Groups, Adaptation, Coordination and Translation (GACT): Digital Documents and the Organizational Genome.

ddspd02.pdf

Elisabeth Davenport
Napier Business School
Napier University
Edinburgh, UK
e.davenport@napier.ac.uk

and

School of Library and Information Science
Indiana University
Bloomington IN47405

Abstract

Research agendas in different disciplines have addressed ways in which groups adapt to their environments, coordinate interactions, and translate such activities into practices which can be shared by other groups.This paper incorporates research on digital environments from a number of disciplinary perspectives, and presents an extended analogy: documentary/digital genres are like genes, and the genres that characterize a workgroup may be treated as a 'group genotype'. It is intended to provoke discussion of a 'common core' for a research front that addresses the 'organizational genome', that is documentary elements and'sequences' that shape organizational practices in different sectors and contribute to organizational phenotypes.

1. Introduction: genres and group genotypes

Digital genres may be the key to understanding the workings of digital documents, those pervasive and heterogeneous constituents of virtual work. Because they both produce and reproduce the interactions of groups over time, digital genres in the virtual workplace (which comprises 'office documentation') have a role that may be compared with that of genes, and a set of genres which typifies a stable organizational group may be compared with that of the genotype in an organism. Each is a set of codes (for rules, processes and forms) which produces effects at different levels of organization (manifest in the phenotype, or visible activity), and which is both restrictive (to allow identity to be maintained), and adaptive (to allow organisms/groups to persist in changing circumstances). The digital workplace offers rich opportunities to those with an interest in how groups adapt to and shape their internal and external milieux, or environments, how they coordinate interactions to achieve this, and how they translate such activities into practices which can be shared by other groups. A plethora of detail, formerly separated by modality, time, place, can now be stored on the desktop machine, and accessed by an interface which collocates all that is needed to coordinate interests and resources, and align a group's

practices and representations with those of appropriate allies. These digital details are created, stored at different levels of aggregation and assembled in different sequences, to support different workplace needs by means of documentary genres like manuals, memos, minutes, tables, reports, case studies.

Our understanding of digital documents (as Yates and Sumner indicate [1], these are to be broadly defined as 'any socially and contextually complete semantic unit of communication - including text, video, audio, hypermedia, multimedia and computer-mediated communication - which is created, stored, and transmitted via digital media' (p. 3)) and their intersection with physical artifacts and practices is incomplete [2-3], though research agendas in a number of disciplines in recent years have addressed technology and social practice.These include: work on social issues (what do digital texts reveal about the roles, responsibilities and registers that define/characterize behaviors in computer-supported workgroups?; work on architectures (what structures are required to support digital or virtual organization?; studies of process (to what extent can digital documents reveal recurrent functions which define typical organizational forms?; and work on ontology (how are digital texts categorized locally and globally, and what are the translation processes which allow categories to be shared?

In the text which follows, I develop a rationale for the genre/gene analogy, and review a number of case studies of digital genres, which suggest that a model for workgroup 'genotypes' based on documentary genres may help to structure and explain virtual work. Left open for discussion is the question of how to develop a research front that addresses the larger issue of an 'organizational genome', that is documentary elements and 'sequences' that shape organizational practices in different sectors and contribute to organizational phenotypes.

Zuboff, writing in 1995 [4], observes that the information economy demands the demise of traditional hierarchical corporation as the exemplar of organizational work. In its place, a network of small organizations, which are open in form, will draw competitive strength from the power of detail that can be represented in the digital infrastructures that support them. Groups in this digital environment (what may be called a 'new organizational order') must be able to rapidly configure resources and tactics in the interests of both change (when required) and consolidation. Though many analysts are sceptical of this, and similar scenarios, I would like to run with it for the purposes of speculation. Much of what an analyst needs to know will be available in detail in digital documentation, held in intranets and extranets, which can offer insight into the change and consolidation process. The genre/gene analogy is a lens through which insight may be gained: a documentary genotype can offer a representation of a group's business which will function as an ontology, that makes visible, and stabilizes, the workings of a virtual work domain [5-7]. (Weinstein and Alloway's presentation [6] of an ontology for literary genres is an analogy).

