95 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
1255	68	1151	0.92	32.35	17.81	23.53

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
37.31	0	44.78	7.46	1.49	8.96

Topic Distribution of Total Messages (%)

Appendix D.3 – *DEUKALION Mailing List*

List Name: deukalion@platon.ee.duth.gr
Listserver: listproc@platon.ee.duth.gr

Description:

> DEUKALION is a discussion list about the life sciences, and the technology and culture coming into being from them. This is an interdisciplinary area spanning a variety of disciplines such as biology, medicine, anthropology, sociology, and philosophy. Topics of discussion include evolution, biotechnology, bio-ethics, genetics, cloning, the human genome project, AIDS, neurosciences, artificial life, evolutionary and computational epistemology, sociobiology, socio-cybernetics, ecology, complexity, etc. Although Greek is the language of the discussions in the Deukalion List, English is also used.

Web Archives: http://platon.ee.duth.gr/data/maillist-archives/deukalion/
Period of Observation: 8 / 4 / 97 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
577	51	580	1.01	29.41	15.86	11.76

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
2.17	0	96.74	1.09	0	0

Topic Distribution of Total Messages (%)

Appendix D.4 – *ETK Mailing List*

List Name: etk@thrace.ee.duth.gr
Listserver: listproc@thrace.ee.duth.gr

Description:

> ETK is a mailing list about "Epistimi-Technologia-Koinonia" (i.e.: Science-Technology-Society). The discussion in this list aims to promote a collaboration between people working in this area. Some emphasis is placed upon the effects of communication information technologies in the global information and network society.

Web Archives: http://platon.ee.duth.gr/data/maillist-archives/etk/
Period of Observation: 11 / 5 / 97 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
544	41	558	1.03	12.20	13.62	2.44

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
3.95	1.32	94.74	0	0	0

Topic Distribution of Total Messages (%)

Appendix D.5 – *EuroCon-Knowflow Mailing List*

List Name: eurocon-knowflow@mailbase.ac.uk
Listserver: mailbase@mailbase.ac.uk

Description:

> The Eurocon-Knowflow mailing list is the discussion forum for the Self-Organization of the European Information Society (SOEIS) research project. The SOEIS is a collaborative project undertaken between six European research institutes, and is a European Union funded project under Targeted Socio-Economic Research (TSER). The project aims to describe social and economic organization with respect to the notion of networks of communication that evolve recursively and interactively among human actors as their reflexive carriers. The project analyzes Science & Technology policy options emerging from RTD networks, innovation and (trans-regional) development in SME-networks, and cultural dimensions added to these processes of change by new ways of communicating. The discussion list addresses these and other issues relevant to the concept of Self-Organization, and is open to any interested parties.

Web Archives: http://www.mailbase.ac.uk/lists/eurocon-knowflow/archive.html
Period of Observation: 17 / 6 / 96 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
872	110	672	0.77	72.73	56.25	42.27

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
8.42	66.02	17.89	0.60	6.32	0.75

Topic Distribution of Total Messages (%)

Appendix D.6 – *Luhmann Mailing List*

List Name: luhmann@listserv.gmd.de
Listserver: listserv@vm.gmd.de

Description:

> The Luhmann mailing list provides for discussion about the sociologist Niklas Luhmann's theory of the society which transfers the traditional paradigms of systems theory to sociological theory formation. One of the core thoughts of Luhmann's theory is the strict separation between the psychological and the social arena. Society is therefore no longer regarded from the point of individuals, but rather the communication between individuals. The theory of autopoietic social systems developed by Luhmann also considers that communication about society falls only within the society it takes place, thus there is no Archimedean point for their observations can lodge a complaint. The aim of this list is to discuss these and other aspects of Luhmann's theory.

