Personal statement—Kevin Crowston

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This personal statement presents my view of my academic career to date. My case for promotion is based firstly on my research contributions (traditional scholarship of discovery), secondly on teaching and lastly on service, and I have organized this document to reflect that ordering. Appendix A presents publications and grant applications organized by topic to correspond to the discussion in my research statement.

Research Statement

The following pages explain my past activities and future plans as an information systems researcher interested in the organizational implications of information and communications technologies (ICT). The main focus of my research is the study of coordination in organizational processes, in order to understand what new organizational forms are enabled by the use of ICT. More recently, this work has extended to consideration of the implications of these organizational changes for industry structures. This work takes its methodology and theoretical base primarily from organization theory, using data primarily from field observation. Because this is such a broad research area, my work has spanned a number of topics, but all with a connection to this central issue of coordination in organizational processes.

Motivation for research

The range of possible organizational designs clearly depends in large measure on the availability and cost of communications and coordination. Before the invention of the telegraph, for example, real-time control of an organization was effectively restricted to the range of a manager's voice or line of sight (essentially to one building or even one room). The distributed organizations that did exist (e.g., O'Leary *et al.*, 2002) were managed by giving the manager on the spot the authority to make decisions on behalf of the organization but without the possibility of detailed coordination. The introduction of long distance communication—telegraph, and later, telephone—as well as accompanying managerial systems—made it possible to coordinate widely-separated operations more-or-less in real-time, thus enabling the development of distributed organizations such as railways or the large corporations that dominate modern economies (Yates, 1989).

Today, newer forms of ICT—electronic messaging, groupware, the Internet, expert systems—are again radically changing the cost of communications and decision making. There are numerous examples of companies making effective use of these technologies. For example, Oticon, a Danish hearing aide manufacturer, used electronic messaging and document retrieval to allow all headquarters staff to work in quickly assembled ad hoc project teams, greatly improving the company's responsiveness (Bjorn-Andersen & Turner, 1998). The Virtual Factory (Katzy & Crowston, 2000) is composed of numerous companies cooperating as a virtual organization. Most strikingly, distributed self-organizing teams of Free/Libre/Open Source Software (FLOSS) developers produce reliable and popular software without working for a

common organization (or in many cases, being paid at all). To capture such benefits of ICT, many corporations are now involved in business process reengineering (BPR), the radical transformation of business processes, often relying on ICT. For each success, however, there are undoubtedly several less public failures. For example, even proponents of BPR estimate that 70% of these efforts fail (Hammer & Champy, 1993, others suggest failure rates from 10–80%).

Overall, we do not yet fully understand how these technologies will affect organizations or what businesses should be doing to take advantage of them, any more than we can clearly articulate the overall effects of earlier generations of technology such as the telephone or the book. I believe that this situation is a reflection of the atheoretic nature of most redesign efforts. I have therefore chosen to focus my research on the in-depth analysis of novel organizations, development of theories that describe and explain the roles ICT do and can play in organizational processes, and the implications for this use on individual work and organizational and industrial structures. My main contribution in this area has been the focus on processes and in particular the use of coordination theory as an analysis approach. I find this area interesting because it approaches a recognized problem— improving organizational effectiveness—from a new direction—analysis of ICT and organizational processes—thus providing insights for current research as well as creating possible benefits for the practice of management.

The remainder of this document is organized into four sections. The first section presents the framework I use in thinking about the connection between ICT and organizations. This framework is centred on the notion of process and coordination. The following sections discuss in turn my research on the central topic of analysis and modelling of coordination in organizational processes, followed by research on the design and assessment of information technologies and studies of novel organizational forms.