2. The approach: chasing Darwin with borrowed terms

Borrowed evolutionary terms are both seductive and perplexing. As metaphors in the field of strategic information management, for example, they can provide insight into structure and change. In the context of studies of organizational change [8], they demonstrate that evolutionary biology can be used as an explanatory framework that goes beyond metaphor. In using the terms 'genes' and 'genotype' in this paper, however, I do not wish to carry the analogy from biological science too far. A demonstration of

Darwinian 'descent with modification' in the world of office documentation might try the reader's patience. When biologists themselves disagree as to where variation and adaptation are to be observed [9], those using an evolutionary metaphor may have difficulty in establishing the level of organization where the analogy is useful: is an organization to be treated as an organism, species, or population? Work on the evolutionary dynamics of organizations appears to treat organizations as species [8] whose adaptive fitness is discussed at the level of the population, (i.e. a given industrial sector). If we run with this analogy, the group within the organization is the level where 'variation' will occur, but this leaves the problem of showing that a group operating with an identifiable documentary genotype can adapt more successfully, because of that genotype, to changed circumstances than another group.

Apart from any analogical rationale, groups can be justified on other grounds as the focus of attention in an attempt to explore documents and group 'fitness'. Firstly groups are where the generic functions of organizations are located, represented and enacted in specific types of procedures and documentation. Historically, to be a professional, has been to know how to work with texts in a given functional area [10]. For someone who wishes to explore the role of genres in working documents, functional organizational groups are a likely site for finding the quarry. Secondly, the technologies which are loosely defined by the label 'groupware' offer a platform for the exploration of digital documents, that is equivalent to a well-equipped laboratory. In the interests of simplicity, I am not concerned here with why groups adapt, or the environmental shifts that allow fitness to be demonstrated (the issues explored in the evolutionary dynamics of organization field), but with scoping a mechanism (the 'documentary genotype') which accounts for the persistence of groups across space, time and beyond the span of participation of individual group members.

I would like to stress that what is explored in the sections which follow is an analogy. I do not offer a discussion of 'the extended phenotype' proposed by Dawkins [11-12] where the replication strategies of biological genes may be implicated in social institutions, expressions and forms. The analogy offered here is simplistic: it invokes, in the first instance, no more than a template of instructions to be found at a certain level of organization, whose effects can be perceived at other levels of organization. For digital genres to be 'gene-like', they must function as 'codes for conduct' for members of groups in the virtual workplace in a way that is analogous to a genetic template. My initial reading of 'digital genre' literature offers some support for this view. Yates and Sumner [1], for example, suggest that genres are a mechanism for balancing stability and transformation (the 'centripetal' and 'centrifugal' tendencies that characterize social interaction, according to Bakhtin); by offering 'fixity', genres help organizations to persist.

3. The literature: some perspectives on texts at work

From the Management Science (MS) perspective, the study of documents at work has followed a cumulative path of development in the last fifty years, with phases shaped by both Zeitgeist and technology: a focus on strategy and control (characterized by MIS and precise (context-free) decision making), for example, in the wake of WWII; on intelligence gathering in the Cold War Era, and recently on 'knowledge management', which stresses transparency across and within groups rather than competition between individuals and is premised on networking and relational

technology.In both MS, and Library and Information Science (LIS), much of the narrative has emphasized 'the manager', a helmsman, or steering agent, as presented in the literature, whose 'information habits', 'information needs', and 'information use environments' have been profiled in a number of studies which suggest that managers have little use for formal documentation, and rely heavily on informal sources and tacit knowledge, and base much of their activity on premises that remain hidden. In spite of detailed knowledge of sources of intelligence that are available to organizations, deep understanding of how these are structured and may be searched, and numerous studies of 'knowledge management' (amply reviewed by Choo [13]) we have had little idea until recently [14-16] of how documents are 'mobilized' in organizations; in particular, we have had little knowledge of how documents are appropriated in decision-making, and though groupware has improved understanding in this area [17-18], it is far from pervasive as a work platform. This lack of understanding is due in part to what may be called an 'interiority complex', that is a mentalist framework which has treated managerial work as a black box, based on inaccessible internalizations. (A broad critique of this stance is offered by Davenport and Cronin [19]).

An alternative approach has taken activity in the workplace as the focus of attention [20-22]. This inevitably invokes a social dimension which is missing in individualistic accounts of decision-making (MIS analysis), and has to some extent improved understanding of the interplay of context and action as groups meet objectives. Activity analysis *per se* has provided little insight into how groups persist over time, a problem addressed by work on organizational memory.

There are several strands in this work [23-26]: the archive and how it may be exploited for organizational advantage; the interplay of memory and action; Stein [25], who covers all of these areas, presents their relationship as problematic: tacit or hidden knowledge is part of the problem, as it is difficult to store what is not represented. (This problem is one of the drivers of the 'knowledge management' movement, which may be seen as a kind of 'memetic engineering' drawing on process techniques which encourage mutual disclosure.) Though other aspects of the digital workplace have been explored (consensus building, group process, interoperability), neither MS (where it emphasizes individual managerial decision-making) nor LIS (with its emphasis on 'needs' and 'use environments') offers a persuasive model of how documents (again, broadly defined) create, embody and contribute to memory, persistence and group identity.