Web Archives: http://sti1.uni-duisburg.de/Luhmann/home.html
Period of Observation: 17 / 9 / 90 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
2674	355	1553	0.58	77.46	76.69	54.93

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
3.65	0	58.90	30.59	3.65	3.32

Topic Distribution of Total Messages (%)

Appendix D.7 – *Principia Cybernetica Mailing List*

List Name: prncyb-l@bingvmb.cc.binghamton.edu
Listserver: listserv@bingvmb.cc.binghamton.edu

Description:

> Principia Cybernetica is the discussion list for the Principia Cybernetica Project (PCP) It provides an open forum for all participants in the project, allowing direct discussions about all related issues. Issues discussed include entropy increase and self-organization, causality as co-variation, thermodynamics and evolution of mortality, memetics and the evolution of cooperation, formal expression, criteria for reality, values and religion, definitions of "control", complexity and the edge of chaos, Rosen's theory of anticipatory systems, etc. A selection of relevant information (e.g. congress announcements, publications, hypertext, electronic publishing, evolution of the brain, etc.) from other electronic forums is regularly cross-posted on the list.

Web Archives: http://www.cpm.mmu.ac.uk/~bruce/prncyb-l/
Period of Observation: 10 / 5 / 94 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
1640	127	1767	1.08	78.74	61.52	42.52

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
6.96	0.63	80.37	6.96	1.90	3.16

Topic Distribution of Total Messages (%)

Appendix D.8 – *SIMSOC Mailing List*

List Name: simsoc@mailbase.ac.uk
Listserver: mailbase@mailbase.ac.uk

Description:

> This list is for announcements, news and discussion related to the use of computer simulation in the social sciences, including approaches based on micro-simulation and multi-agent modelling.

Web Archives: http://www.mailbase.ac.uk/lists/simsoc/archive.html
Period of Observation: 14 / 4 / 97 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
571	413	366	0.64	30.27	57.38	16.46

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
19.51	0	41.46	34.15	2.44	2.44

Topic Distribution of Total Messages (%)

Appendix D.9 – *SOIS Mailing List*

List Name: sois@thrace.ee.duth.gr
Listserver: listproc@thrace.ee.duth.gr

Description:

> SOIS is a discussion list about the Self-Organization of the Information Society. The aim of the list is to promote discussion and collaboration and to contribute to a dissemination of information on emergent phenomena and the study of complexity concerning the Information Society. Special emphasis will be given to a critical analysis of theories of social constructivism and other Science and Technology Studies, social simulation and sociological/cultural discussion of the virtual environments created by the mediation of information and communication technologies.

Web Archives: http://platon.ee.duth.gr/data/maillist-archives/sois/
Period of Observation: 22 / 4 / 98 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
198	77	190	0.96	18.18	32.63	15.58

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
65.79	12.63	21.05	0	0	0.52

Topic Distribution of Total Messages (%)

Appendix D.10 – *STS Mailing List*

List Name: sts@kant.ch.umkc.edu
Listserver: listserv@utkvm1.utk.edu

Description:

> STS-L is a moderated discussion group sponsored by the Science and Technology Section of the Association of College and Research Libraries and it uses the revised LISTSERV software. All messages are received by the moderators and then distributed to the group. The purpose of the list is to provide a forum for the discussion of issues of primary interest to science and technology librarians, to provide a quick communication link between STS leaders and list members, and to serve as a distribution point for STS publications. It is a public list, open to all interested persons.

Web Archives: http://vest.gu.se/vest_mail/
Period of Observation: 1 / 1 / 97 – 6 / 11 / 98

Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
675	967	950	1.41	20.99	38.42	9.72

Mailing List Statistics

Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
41.61	0	39.35	12.26	4.84	1.94

Topic Distribution of Total Messages (%)

Appendix D.11 – *XAOS Mailing List*

List Name: *xaos@demokritos.cc.duth.gr*
Listserver: *listproc@demokritos.cc.duth.gr*

Description:

> The purpose of the XAOS List is to share information among the list members on a variety of topics as: *Nonlinear Dynamics, Chaos, Fractals, Criticality, Self Organization, Emergent Behaviour, Artificial Life, Neural Networks, Learning Systems, Complexity, Biocomplexity, Cellular Automata, Neural and Artificial Evolution, Virtual Worlds, Cyberspace.* Many of the postings at the Xaos list originate from USENET Newsgroups and as such they are in English. However, the Greek speaking list members are encouraged to write in Greek, if they choose to do so. The members of the Xaos list can freely post messages expressing their opinions, ask questions about the posted topics, announce important information or events on these topics, and contribute to the discussions about them.