Introduction: The organizational impacts of information technology

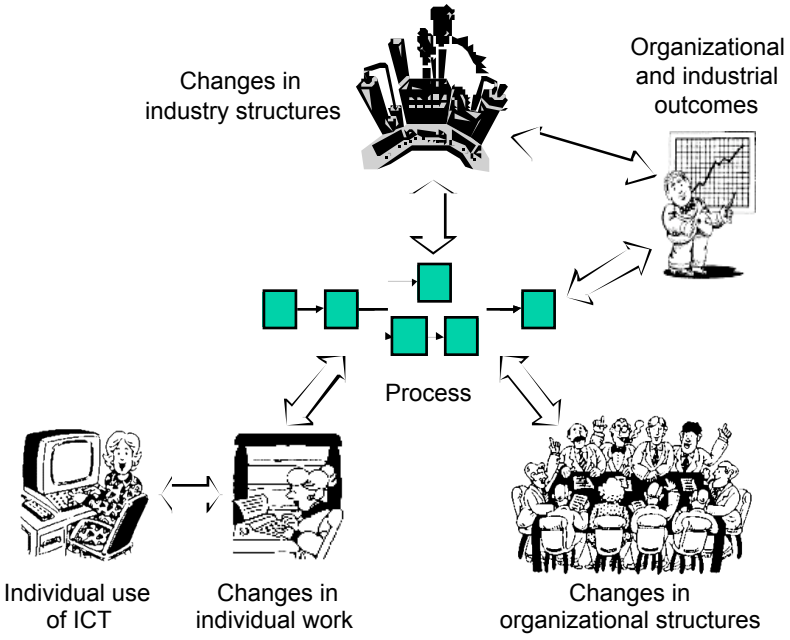
In this section, I describe the framework I use to conceptualize how the use of ICT affects organizational performance. In my view, technology, embedded in various systems—e-mail, conferencing, decision-support, etc.—does not affect organizational performance directly. Indeed, the lack of a link is at the core of the "productivity paradox": information technology has become the largest component of business investment and yet few studies show any overall effects on organizational productivity despite obvious changes in how individuals work. More recent evidence suggests that overall productivity improvements occur only when managers and employees learn how best to use technology (Brynjolfsson & Hitt, 2000). Therefore, it is important to explore the link between technology and performance to facilitate this learning.

I first touched on the question of ICT and organizational performance in a conference paper (Crowston & Treacy, 1986), where I argued that some kind of theory of the organization was necessary to fill the "black box" between technology and organizational performance. In a later book chapter surveying the literature on the impacts on organizations of information technology (at the time, primarily mainframe computing) (Crowston & Malone, 1988a), I considered four perspectives that might be applied. My current work links the individual,

organizational and industrial levels with a focus on organizational processes (Markus & Robey, 1988), as shown in the figure below and described in (Crowston, 2000).

My view of the relation between ICT and organizational or industrial outcomes starts with the recognition that the mere existence of some system is unlikely by itself to directly affect an organization. Instead, ICT use has an impact first by affecting how individuals work (and vice versa). At the individual level, computing and communication technologies are increasingly merging into work in ways that make it impossible to separate the two (Bridges, 1995; Gasser, 1986; Wigand *et al.*, 1997; Zuboff, 1988). Examples of such pervasive ICT abound, from the mundane—telephones, fax machines and ATMs—to the sophisticated—enterprise-wide resource management, financial trading and manufacturing control systems. More specifically, the use of ICT affects the performance of basic organizational functions such as organizational communication and memory. For example, the use of e-mail makes some functions much cheaper, e.g., communications (e.g., one-to-many broadcasts), memory (e.g., searching of individually archived e-mail), and so on. Of course, technologies are not panaceas—sending an email may be cheap but risks overloading recipients with irrelevant messages (or spam), searching does not always mean finding, and an old email message read out of context can be impossible to interpret. Nevertheless, appropriate uses of ICT can radically alter the shape of the organizational design space.

To analyze the range of organizational possibilities, I adopt a perspective of organizations as recurrent patterns of communication and focus on how individuals communicate and enact processes while being guided by the organizational context. In this view, uses of ICT are enacted by individuals who, through their actions, change the conduct of their work in response to the capabilities of these technologies. For example, literature highlights changes in the way software developers use computer-aided software engineering (CASE) tools (Orlikowski, 1993) or electronic meeting systems (EMS) (Sawyer *et al.*, 1997), engineering technicians use computer-



aided design (CAD) tools (Kelley, 1990), help-desk personnel use Lotus Notes (Orlikowski *et al.*, 1995), and telephone operators use new information systems (Kraut *et al.*, 1989). Of course, changes in work also affect the use of ICT, as indicated by the double-headed arrows in the figure. In this sense, a process is a form of structure (in the sense of structuration theory) and thus this view is congruent with a practice approach to studying organizations (Orlikowski, 2000). The framework also suggests the value of studying the nature of an individual's interaction with the technology more specifically, e.g., to understand what makes a system more or less useable and useful in a particular process.