The 'social shaping of technology field' offers a richer text trove, specifically work on a class of documents which encode work practices - and I would like to suggest that these, inasmuch as they are recipes for how to behave, may be candidates for 'genotype' status. This body of text addresses what may be called 'social epistemics' - the creation and maintenance of group knowledge by means of document sets which arise from and have consequences in specific social circumstances. I offer a *resume* of aspects of this work under three headings: the study of texts that function as translation devices, the study of texts for coordination, and the microstudy of textual genres at work. The insights and frameworks offered by this corpus can contribute to a set of criteria to identify documents that perform a social engineering function of the kind that I have ascribed to genes. Where the criteria are applied in a given context (a school, a library, an aerospace plant) we may be able to identify a 'documentary genotype' at work.

3.1 Translation devices

At this point, I'd like to focus on 'translation devices' within the 'social scripts' concept. Star and Greisemer's 'boundary objects' [27] are an example. These provide common ground for heterogeneous social actors to work together. They may be artifacts (like instruments or maps), texts, prescriptions, classification systems: they are to some extent protean - 'plastic enough to adapt to local needs, and the constraints of the several parties employing them, yet robust enough to maintain common identity across sites'. As they 'inhabit several intersecting social worlds and satisfy the informational requirements of each of them', boundary objects are essential components of information infrastructure. The creation and maintenance of boundary objects is a political process. Organizational actors who engage with boundary objects will seek to privilege their own concerns, and enlist allies with this end in view; in the museum case study where Star and Greisemer situate their discussion, boundary objects were a way of 'translating the concerns of the non-scientist into those of the scientist'. In using 'translation' in this way, they draw on the work of Latour and Callon [28]: translation happens through a process of 'inscription'; artifacts embody the interests of those who engage with them, and carry (as Greisemer and Star indicate) 'at every stage the traces of multiple viewpoints, translations and incomplete battles'. Such observations suggest that classification, a political resource, is central to the relationship between inscriptions, work practice and standards. By virtue of inscription, artifacts become political palimpsests, or 'political amber' [40]. This corroborates Suchman's view [29] that 'categorization devices are devices of social control involving contests between others' claims to the territories inhabited by persons or activities and their own, internally administered forms of organization'.

Monteiro and Hansett's [30] study of EDI in the Norwegian health sector provides an illustration. In constructing the case they have drawn on Latour's Actor Network Theory, as it 'supports an inquiry which traces the social process of negotiating, redefining, and appropriating interests back and forth between an articulate, explicit form where the are inscribed within a technical artefact'. They show how different interest groups (pharmacists, GPs, the government agency) jostled to have the EDI initiative implemented in ways which would favor their own position. As they observe, to build one's own advantage into a social genre is to increase one's power base: inscriptions (and the power base they reflect) become stronger as the network of those who are involved expands: the broader the alliance, the stronger the inscription; but a broad alliance may also dilute the power of inscription, as use becomes indeterminate. (Davenport [31] has recently described the process of 'inscription' in the construction of clinical guidelines in the UK health sector).

As part of an ongoing exploration of 'the quiet politics of voice and values in information infrastructure' [32-33], Bowker and Star and their colleagues have focused on a specific device: the classification system, drawing on the boundary object concept, inter alia, to show how classification can be an act of inscription. In one of a series of cases (a study of the Nursing Interventions Classification) they propose three 'dimensions' for the evaluation of classification systems: comparability (equivalence across sites which is based on 'regularity' in semantics and objects), visibility (in some cases, this means to accommodate what is 'wrongly invisible'), and control, or hospitality to appropriation by users. These might be a starting point for a taxonomy of members of documentary genotypes, which have currency across sites, are visible or recognizable to members of the group, and lend themselves to modification if

circumstances change.

The class of documents which I have dubbed 'social scripts' ('boundary objects','classification systems','inscriptions', all have a common referent: a body of documentation with social antecedents and consequences which constitutes and enacts social practice; carries with it the politics of the group, or the outcomes of political struggles and consolidates the tacit knowledge of those involved in the group designated by the label. The capturing and classification of activities and documentation to demonstrate the power of social scripts is a painstaking and non-trivial pursuit - the most ambitious articulations of the inscription concept (Bowker's study of Schlumberger [34], for example, or the work of Latour and Woolgar [35] on laboratory life) are the outcome of substantial research projects. Following Erickson [36], I would like to suggest that a fast track is available, under certain conditions: the digital detail (or 'documentation') of an electronically supported group, sustained and enacted in a corporate intranet, for example, can reveal the process of inscription at work in the construction of genres. A taxonomy of genres at work in groups (group 'genotypes') which constitute the different levels of organization (a heterotopic taxonomy), will constitute the organizational genome. 'Inscription' is not confined to translation devices; it can also be observed where members of groups are subject to coordination protocols.