Web Archives: http://platon.ee.duth.gr/data/maillist-archives/xaos/
Period of Observation: 14 / 1 / 97 – 6 / 11 / 98

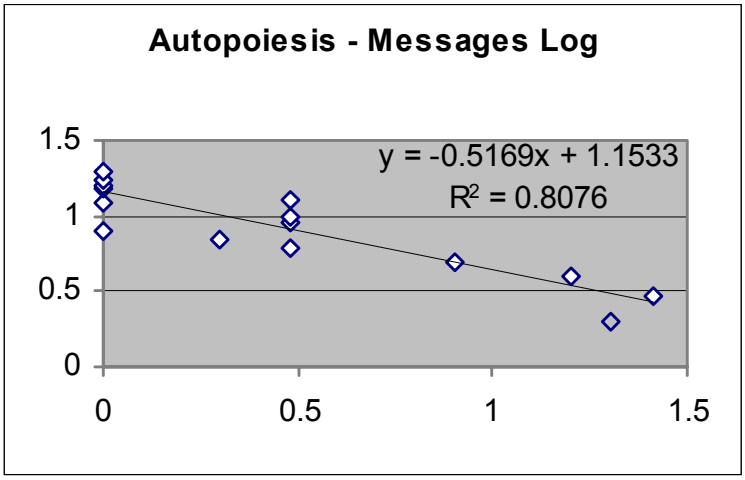
Duration in Days	Number of Subscribers	Total Number of Mails	Activity: Mails per Day	Participation %	Threaded Mails %	Subscribers in Threaded Mails %
661	171	835	1.26	18.13	5.27	9.36

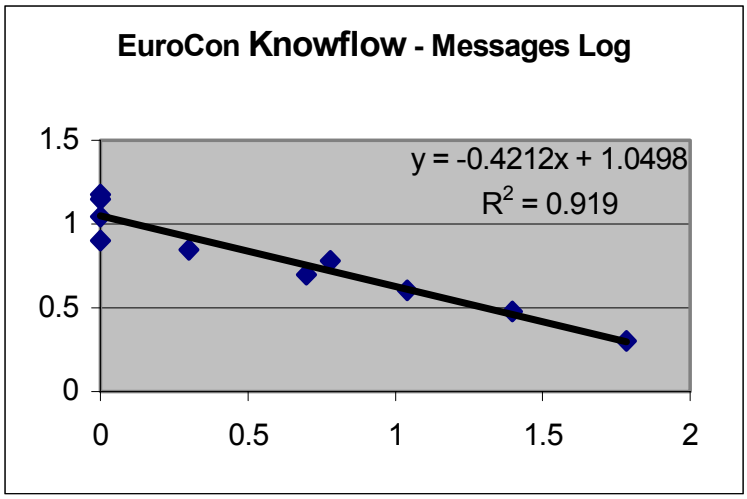
Mailing List Statistics

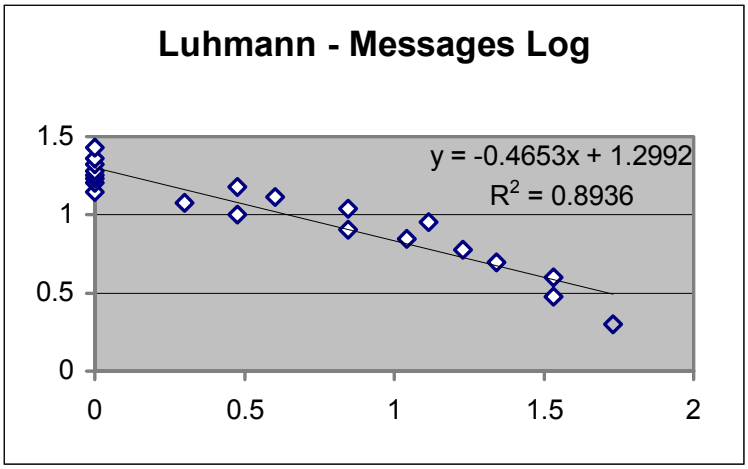
Announcement	Administrative	Theory	Query	Maintenance	Miscellaneous
55	0	20	15	5	5