Simply changing the way individuals communicate does not necessarily improve an organization's performance, of course. Rather, individual-level changes in work lead in turn to changes in the organizations in which the work is done. These effects manifest themselves first as changes to *organizational processes* and perhaps eventually to changes in *organizational structures*. *Organizational processes* reflect the choice and sequencing of tasks to accomplish intended outcomes. For example, a car company has processes for designing cars, purchasing parts and assembling them; a software company, for determining requirements and writing code; and a restaurant, for seating customers, taking orders and preparing and serving food. An organization's performance is improved by changing the relevant processes. For example, to make a restaurant more efficient (i.e., lower cost per customer served), a manger might change the process for serving customers to reduce waiting time and thus increase the number of customers served per unit time (which may or may not be good for the overall effectiveness of the restaurant, of course). To conceptualize the linkage between the use of ICT and changes in processes, I consider in particular the how the use of ICT affects the relative cost of different coordination mechanisms. Coordination mechanisms are the topic of coordination theory, which is discussed in more detail below. It is this link that has been largely missing in earlier research, and which is a key contribution of my research.

Organizational structures (in the non-structuration theory sense) include how people are organized for reporting and dissemination of information For example, in Crowston, Malone and Lin (1987), I described a company that introduced a computer-conferencing system to link plant human resource managers to the specialists at headquarters. This system made it possible for the first time for plant-level personnel to see questions asked by their peers and to participate in discussions (formerly, they had communicated only with an intermediate level of managers who provided expert guidance). As a result, the firm was able to have headquarters specialists interact directly with plant personnel.

The analysis above can be extended to consider the effects of ICT on industrial structures. Again, I approach this question by considering how changes in organizational processes have implications for *industrial structures* and *value-chains* (Baker, 1990). *Industrial structure* includes the division of work among companies (i.e., the position of firm boundaries) and the *industrial value-chain* can be seen as processes extended across multiple firms. In other words, as individual workers use various forms of ICT in their work, they alter both how they conduct their work and how they participate in the organization's structure, and thus indirectly

how their organizations participate in the industry-wide value-chain. As an example, toll free (1–800) telephone numbers and more recently, the World Wide Web and electronic ticketing, enable airlines to sell their tickets directly to the public, bypassing (or disintermediating) travel agents and thus reshaping this industry (Lewis *et al.*, 1998).

The framework presented in this section has been applied most completely in a study of the impact of ICT in the real estate industry. This work was supported by two grants from the NSF, IIS Grant 97-32799, "A multi-method multi-level pilot study of the use of information technology in real estate" and IIS 00–00178, "Towards friction-free work: a multi-method study of the use of information technology in the real estate industry" (both with Rolf Wigand and Steve Sawyer). Real estate has been a particularly interesting industry to study because it is information-intensive and experiencing IT-related change. We began this study to test predictions of disintermediation of real estate agents caused by Web access to property listings and other uses of ICT.

Our research has resulted in a number of conference and journal papers, including (Crowston *et al.*, 1999; Crowston *et al.*, 2001; Crowston & Wigand, 1999; Myers & Crowston, 2004; Sawyer *et al.*, 2000; Sawyer *et al.*, 1999; Sawyer *et al.*, 2003; Wigand *et al.*, 2001). We are currently analyzing the results of a national survey of agents regarding their ICT use. Our preliminary analysis suggests that for US real estate agents, the level of strong ties to other professionals are more predictive of overall earnings than are weak ties to potential clients. We interpret this result by noting that a real estate transaction is embedded in a sequence of other transactions (i.e., is part of a larger sales process) and that ICT affects some steps of these process (e.g., finding a listing) but not others (e.g., moving the transaction to the close). Strong ties from agents to other professionals are particularly valuable for the parts of the process that ICT has not affected.