3.2 Texts for coordination

Texts for coordination have been the focus of attention for designers of digital environments for at least two decades. Some of the most complex articulations of coordination have been developed by Malone and his colleagues [37-38]. In addition to looking at coordination of points of view at the micro-level of the group, they have explored coordination devices (in the form of visible frameworks) for workflows at the level of the firm. One of the outcomes of this work is the prototype 'handbook of organizational processes', a *vade mecum* for organizational analysts which pulls together a multidisciplinary portfolio of tools, frameworks and taxonomies. In some ways, my aspirations in this paper, though clearly restricted when the comparison is made, shadow those of the process handbook; though genres are not commensurate with processes, the search for a template (a 'genotype', or 'cookbook' to use Crowston's [38] term) to account for genres may draw on similar sources.

The process handbook may be seen as a member of a documentary set: re-engineering texts, which, when offered online and used as a lever for organization, may be treated as digital genres. As Boland and Schultze [39], and Grint et al. [40] demonstrate, process engineering documents are political levers, 'inscriptions' in the terminology of the previous section: they are not context free. In many cases, business process re-engineering (BPR) texts are templates for 'starting over' in altered circumstances. As the emphasis in this genre (of coordination texts) is less 'consensus', and more 'transformation', BPR texts may be broadly described as 'centrifugal' rather than 'centripetal', to use Yates and Sumner's [1] terminology .

3.3 A brief history of office forms

Historically, certain genres of documentation, have functioned as the ghosts of offices past - codes of practice, articles of association, contracts, the inventory (a documentary coelacanth), records of property transfers, daybooks. Though such forms show local diversity, they are recognizable within trading zones as performing or enacting similar functions; in other words, they function as codes of conduct. They are not totally fixed however; as new habits emerge and are

endorsed by a community of practice, they in turn become encoded, nd join the repertoire of knowledge of how to behave. Yates et al. Provide details of this process at work in a study of a virtual ‘teamroom’. [41]. Changes in practice may be responses to external constraints (changes in the law, changes in suppliers and or customers, changes in the way competitors do things), and they may themselves alter the external environment. The documents which encode them are to some extent open texts. These texts for social encoding (‘genres’) persist though strategists and decision-makers (managers) come and go, and have bene the foundation for historical reconstructions of studies of major business systems: Hoskin’s exploration of the rise of accounting [42] in the 18th and 19th centuries; Beniger’s work on the control systems that characterize the late modern period [43] are examples.

Pertinent to this paper, is work on the emergence of a high volume, modular system of office documentation designed for mass circulation in complex bureaucracies. Yates [44] has painstakingly charted the development of office documentation in the 19th century, and shown how ‘classic’ documentary genres embodied evolving bureaucratic practice, itself influenced by emerging office technologies like the typewriter, the vertical file and so on. Everyday practice recorded, made replicable, archivable and visible, amenable to control, enlarged the scope of centralized management, thereby increasing the efficacy of surveillance and the robustness of compliance with internal and external regulations. I would suggest that what is important about these representations of everyday practice (which vary in their level of formalism) is not their truth value (a common discussion point in critiques of reductionist trends in management), but their efficiency value: they lower the costs of many to many transactions in complex groups by compressing the ‘situated learning’ curve for participants in recurring activities. The persistence of many of these forms is a measure of their success; it takes a great deal of effort to establish novel ‘process genres’: Malone and Evindsson [45] document in detail the effort required to introduce a new form of financial reporting, the Intellectual Capital Report, which has yet to establish itself as an industry standard.

‘Genre repertoire' theory, developed by Orlikowski and Yates [47], (building on earlier [44, 46] work) offers a seminal framework for the exploration of documentary genotypes. In a discussion of the fitness of certain 'communicative acts' (or genres) to individual objectives, and demonstrate how observance of rules (which embrace deference and prioritizing) in interactive environments sustains the effectiveness of these communicative acts: examples of office genres in their case study are the memo, the proposal, the dialogue and the ballot, all of which are reproduced in the new modality of e-mail. The process of establishing a genre repertoire, say Orlikowski and Yates, is "largely implicit, and rooted in member's prior experiences of working and interacting. Once established, a genre repertoire serves as a powerful social template for shaping, how, why and with what effort members of a community interact to get their work done". Genres are not static but can be reinforced and challenged and their content is indeterminate. Orlikowski and Yates invoke structuration theory, to explain that "the enactment of genres occurs through a process of structuring" and thus group members "are always negotiators, interpreting and improvising". I would argue further that for genres to be effective they have to be recognized as guides to behavior by those who enact them: like Grint’s ‘configurational’ systems, they are, in effect, attractors [48], and each time a behavior is reproduced, or encoded in its corresponding document, the

strength of the attractor is increased, as others perceive that the genre offers the path of least resistance: in this way, helpdesk enquiries consolidate into procedural guides, benchmarks emerge from best practice.