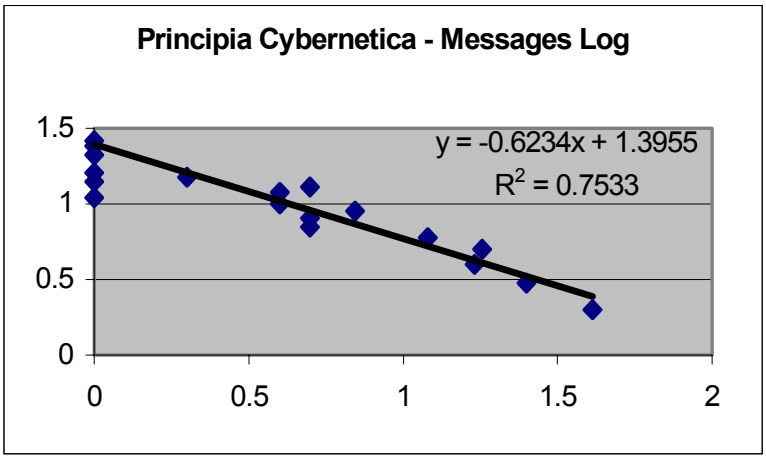
Topic Distribution of Total Messages (%)

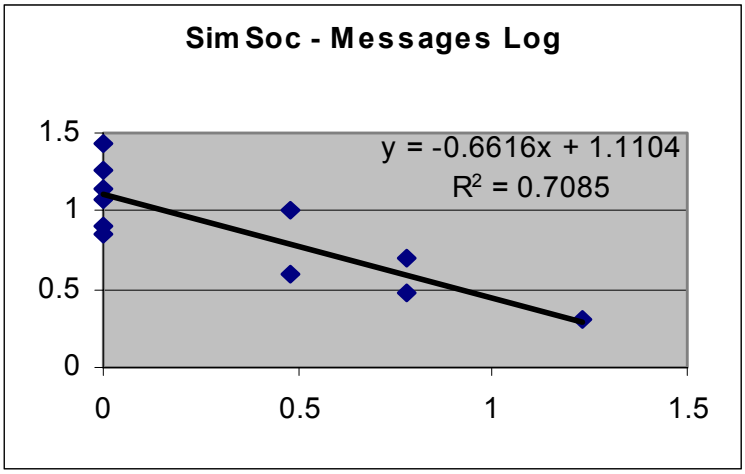
Appendix D.12 – *Mailing List Log Figures*

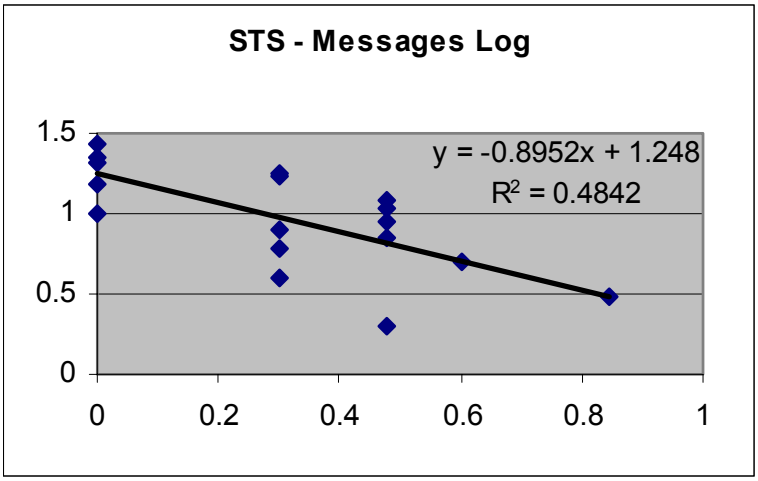







Principia Cybernetica - Messages Log
y = -0.6234x + 1.3955
R2 = 0.7533
1.5
1
0.5
0
0
0.5
1
1.5
2


Sim Soc - Messages Log
y = -0.6616x + 1.1104
R2 = 0.7085
1.5
1
0.5
0
0
0.5
1
1.5


STS - Messages Log
y = -0.8952x + 1.248
R2 = 0.4842
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1

Mediated Communication and the Evolving Science System:
Mapping the Network Architecture of Knowledge Production

Summary

The advent of electronic media into the academic environment has forever changed the way that academics communicate, perform their research, and contribute to the production of knowledge. These relatively recent changes in the mode of knowledge production have been theorized by Gibbons (et.al.;1994) as a shift from Mode I to Mode II which indicates a move away from knowledge produced in traditional research contexts to an environment in which knowledge is created in broader, trans-disciplinary social and economic contexts. Similar arguments have been made in two significant OECD publications (1996, 1997), where the advent of electronic media is considered part and parcel of this shift in the predominant mode of knowledge production. The increasing use electronic media for communication and the current changes in the ways that knowledge is produced are mutually implicated phenomena, and this introduces a problematic: what is the relationship between print and electronic media with respect to how knowledge is produced in academic environments? In part, this problematic motivates the thesis.