In the remainder of this document, I discuss research related to different pieces of the framework: analysis and modelling of organizational processes, including coordination theory (the centre of the figure), design and assessment of information technologies (the lower left portion of the figure), and analysis of novel organizational forms (the lower right portion of the figure).

Analysis and modelling of coordination in organizational processes

My initial research focused on the analysis and modelling of coordination in organizational processes, and this work is the foundation for my current research. Some of my early papers presented an object-oriented approach to representing mechanisms and processes. The case studies in my dissertation were documented using an object-oriented logic modelling technique, which is an extension of one I developed for an earlier study of the use of computer conferencing (Crowston et al., 1987). The technique is described briefly in a book chapter (Crowston, 1991a) and developments have been reported at several conferences and workshops. An integral part of this technique is determination of the kinds of messages organizational actors send each other, an analysis that led to my current interest in document genre (discussed below).

My primary contribution in this area has been work on and with coordination theory (Malone & Crowston, 1990, 1994). Since its initial presentation, coordination theory has been applied by a number of researchers in a variety of settings, as shown in a review that two students and I recently completed (Crowston *et al.*, In press-b). The basic ideas behind coordination theory are simple. Processes are composed of activities that require and create resources. For example, in software bug fixing, a process I studied in my dissertation (Crowston, 1991b), activities include determining that a bug exists, creating a patch for a bug and integrating the patch into the system. Resources include a description of the bug and software modules as well as the efforts of the programmers. The key notion in coordination theory is dependency, created by the interplay between activities and resources and requiring additional work to manage. For example, only someone with specialized skills can create a patch, so additional work is necessary to find an appropriate programmer (a task assignment problem). When multiple bugs need to be fixed in a single software module, then additional work is necessary to ensure that the changes made do not conflict with each other (a shared resource problem).

In my dissertation (Crowston, 1991b), I studied engineering change management processes in three large manufacturing companies. The main theoretical result of this research was a typology of different coordination problems and methods used to manage them in these processes. This dissertation won the International Centre for Information Technology prize for best dissertation in 1991 and was a runner-up for the International Conference on Information Systems thesis prize the following year. The typology has recently been published as a book chapter (Crowston, 2003a). More recent work focused on applications of the framework. For example, one paper examined mechanisms used in air, land, sea and railroad transportation for collision avoidance as a coordination problem, specifically, as a resource allocation problem (Crowston, 2003b).

Most of my papers use the typology to generate alternative processes, in particular, processes enabled by the use of ICT. Again, the basic idea is straightforward: given a process, one way to generate alternative processes is to consider how alternative coordination mechanisms could replace the ones currently used. This approach seems especially useful for analyzing the effects of information technologies, since coordination mechanisms are primarily information processing tasks. Indeed, Malone, Yates and Benjamin (1987) predict a shift towards more coordination-intensive forms as information technologies differentially reduce the cost of coordination. The review paper mentioned above includes a coordination theory analysis of service processes at two TGI Friday's restaurants, one with and one without a computerized seating and communications system. Our analysis shows that the ICT has an impact on these processes by changing the way producer-consumer (or flow) dependencies are coordinated, illustrating the value of a coordination theory analysis. Another article (Crowston, 1997a) analyzed the software bug fixing process I studied in my thesis; alternative processes are developed by considering alternative mechanisms for assigning bug-fixing tasks to programmers, such as first-come-first-served, specialists or even bidding, and for managing the resulting resource dependencies. This work led directly to my current study of Free/Libre/Open Source

Software development teams, described in detail below. A recent book chapter compared the bug fixing process for proprietary software to the process for Linux (Crowston, In press).

Other papers operationalize coordination theory by presenting a method for analyzing dependencies. With Charlie Osborn, I published a book chapter presenting a dependency analysis technique, which we hope will allow it to be more widely applied (Crowston & Osborn, 2003). The approach pioneered in these papers was extended greatly in the Process Handbook project, of which I was one of four principal investigators (Malone *et al.*, 2003; Malone *et al.*, 1999). The project has three major components: development of techniques for representing processes, collection of descriptions of processes from a variety of organizations and development of computer software to allow these descriptions to be easily searched and compared. The work has resulted in three patents and has since been spun off to a start-up.