4. Some digital genre scenarios

At this point, it may be helpful to review the argument. Documentary genres, as templates which carry codes of conduct, are analogous to genes; if the analogy is taken further, it may be possible to identify and represent the 'documentary genotypes' of groups at work. What persists in organization is documentation; most importantly , the documentation that embodies recurring practice, and is consulted in times of breakdown. Some support for this claim is to be found in theoretical and historical accounts in the 'social shaping of technology literature'. Historically, office documentation has clustered into 'genres' which reflect both practice and technology. Genres may be seen to 'inscribe' tacit knowledge, to the extent that they allow participants in social practice to do the right thing. Such knowledge can be made explicit at times of breakdown: a list moderator, for example, may call a participant to order, by invoking rules of conduct. If we speculate that distributed virtual work will be a norm (the 'new organizational order'), and if we accept that, for the purpose of analysis, virtual organizational work, or digital documents, can be a surrogate for organizational work, we have to hand a rich field area/laboratory to explore the genotype concept. Past problems associated with or understanding of documents and organizational fitness may be due to taking too narrow a disciplinary approach. To understand the link between documentation and organization fitness in his area, we need to take a multidisciplinary perspective. The 'social shaping of technology' field offers such a perspective.

Genres are an example of a class of 'social scripts' which have emerged in the past decade as serious objects of research attention in this field. 'Boundary objects' are instances of social scripts: they are shared artifacts, textual and other, that function as translation devices that accommodate the differing interests of individuals who are required to work together - a social network diagram, for example, or a thesaurus, 'Inscriptions' are a second instance of social scripts: artifacts, textual and other, that enact the political interests of those who engage with them. A classification system is an example (it is also a boundary object), or, at a different level, a laboratory, a major institutional genre within which a plethora of embedded genres are at work. Social scripts may be organized under two broad categories: 'translation devices' and 'coordination devices'.

In the text which follows, I briefly review some 'digital genre scenarios' [1, 37, 49, 50] which lend support to the idea that the digital environment does indeed allow us to see how documentation genres emerge, and how these may function as social *fulcra*. Crowston and Williams [50] offer an analysis of web pages and the genres that they envelop. Drawing on the genre repertoire work of Orlikowski and Yates, they show how genres may be nested or embedded. A case in point is discussion lists (a 'surface' genre) within which FAQs (an 'embedded' genre) emerge. Where FAQs persist as guides to action, they become encoded practice, an 'independent genre', which may be more or less long-lived as practice becomes self-evident. From this perspective, Ackerman's 'Answer Garden' [51] may be seen as an extended repertoire based on the 'helpdesk' genre, which bundles a number of other genres: the FAQ, e-mail, and the full reference interview in response to an escalating reference need. (In a recent study of remote reference work, Procter and his colleagues [52-53] indicate that a visualization of this particular genre repertoire

and its sub-elements may help 'strangers' to cope in a novel situation; where such representations becomes normative (accepted, for example, as a 'virtual helpdesk' template for collaborative online service across multiple library sites), they may function as a 'reference work' genotype). I would offer bookmarks as another case of a 'layered' genre with the potential for extension: on the surface the file is a resource locator; with manipulation, further genres may emerge - a citation map, for example, which can allow a 'stranger' to fast track into the group's social network, or allow a resident to check the changing configuration of that network.

Yates and Sumner [1] offer two case studies to support the proposition that genres act as a stabilizer that counteracts centripetal and centrifugal tension in groups. (Their development of the 'stability/transformation' theme is extensive and eloquent). In the first study, they use techniques from conversation analysis to show how micro-genres emerge in CMC communication (in this case, a discussion list); the CMC revealed a complex interplay of speech and written genres (some of them signalled by typographic devices (the standard netiquette icons). The second case is a study of a cross-disciplinary design project, and the re-working of what are called here 'translation' and 'coordination' genres by one of the designers, in a response to a less than optimal previous genre repertoire: 'As the community recognized common breakdowns in the design process, they improved their representations to overcome these breakdowns. The outcome was a progression towards well-defined design representations that made explicit significant objects and their relationships'.