To adequately address the complexities of this problematic, several distinct literatures were reviewed. *Chapter I: Introduction – Key Concepts* introduces the complexities between media difference and distinct modes of knowledge production, and articulates the problematic in terms of the centrality of media to human communication, and in terms of the ability as an analyst to adequately assess the impact upon the academic environment, given their overlap. The chapter provides a review of dominant metric approaches which are used in a variety of ways to map networks of human communication. *Bibliometrics* is introduced as a burgeoning academic tradition that stretches back to the middle ages, *scientometrics* as a technique to monitor publication patterns and discipline formation, and *cybermetrics* as an umbrella term meant to incorporate a myriad of different types of analyses on data such as web-traffic, credit card transactions, and the like. The metric analyses situate the present study, and are introduced as a means through which the problematic of media overlap and its impact on processes of knowledge production could be addressed.

Chapter II: Theoretical Grounding served to review a variety of theoretical positions from Science & Technology Studies and Communication Studies, inasmuch as they dealt with issues of mediation or knowledge production. The central proponents of Medium Theory (Innis, McLuhan, Ong, Meyrowitz) were reviewed to provide the theoretical grounding of the research project. Stucturalism (Saussure, Lévi-Strauss, Ricoeur), Postructuralism (Derrida), and Structuration Theory (Giddens) were then reviewed as symbolic approaches to the problematic of mediated human communication, in light of where they respectively placed the 'locus' of meaning. Finally, Actor Network Theory (Callon, Latour, Wise) and Second Order Cybernetics (Luhmann, Leydesdorff) were reviewed as modelling approaches to mapping human communication. The theory chapter served to bind these diverse approaches into a single dissertation heuristic of *Architecture – Network – System* through which the subsequent analyses would be performed. *Architecture* isolates the parameters of

communication, *Network* identifies the interrelationships between relevant actants, and *System* addresses the overall dynamics of the communication system. The research is thereby positioned within the fields of Science & technology Studies and Communications Studies, and aims to contribute to both disciplines via their integration.

Chapter III: Materials & Methodologies introduces the EU Research Project selected for the case study. It was selected precisely because it exhibited both Mode I and Mode II types of knowledge production, and because it simultaneously used both print and electronic media in its manifestation. The chapter outlines the different SOEIS project communicative domains selected for analysis (print communication, electronic communication, publication behaviour, and mailing list dynamics), and details the methodology of each of the metric analyses performed in each stage of the dissertation. The chapter sought to combine a variety of metric approaches to deal with the central problematic of media centrality in academe; here the different metric approaches are interwoven with the different theoretical positions that make up the heuristic triad. In this way a general schema is outlined, and the study contextualized. Finally, the chapter specifies several overriding assumptions of the dissertation; including: 'ICTs affect the ways that scientists communicate', 'metric analyses can help understand the print / electronic media difference', and the 'theoretical triad can be used to organize, contextualize, interpret and understand the results of the analysis'. A formal research question was then asked: "Given that media and knowledge production are mutually implicated phenomena, and that changes can be attributed in part to media difference, can metric analyses informed by theoretical grounding show these differences?"

The Analysis section of the dissertation consists of four chapters. Each chapter has as its focus an empirical analysis of one of four isolated communicative domains of the SOEIS research project: print communication, electronic communication, journal publication, and mailing list environment, respectively. *Chapter IV: Analysis of Print Communication* examines the dynamics of print exchange in the context of the SOIES project and reveals patterns of codification of scientific information, networks of cognitive orientation, and the systemic dimensions of print word distribution. Similarly, *Chapter V: Analysis of Electronic Communication* examines the dynamics of electronic writing as exhibited by the SOEIS community – here the results are compared with the results of the print analysis and are shown to exhibit different modes of scientific information codification, different networks of cognitive bias, and different overall word distributions.