I have also done some work that considers the strengths and limitations of coordination theory. Ericka Kammerer and I studied software requirements development in two companies that develop very large real-time software systems. Our article (Crowston & Kammerer, 1998) compares coordination theory with Weick and Roberts' collective mind perspective (Weick & Roberts, 1993). The two perspectives complement each other nicely: coordination theory suggests what individuals need to do to develop requirements and what they need to know, while the collective mind perspective suggests how they come to know those things. The combination of these two perspectives has informed much of my subsequent work, as will be noted below. More recently, with Barbara Scozzi, Claudio Garavelli and I compared a variety of process modelling approaches that might be useful to small and medium enterprises (Scozzi *et al.*, 2005).

Design and assessment of information technologies

My second area of research focuses on the design and assessment of new information systems (the lower left part of the figure). Systems designers have become much better at designing usable systems for individuals, but our understanding of the principles of design for groups or entire organizations is less well developed. I have done some work exploring the design of systems to support group work. For example, I was involved with the design and assessment of the Information Lens project at MIT (Mackay *et al.*, 1989; Malone *et al.*, 1989). I have also explored the possibilities of intelligent software agents (Crowston & Malone, 1988b) and the diffusion of the Web (Chen & Crowston, 1997).

My recent work in this area has focused on the study the genre of digital documents with an eye towards system design. My interest in document genre was originally sparked by my efforts to model organizational communications in terms of different message types (discussed above). Document genre is defined as "a distinctive type of communicative action, characterized by a socially recognized communicative purpose and common aspects of form" (Orlikowski & Yates, 1994, p. 543). Genres are interesting because they are social constructions that embody a community's communicative practices, and are thus an important element of an information system taken in the broadest sense. As technology enables new forms of communication, the set

of genres in use evolves, providing insight into how users are adopting and adapting to technology.

Marie Williams and I published two conference papers and one journal article on this topic. In the first paper (Crowston & Williams, 1997), we examined a sample of Web pages to determine what genres are currently in use and to see if new genres were beginning to emerge on the Web. An extended version of this paper has been published as a journal article (Crowston & Williams, 2000). In the second paper (Crowston & Williams, 1999), we examined a particularly common genre, the Frequently Asked Questions document, or FAQ, to see how the ability to link pages changed this genre.

Currently, Barbara Kwasnik and I (along with doctoral students Joe Rubleske, You-Lee Chun and John D'Ignazio) are exploring how exploitation of the dual nature of genres, purpose and form, might be used to improve information access systems, such as Web search engines. After many tries, we recently received NSF support for this work (NSF IIS Grant 04–14482, 2004–2006, $302,685). The project is based on the observation that humans rarely have to read every word of every document to be able to use them effectively. Instead, they start by identifying the kinds of documents they are faced with, then use different types of documents in appropriate ways. For example, a grant proposal is used differently from a syllabus, a product brochure or a bank statement. We hypothesize therefore that information-access systems would be more useful for many tasks if they could similarly distinguish the genre of documents. To do so, systems could take advantage of the dual nature of genres. On the one hand, genres have recognized purposes, so a user's information use task is likely to be satisfied by documents of particular genres (and not by others). On the other hand, genres exhibit regularity of form, so it should be possible to use machine-learning techniques to automatically recognize the genre of a document.

We are presently conducting a series of human-centered studies of information use by K-12 teachers and journalists to develop our understanding of genre and its role in information use. The output of this phase of the study will be a taxonomy of genres based on the users' terms and linked to their information use tasks, and a corpus of pages with identified genres. The study will next include the development and preliminary testing of genre-enhanced interface prototypes for information access tools. This study is in its first year, but has begun to yield a series of papers, including (Crowston & Kwasnik, 2003; Kwasnik & Crowston, 2004; Kwasnik *et al.*, 2000). We have also been able to lead in the further development of this research area by organizing a HICSS mini-track (for two years) and editing a special issue of the journal *Information, Technology and People* (Kwasnik & Crowston, 2005).