The third of the digital genre scenarios is not explicitly presented as such by its authors. It is a description [49] of GS_{web}, a web version of a complex groupware system with 'over 10 years' of development history behind it. A predecessor product designed by the group, Groupsystems, built on standard genres for decision-making (brainstorming, ranking, voting), supplemented over the years, by dialogue boxes, and e-mail, and other relevant digital genres. The GS_{web} prototype develops the idea of a collaborative portfolio further, combining tools that 'categorize and converge' on key issues ('translation' tools, in other words) with tools that can offer a 'process overview' ('coordination'). The principal representation device is the folder, nested and structured and accessed in windows sequences. In addition, GS_{web}, like its predecessor GroupSystems, provides 'tools for thought' - 'categorizer',' outliner', 'commenter' and 'vote'. Categorizer may be agent-based. The structures and representations offered by GS_{web} may greatly facilitate observations of genres at work: 'folders' might represent genres, and a tool like categorizer, might function as a 'genre' generator. 'Group outliner', might produce an ontology for any given group whose work is embodied in the GS_{web} application. A 'genretic' filter for Gsweb, which incorporate 'teamroom' insights from Yates et al. [41] might provide a 'fast laboratory' to explore group, and in a complex application, organizational genotypes.

5. Conclusion

This speculation may be premature, or simply misguided: other 'genetic algorithm' approaches to understanding organizations, like Crowston's which takes 'process' as its structural unit, have already provided rich insights. Much work needs to be done to justify the addition of a documentation dimension (the 'documentary genotype') to the organizational engineering corpus. There are several obvious agenda items. We need to establish criteria to identify members of the documentary genotype (building on work mentioned above [41, 47, 32], and modifying

other taxonomies for infrastructure, like that offered by Star and Ruhleder [54]). In addition, a set of practices must be identified that clearly function as genres (because digital behavior is shaped by them), and that are agreed to be genres by those who enact them, without prompting, which would prejudice membership of the set and simply produce a set of research artifacts. A lexicon must be found that is informative, hospitable and distinctive: the vocabulary developed by Akrich and Latour [55] for Actor Network Theory, may serve as an example. And a set of visualizations or representations must be provided [6, 56] that would act as a 'fast inscription' and allow participants in workgroups to quickly exploit the power of a genotype.

6. Acknowledgments

I am grateful to the School of Library and Information Science at Indiana University for housing and resourcing me while this paper was written. Specific thanks are due to Blaise Cronin for comments on earlier drafts, and for the phrase 'interiority complex'.

7. References

[1] S. J. Yates, and T. R. Sumner, "Digital genres and the new burden of fixity", in *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track*, R. Sprague, Ed. Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 3 - 12.

[2] S. L. Star, "Slouching towards infrastructure". At http://www.gslis.ucla.edu/DL/star.html

[3] D. Levy, and C. Marshall, "Going digital: a look at assumptions underlying digital libraries," *Communications of the ACM*, vol. 38, no. 4, 1995, pp. 77 - 84.

[4] S. Zuboff,"The emperor's new information economy", In *Information technology and changes in organizational work. Proceedings of the IFIP WG8.2 working conference on information technology and changes in organizational work, December 1995*, W. Orlikowski, G. Walsham, M. R. Jones, & J. I. DeGross, Eds. London: Chapman and Hall, pp. 13 - 17.

[5] B.C.Vickery, "Ontologies", *Journal of Information Science*, vol. 23, no.4, 1997, pp. 277-286.

[6] P. Weinstein and G. Alloway, "Seed ontologies: growing digital libraries as distributed, intelligent systems", in *Proceedings of Digital Libraries 97*. New York: ACM, pp. 83-90.

[7] M. Gruninger, et al. "Using process requirements as the basis for the creation and evaluation of process ontologies for enterprise modelling", *SIGGROUP Bulletin*, vol 18, no. 2, 1997, pp. 52-55.

[8] J. A. C. Baum, and J. V. Singh, *Evolutionary dynamics of organizations*, New York: Oxford University Press, 1994.

[9] J. Brockman, *The third culture: beyond the scientific revolution.*, New York: Touchstone, 1996.

[10] A. Abbott, *The system of professions: an essay on the division of expert labour*, Chicago: University of Chicago Press, 1988.

[11] R. Dawkins, *The extended phenotype: the gene as a unit of selection*., Oxford: W. H. Freeman, 1982.

[12] M.Schrage, "Revolutionary evolutionist", *Wired*, 3.07, July 1995, pp. 120 - 123, 185.