Chapter VI: Analysis of Journal Publication examines the changes in the publication patterns of the SOEIS community on both the project level (article generation) and field level (the journal environment) and reveals both similarities and differences in the collective cognitive orientation of both the cited dimension (comprised of publications by the SOEIS community) and the citing dimension (those that cite SOEIS relevant materials) over the five year scope of analysis. Finally, in *Chapter VII: Analysis of Mailing List Environment* the network dynamics of eleven Science & Technology Studies and Self-Organization Theory oriented mailing lists are compared in terms of their individual threaded messaging behaviour to reveal that the SOEIS

related project mailing lists function like field level lists, despite exhibiting project level dynamics.

The final section of the dissertation serves to reflect upon the reviewed literature and the analyses performed, and it is comprised of two chapters. *Chapter VIII: Integration & Conclusions* establishes a central line of commensurability between the theoretic lens and empirical methods employed herein. The chapter directly reviews and answers the original research questions, and appraises the expectations. Finally, *Chapter IX: Discussion & Relevance* describes the challenges associated with integrating symbolic and modelling approaches, provides suggestions for future researchers in the field as well as suggests the design parameters of a modularized software program to aid in future analyses. The central question of the dissertation is thereby addressed and answered: do print and electronic media foster unique types of media environment, and are different modes of knowledge production and meaningful exchange thereby implied with each medium and its use? Yes, print and electronic media do foster distinct types of knowledge production, and it is in the context of their interrelation that the general import of media, and of media difference, becomes clear.

Gemedieerde communicatie en het evoluerende wetenschapssysteem: netwerk architectuur van wetenschappelijke kennis-productie in kaart gebracht

Samenvatting

De uitbouw van elektronische communicatie in de academische wereld heeft de manier veranderd waarop wetenschappers samenwerken, hun onderzoek verrichten, en bijdragen aan de productie van kennis. Deze relatief recente veranderingen in de wijze van kennis-productie zijn door Gibbons (et. al. 1994) beschreven als een verschuiving van Mode I naar Mode II. Het gaat hier om een verschuiving van de productie van kennis in traditionele onderzoekscontexten, naar een omgeving waarin kennis voortgebracht wordt in bredere, transdisciplinaire, sociale en economische contexten. Soortgelijke argumenten werden aangedragen in twee belangrijke OECD publicaties (1996, 1997), waarin de ontwikkeling van het Internet beschouwd werd als een intrinsiek onderdeel van deze verschuiving in de dominante wijze van kennis-productie. De hypothese is dat het toenemende gebruik van elektronische media voor communicatie en de huidige veranderingen in de wijze waarop kennis wordt geproduceerd, ontwikkelingen zijn die elkaar wederzijds impliceren en versterken. Dit roept een vervolgvraag op: wat is dan de relatie tussen geschreven en elektronische media met betrekking tot de manier waarop kennis voortgebracht wordt in de wetenschappen? Deze theoretische vragen worden in de dissertatie empirisch onderzocht door gebruik te maken van scientometrische technieken.

Eerst wordt de relevante literatuur behandeld die de concepten aanreikt om de complexiteiten van deze vraag te kunnen bespreken. *Hoofdstuk I: Introductie – Sleutel Concepten* introduceert hoe de complexiteit van media verschilt. De verschillen in de wijzen van kennis-productie worden uitgewerkt. In dit hoofdstuk wordt de problematiek gearticuleerd in termen van het centrale belang van media voor menselijke communicatie en het vermogen van de analist om, gezien de overlap tuseen de media onderling, de invloed van elk van hen op de academische omgeving en de wetenschapsontwikkeling adequaat te beoordelen. Het hoofdstuk geeft ook een overzicht van de dominante metrische benaderingen, die op verschillende wijzen gebruikt kunnen worden om netwerken van intermenselijke communicatie in kaart te brengen. *Bibliometrie* wordt geïntroduceerd als een academische traditie die terugreikt tot de Middeleeuwen, *scientometrie* als een techniek voor de observatie van publicatiepatronen en wetenschappelijke beroepsformatie, en *cybermetrie* als een kapstok term voor talloze data analyses, zoals webverkeer, "creditcard" transacties, etc. De metrische analyses situeren de voorliggende studie. Ze worden geïntroduceerd als een middel om het gesignaleerde probleem van media-overlapping en de invloed ervan op de processen van wetenschappelijke kennis-productie te kunnen onderscheiden.