Studies of novel organizational forms

My final research area builds on the ideas of earlier sections, but focuses more specifically on understanding novel kinds of organizations that have emerged with the extensive use of ICT in particular contexts. This area is the current focus of much of my activities. One set of papers considers the economic impacts of information technology on business-to-consumer

electronic commerce. One project examined the impact of Internet buyers' agents (that is, programs that search vendors' offerings to find the best price) on prices and the behaviour of vendors. This work has resulted in a conference paper (Crowston, 1996), a research-in-progress presentation at ICIS (Crowston, 1997b) and a journal article (Crowston & MacInnes, 2000). I have also done some work with a PhD student, Nelson Massad, on customer satisfaction with electronic commerce service encounters (Massad *et al.*, In Press).

Recently, my primary interest has been in the area of virtual organizations. Virtual organizations are those that appear to the outside world to be a single organization but where the work is done by multiple cooperating companies. One unpublished paper (Katzy & Crowston, 2000) discussed an action research study of a virtual organization in the precision machining industry in Germany. This paper presents a model of how the competencies of multiple companies can be "rallied" into a coordinated effort. We are currently revising this manuscript and plan to resubmit it this fall. A second paper in preparation presents a case study of a system development project in a different virtual organization, ARC Transistance, the alliance of European automobile clubs (Katzy *et al.*, 2005).

Other work has unpacked the word "virtual" to provide a more precise meaning for this over-used term. Mary-Beth Watson-Manheim, Kathy Chudoba and I published a paper (2002) that suggested that one way to think about virtual work is a work characterized by numerous discontinuities: a lack of coherence in some aspects of the work setting (e.g., organizational membership, business function, task, language or culture). We are currently working on a paper analyzing how discontinuities are perceived by workers in virtual settings. Understanding these discontinuities is important as they hinder members in making sense of the task and of communications from others (van Fenema, 2002), or that produce unintended information filtering (de Souza, 1993) or misunderstandings (Armstrong & Cole, 2002), making it hard for team members to develop shared mental models (Curtis *et al.*, 1990, p. 52; Espinosa *et al.*, 2001) (or to develop collective mind, to use Weick and Robert's (1993) term). A lack of common knowledge about the status, authority and competencies of team participants can be an obstacle to the development of team norms (Bandow, 1997, p. 88) and conventions (Mark, 2002). An empirical paper in preparation examines the types and frequency of meetings to understand how virtual work is becoming in this organization.

A particularly prominent example of virtual organizations enabled by the use of ICT can be found in the recent blossoming of Free/Libre/Open Source Software[1] (e.g., Linux or Apache). FLOSS is a broad term used to embrace software developed and released under an "open source"

1 The free software movement and the open source movement are distinct and have different philosophies but mostly common practices. The licenses they use allow users to obtain and distribute the software's original source code, to redistribute the software, and to publish modified versions as source code and in executable form. While the open source movement views these freedoms pragmatically (as a development methodology), the Free Software movement regards them as human rights, a meaning captured by the French/Spanish word 'libre' and by the saying "think of free speech, not free beer". (See http://www.gnu.org/philosophy/ and http://opensource.org for more details.) This paper focuses on the development practices of these teams, which are largely shared across both movements. However, in recognition of these two communities, I use the acronym FLOSS, standing for Free/Libre and Open Source Software, rather than the more common OSS.

license allowing inspection, modification and redistribution of the software's software. There are thousands of FLOSS projects, spanning a wide range of applications. Due to their size, success and influence, the Linux operating system and the Apache Web Server and related projects are the most well known, but hundreds of others are in widespread use, including projects on Internet infrastructure (e.g., sendmail, bind), user applications (e.g., Mozilla, OpenOffice) and programming languages (e.g., Perl, Python, gcc) and even enterprise systems (e.g., eGroupware, Compiere, openCRX).