[13] C. W. Choo, *The knowing organization: how organizations use information to construct meaning, create knowledge, and make decisions*, New York: Oxford University Press, 1998.

[14] R. Kling, R. and M. Elliott, "Digital library design for organizational usability", *SIGOIS Bulletin*, vol. 15, no. 2, 1994, pp. 59-69.

[15] M. Elliott, and R. Kling, "Professional use of digital libraries in organizations: case study of legal research in civil and criminal courts", *Journal of the American Society for Information Science*, vol. 48, no. 11, 1997, pp. 1023-1035.

[16] L.R. Schiff et al. "Understanding complex information environments: a social analysis of watershed planning". In *DL 97*, New York: ACM, 1997, pp. 161-168.

[17] R. J. Boland, and U. Schultze, "Narrating accountability: cognition and the production of the accountable self", in *Accountability: power, ethos and the technologies of managing*, R. Munro and J. Mouriston, Eds. London: International Thomson Business Press, 1996, pp. 62 - 81.

[18] U. Schultze, U. and R.J. Boland, "Hard and soft information genres: an analysis of two notes databases". In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track.* R.

Sprague, Ed. Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 40 - 49.

[19] E. Davenport, and B. Cronin, “Texts at work: some thoughts on ‘Just for you’ service in the context of domain expertise”. *Journal of Education for Library and Information Science*, vol. 39, no. 4, 1998, pp. 1-12.

[20] K. Abbott, K. and S. K. Sarin, “Experiences with workflow management: issues for the next generation”, in *CSCW 94*. New York: ACM, pp. 113-120.

[21] A. Sheth, “From contemporary workflow process automation to adaptive and dynamic work activity coordination and collaboration”, *SIGGROUP Bulletin,* vol. 18, no. 3, December 1997, pp. 17 - 20.

[22] H. Groiss, H. and J. Eder, “Workflow systems for inter-organizational business processes”, *SIGGROUP Bulletin*, vol. 18, no. 3, December 1997, pp. 23-26.

[23] J. Morrison, “Organizational memory information systems: characteristics and development strategies”. In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume II. Information Systems Track-organizational systems and technology*, J. F. Nunamaker and R. Sprague, Eds. Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 300-309.

[24] B. Ramesh, “Towards a meta-model for representing organizational memory”. In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume II. Digital Documents Track.*, J. F. Nunamaker and R. Sprague, Eds. Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 320-329.

[25] E.W. Stein, “Organizational memory: review of concepts and recommendations for management”, *International Journal of Information Management,* vol. 15, no. 2, 1995, pp. 17-32.

[26] E.W. Stein, and V. Zwass, “Actualizing organizational memory with information systems”, *Information Systems Research* , vol. 6, no. 2, 1995, pp. 85-117.

[27] S. L. Star, and J. R. Griesemer, “Institutional ecology,'Translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939”, *Social Studies of Science*, vol. 19, 198, pp. 387-420.

[28] B. Latour, "Technology is society made durable", in *A Sociology of monsters: essays on power, technology and domination*, J. Law, Ed. London: Routledge, 1991, pp. 103-131.

[29] L. Suchman, L. “Do categories have politics? The language/action perspective reconsidered”, *Computer Supported Cooperative Work*, vol 2, 1994, pp. 177-190.

[30] E. Monteiro, and O. Hansett, "Social shaping of information infrastructure: on being specific about the technology", in *Information technology and changes in organizational work. Proceedings of the IFIP WG8.2 working conference on information technology and changes in organizational work, December 1995*. W. Orlikowski, G. Walsham, M. R. Jones, & J. I. DeGross, Eds. London: Chapman and Hall, 1995, pp. 325-343.

[31] E. Davenport, “Translating texts into care: evidence-based healthcare and the UK nursing profession”, in *Proceedings of the ASIS Classification and Research Special Interest Group*, June 1998 (in press).

[32] G. Bowker, S. Timmermans, and S.L.Star, "Infrastructure and organizational transformation: classifying nurses' work", in *Information technology and changes in organizational work. Proceedings of the IFIP WG8.2 working conference on information technology and changes in organizational work, December 1995*. W.Orlikowski, G.Walsham, M.R.Jones, & J.I. DeGross, Eds. London: Chapman and Hall, 1995, pp. 344-370..

[33] G. Bowker, and S.L.Star, "Science, accounting and administration: the worlds of the nursing intervention classification". Paper presented at the ASIS SIGCR workshop, "Classificatory structures and the construction of reality". In *Proceedings of the 60th ASIS Annual Meeting November 1-6, Washington, 1997*. C. Schwarz and M. Rorvig, Eds. Medford, NJ: ASIS/Information Today, 1997, p. 376.