Hoofdstuk II: Theoretische Fundering is een bespreking van een verscheidenheid aan theoretische posities van Wetenschaps- en Technologie-Studies en Communicatiewetenschappen, inzoverre zij kwesties behandelen betreffende bemiddeling en kennis-productie. De centrale auteurs van de Mediatheorie (Innis, McLuhan, Ong, Meyrowitz) worden behandeld om een theoretische fundering aan het project te geven. Structuralisme (Saussure, Lévi-Strauss, Ricoeur), Poststructuralisme (Derrida), en Structuratietheorie (Giddens) worden behandeld als symbolische

benaderingen ten aanzien van bemiddelde communicatie, met name met het oog op de plaats waar betekenis wordt gesitueerd. Tenslotte worden Actor-Netwerk-Theorie (Callon, Latour, Wise) en Tweede-Orde Cybernetica (Luhmann, Leydesdorff) bezien als benaderingen om menselijke communicatie te modelleren.

Dit theorie-hoofdstuk dient om deze verschillende benaderingen in één dissertatie-heuristiek van *Architectuur – Netwerk – Systeem* te verbinden. De hierna uitgevoerde analyses worden geleid door deze heuristiek. *Architectuur* isoleert de parameters van communicatie, *Netwerk* identificeert de wederzijdse relaties tussen relevante actanten, en *Systeem* behandelt de algehele dynamiek van het relevante communicatiesysteem. Het onderzoek plaatst zich daarmee binnen het gebied van zowel Wetenschaps- en Technologie-Studies en alsook Communicatiewetenschappen. Er wordt gepoogd deze twee vakgebieden te integreren op empirisch niveau en zodoende bij te dragen aan de ontwikkeling van de beide disciplines.

Hoofdstuk III: Materiaal en Methodologie introduceert het EU onderzoeksproject SOEIS ("Self-Organization of the European Information Society") dat gekozen werd als "case study". Dit project is specifiek gekozen omdat daarbinnen zowel Mode I als Mode II soorten van kennis-productie zichtbaar waren en bovendien omdat zowel geschreven als elektronische media intensief werden gebruikt. De auteurs waren specifiek gericht op de ontwikkeling van electronische media van communicatie, maar binnen een academische setting. Bovendien had deze auteur als lid van het project zonder specifieke taak in de "deliverables" zowel toegang tot de relevante materialen alsook de positie om onafhankelijk te kunnen observeren.

Het hoofdstuk schetst de verschillende communicatieve domeinen van het SOEIS project die voor de analyse gekozen werden (geschreven communicatie, elektronische communicatie, publicatiegedrag en "mailing list" dynamieken). Er wordt hier samenvattend ingegaan op de methodologie van elke uitgevoerde metrische analyse in ieder stadium van de dissertatie. Het hoofdstuk een verbindt de verscheidenheid aan metrische analyses door te focussen op de centrale vraag van het belang van media voor wetenschapsontwikkeling. Ook worden de verschillende metrische benaderingen verbonden met de theoretische posities waaruit de heuristische triade "architectuur-netwerk-systeem" is samengesteld. Op deze manier wordt een algemeen schema ontwikkeld voor empirische analyse zonder de theoretische context te verliezen.

Verder worden in dit hoofdstuk verscheidene centrale aannames van de dissertatie verder gespecificeerd met het oog op empirische analyse, zoals de these dat informatie en communicatietechnologieën de manier beïnvloeden waarop wetenschappers communiceren, de methodologische aanname dat metrische analyses kunnen bijdragen aan het beter begrijpen van het verschil tussen communicatie op papier en electronische vorm en de heuristische aanname dat de theoretische driehoek kan worden gebruikt om de resultaten van de analyses te organiseren, contextualiseren, interpreteren en begrijpen. Een formele onderzoeksvraag kan nu aanvullend worden geformuleerd: Gegeven dat media en kennis-productie elkaar wederzijds impliceren en de veranderingen deels toegeschreven kunnen worden aan het verschil tussen de media, hoe kan een metrische analyse geïnformeerd door de theorieen die in het vorige hoofdstuk beschreven zijn, deze verschillen ook systematisch aan het licht brengen?