FLOSS project teams are the setting for much of my current research. This work has been supported by a series of grants from the NSF (NSF IIS SGER Grant 03–41475, 2003–2004, $12,052, NSF IIS Grant 04–14468, 2004–2006, $327,026, with a third presently under review with positive feedback) and involved a number of doctoral students (Hala Annabi, James Howison, Yeliz Eseryel, Kangning Wei and Qing Li). Key to our interest is the fact that most FLOSS software is developed by dynamic self-organizing distributed teams comprising professionals, users (von Hippel, 2001; von Hippel & von Krogh, 2002, 2003) and other volunteers working in loosely coupled teams. These teams are close to pure virtual teams in that developers contribute from around the world, meet face-to-face infrequently if at all, and coordinate their activity primarily by means of computer-mediated communications (CMC) (Raymond, 1998; Wayner, 2000). The teams have a high isolation index (O'Leary & Cummings, 2002) in that most team members work on their own and in most cases for different organizations (or no organization at all). For most FLOSS teams, distributed work is not an alternative to face-to-face: it is the only feasible mode of interaction. While these features place FLOSS teams towards the end of the continuum of virtual work arrangements, the emphasis on distributed work makes them useful as a research setting for isolating the implications of this organizational innovation.

My first paper in this area, written with Barbara Scozzi, analyzed FLOSS teams using the framework developed with Bernhard Katzy for the Virtual Factory (Crowston & Scozzi, 2002). Subsequent papers have presented a research model for studying FLOSS team practices (Crowston *et al.*, 2005a) and examined parts of this model, including the nature of success for FLOSS teams (Crowston *et al.*, 2003; Crowston *et al.*, In press-a), team social structure (Crowston & Howison, 2005, In press; Crowston *et al.*, 2006) and coordination of development processes (Crowston *et al.*, 2005c). With Robert Heckman, I am starting to look at the nature of leadership for these teams (Crowston *et al.*, 2005b).

Academic interest in FLOSS development has increased substantially in the past few years, and I have been able to play a small role in shaping the development of this research area through participation in some of the early conferences. Examples of recognition of this status was an invitation to give a keynote address for conference on *Empirical Assessment of Software Engineering* and to contribute a position paper for a special issue of the journal *First Monday* on Open Source Software (Crowston, 2005). I have also sponsored the development of shared resources for the community through the FLOSSMole project (http://ossmole. sourceforge.net/), a repository for data on FLOSS teams (Conklin *et al.*, 2005; Howison *et al.*, 2005). More

recently, I have taken on more of a leadership position in this field, by organizing a HICSS mini-track on *Empirical Studies of Open Source Software Development* (now in its second year) and by joining the organizing committee as panel chair for an upcoming *International Conference on Open Source Software* (to be held in Como, Italy in June 2006). We hope that the conference will provide a basis for organizing an IFIP Working Group on the topic of Open Source Software. Reflecting my broader interest in virtual organizations, I will serve as program co-chair for the 2007 IFIP WG 8.2 Working Conference on *Virtuality and Virtualness*, to be held in Portland, Oregon, USA in the summer of 2007.

In summary, my work has spanned a number of topics, but always with a connection to the central theme of coordination and organizational processes. I believe my research output taken as a whole makes an important contribution to the theory and practice of advanced information systems development and technology-based organizational design.

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Statement of Teaching and Advising Philosophy

The following pages briefly describe my approach to teaching and advising. At the undergraduate and masters level, I have taught two kinds of courses: introductory courses in information systems (e.g., IST 155, CIS 301 and CIS 551) and electives in technical topics such as telecommunications (e.g., IST 452, IST 656 and CIS 580), electronic commerce (IST 342), database (IST 659) and most recently systems analysis (IST 352). At the doctoral level, I have taught several doctoral-level courses, including a seminar on information systems and organizations (IST 830) and an introduction to research design (IST 776) and statistics (IST 777) as well as serving as director of the School's PhD program.