[34] G. Bowker, *Science on the run: information management and industrial geophysics at Schlumberger, 1920 - 1940*. Cambridge, Mass: MIT Press, 1994.

[35] B. Latour, and S. Woolgar, *Laboratory life: the social construction of scientific facts*, Beverly Hills: Sage, 1979.

[36] T. Erickson, “Social interaction on the Net: virtual community as participatory genre”, in *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track*. R. Sprague, Ed. Los Alamitos, CA: IEEE Computer Society Press, 1997, 13-21.

[37] T. Malone et al. *Tools for inventing organizations: toward a handbook of organizational processes. Center for Coordination Science, Massachusetts Institute of Technology, 1997*. At http://ccs.mit.edu/ccswp198/

[38] K. Crowston, *Evolving novel organizational forms.* At http://ccs.mit.edu/ccswp185.html

[39] R. J. Boland and U. Schultze. “From work to activity: technology and the narrative of progress”, in *Information*

Technology and changes in organizational work, Wanda Orlikowski, G. Walsham, M. R. Jones and J. I DeGross, Eds. London: Chapman and Hall, 1996, pp. 308-325.

[40] K. Grint, P. Case, and L. Willcocks, "Business Process Re-engineering reappraised: the politics and technology of forgetting", in *Information technology and changes in organizational work. Proceedings of the IFIP WG8.2 working conference on information technology and changes in organizational work, December 1995*. W.J. Orlikowski, G. Walsham, M.R. Jones, and J.I.DeGross, Eds. London: Chapman and Hall, 1995, pp. 39-61

[41] J. Yates, W. Orlikowski and J. Rennecker. Collaborative genres for collaboration: genre systems in digital media, in *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track.* R. Sprague, Ed. Los Alamitos, CA: IEEE Computer Society Press, 1997, 50-59.

[42] K.Hoskin, "The 'awful idea of accountability': inscribing people into the measurement of objects", in *Accountability: power, ethos and the technologies of managing*. R. Munro and J. Mouriston, Eds. London: International Thomson Business Press, 1996, pp. 265-282.

[43] J. Beniger, *The control revolution: technological and economic origins of the information society*, Cambridge, Mass: Harvard University Press, 1986.

[44] Yates, J. Control through communication: the rise of system in American management, Baltimore: Johns Hopkins University Press, 1989, 65-100.

[45] L. Edvinnson and M.S. Malone. *Intellectual capital*., New York: HarperColins, 1997.

[46] Yates, J. and Orlikowski, W.J. "Genres of organizational communication: a structurational approach to studying communication and media", *The Academy of Management Review*, vol. 17, no. 2, 1992, pp. 299-326.

[47] Orlikowski, W. And Yates, J. "Genre repertoire: the structuring of communicative practices in organizations", *Administrative Sciences Quarterly*, vol. 33, pp. 541 - 574, 1994.

[48] Grint, K. *Fuzzy management: contemporary ideas and practices at work*, New York: Oxford University Press, 1997.

[49] N. Romano,et al. "Architecture, design, and development of an HTML/JavaScript web-based group support system", *Journal of the American Society for Information Science*, vol. 49, no. 7, 1998, 649-667.

[50] K. Crowston, K. and M. Williams, "Reproduced and emergent genres of communication on the World-Wide Web", in *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track.* R. Sprague, Ed. Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 30-39.

[51] M.S. Ackerman, and D. McDonald, "Answer garden 2: merging organizational memory with collaborative help", in *Proceedings of Computer Supported Cooperative Work '96*, Cambridge MA, USA. New York: ACM, 1996, pp. 97-111.

[52] R. Procter, A. Goldenberg, E. Davenport, P. Burnhill, and S. Cannell, S. "Genres in support of collaborative retrieval in the virtual library". *Interacting with Computers*, vol 10, 1998, pp. 157-175.

[53] E. Davenport, E. and R. Procter, "Distributed expertise: remote reference service on a metropolitan area network", *The Electronic Library*, vol. 15, no. 4, 1997, pp. 271-278.

[55] M. Akrich, and B. Latour, "A summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies", in Shaping technology/building society. W.E. Bijker, and J. Law (Eds). Cambridge, Mass: MIT Press, 1992, pp. 259-264.

[56] J. Karlgren, J. and T. Straszheim, "Visualizing stylistic variation". In *Proceedings of the Thirtieth Hawaii International Conference on System Sciences. Volume VI. Digital Documents Track*, R. Sprague (Ed). Los Alamitos, CA: IEEE Computer Society Press, 1997, pp. 78-81.