Het empirisch-analytische gedeelte van de dissertatie beslaat vier hoofdstukken. Ieder hoofdstuk richt zich op de analyse van één van de vier afzonderlijke communicatieve domeinen van het SOEIS onderzoeksproject: geschreven communicatie, elektronische communicatie, tijdschrift communicatie, en "mailing list" omgevingen. In *Hoofdstuk IV: Analyse van Geschreven Communicatie* wordt de dynamiek van geschreven uitwisselingen in de context van het SOEIS project onderzocht. De resultaten maken codificatie patronen van wetenschappelijke informatie, netwerken van cognitieve oriëntatie, en de systematische dimensies van geschreven woorddistributies zichtbaar. *Hoofdstuk V: Analyse van Elektronische Communicatie* onderzoekt op vergelijkbare wijze de dynamiek van elektronische teksten zoals deze werden uitgewisseld tussen leden van de SOEIS gemeenschap. De resultaten worden vergeleken met de resultaten van de analyse van de geschreven communicatie en er wordt aangetoond dat de twee dimensies verschillende soorten van wetenschappelijke informatiecodificatie, verschillende netwerken van cognitieve voorkeur, en verschillende algehele woorddistributies vertonen. *Hoofdstuk VI: Analyse van Tijdschrift Publicatie* onderzoekt de veranderingen in de publicatiepatronen van de SOEIS auteurs op zowel het project niveau (artikel generatie) als het veld niveau (de tijdschrift omgeving). Hier worden de overeenkomsten en verschillen zichtbaar gemaakt van de collectieve cognitieve oriëntatie in zowel de geciteerde dimensie (bestaande uit de verzameling van publicaties van de SOEIS auteurs) alsook de dimensie van geciteerd-worden (zij die SOEIS materiaal citeren) gedurende een analyseperiode van vijf jaar. Tenslotte wordt in *Hoofdstuk VII: Analyse van de "Mailing List" Omgeving*, de netwerkdynamiek van elf Wetenschaps- en Technologie-Studies en Zelforganisatie-theorie georiënteerde "mailing lists" vergeleken in termen van "threaded messaging" gedrag in elk van deze cognitief en sociaal anders georganiseerde communicatie-kanalen. Uit deze analyse komt naar voren dat de aan het SOEIS project gerelateerde "mailing lists" functioneren als lists op het veld-niveau, hoewel ze dynamieken op project-niveau vertonen. Een intermediaire vorm van communicatie kan zodoende worden geïdentificeerd.

Het laatste gedeelte van de dissertatie bestaat uit een reflectie op de behandelde literatuur en de uitgevoerde analyses. Het beslaat twee hoofdstukken. *Hoofdstuk VIII: Integratie en Conclusies* toont eerst een commensurabiliteit aan tussen het theoretische gezichtspunt en de gebruikte empirische methodes. Dit hoofdstuk bespreekt en beantwoordt dan de oorspronkelijke onderzoeksvragen en evalueert daarna de initiële verwachtingen. Tenslotte beschrijft *Hoofdstuk IX: Discussie en Relevantie* de uitdagingen die verbonden zijn aan het integreren van symbolische en modellerende benaderingen. Dit hoofdstuk voorziet in suggesties voor toekomstige onderzoekers in het onderzoeksveld. De ontwerpparameters voor een gemodaluriseerd software programma om toekomstig onderzoek te ondersteunen, kunnen worden gespecificeerd. De centrale vraag van de dissertatie is daarmee behandeld en beantwoord: herbergen geschreven en elektronische media unieke types van media omgevingen en zijn verschillende wijzen van kennis-productie en betekenisvolle uitwisseling daarom reeds impliciet gegeven met ieder medium en zijn gebruik? Ja, geschreven en elektronische media herbergen verschillende types van kennis-productie en het is in de context van hun wederzijdse relatie dat het algemene belang van media en van de media-verschillen, duidelijk word.