From teaching introductory information systems courses, I've had to reassess what professional students should learn about information systems and information and communications technologies (ICT). Three trends shape my thinking. First, ICT is fundamentally changing the rules for doing business, as I've argued in my research statement, and students must have some understanding of the threats and opportunities created by these changes. Second, many of our students will be directly involved in implementing systems, and all need enough of an introduction to systems development to be an informed participant in a project, or even the responsible manager. Finally, students will use ICT throughout their careers. All will use personal productivity applications (spreadsheets or word processors) themselves; most will interact with larger corporate systems, such as E-mail, and various transaction processing and management information systems. To be effective in their use of these systems, students need some understanding of their capabilities and functionality.

Given the importance of the first two trends, I feel that an introductory course for our information-technology-majors must focus first on attitudes or points of view about information and ICT. Students need to see ICT as a means to an end rather than an end in itself (which often seems to be the dominant mode of thinking of first-year students). Syracuse's strong user orientation is one that I take seriously and try to convey to all our students. Second, students need to build an awareness of issues in the use of ICT and be prepared to take action when these issues arise. However, given the third trend and the initial mindsets of most students, there is a constant tension between giving students the technical skills they want for their first job and giving them the viewpoints they need (or we believe they need) to be productive throughout their careers. This tension is reflected in the uniformly lower student satisfaction with introductory core courses.

On the other hand, the electives I've taught have become increasingly technology focused. For a decade, I taught the technology of telecommunications, first in a general course at Michigan and in two electives at Syracuse, IST 656, Information networking technologies, and IST 452, Local area networks. Telecommunications is changing even more rapidly than other areas of information technology, driven by widespread deployment of digital technology. Formerly distinct industries such as telephone, cable TV, data transmission and computing are rapidly converging, and entirely new industries, such as interactive entertainment, on-line

services and the Internet are constantly emerging. My course on electronic commerce addressed a related field with many of the same characteristics. These on-going developments make these courses exciting to teach but also challenging to keep current. Essentially all the course material has been replaced since I started teaching these courses (and having not taught these courses for several years, I'm basically obsolete). On the other hand, database and systems analysis represent somewhat more stable technologies, though even there it is important to understand new developments and incorporate them as appropriate.

This continued technological evolution has convinced me of the importance of concentrating these courses on the underlying design principles involved in the subject. Such an approach is commonly applied in doctoral-level courses, such as research design, which emphasize basic principles such as reliability, validity or generalizability. Specific research designs are then examined to understand the trade-offs involved between these principles. However, I strongly believe that courses at all levels can benefit from a focus on design principles rather than just technology. Current technologies can be understood as illustrations of these principles and the trade-offs among them. For example, if students learn the details of IP and IP routers, then they will understand something about how the current Internet works. However, when the next generation Internet is deployed, they will have a new set of terminology and details to learn. By contrast, if they learn the principles by which IP and routers are designed (e.g., addressing, route discovery, the need for flow control and error control, etc.) they will not only understand the current Internet, but also why the next generation was necessary and what problems it fixes (and creates). A challenge in teaching electronic commerce and other technical topics is to identify and communicate a similar set of core principles. For example, in systems analysis, I emphasize the role of modelling techniques as a way to describe part of the world in order to communicate to someone else. This stance deemphasizes "right" vs. "wrong" descriptions in favour of verisimilitude or even just helpfulness for a developing taking the next step in system development.

Finally, my most basic belief is that students need to confront material in-depth to really learn and internalize it. For example, I like the focus in the telecommunications electives on principles because it seems to lead to this deeper level of understanding. Similarly, I have designed the electronic commerce, database and systems analysis courses around a major group project that integrates business and technological concerns. I am happy that my courses are usually seen as challenging. Unfortunately, my desire to challenge students is sometime interpreted as not caring about their progress, something I have tried to work on.

I have also been involved in student learning beyond regular classes. I've advised several masters and undergraduate independent studies and served on a number of PhD committees, both at Michigan and at SU. My major contribution in this area has come as director of the School's PhD program. As director, I've mostly maintained the established philosophy of the program, which is an apprenticeship model. We believe that the most effective and long-lasting way for students to learn to be researchers is by being actively involved in research through the program. Reflecting this belief, our students are involved in research from the week they begin the

program until they graduate (and hopefully throughout their careers). The initial vehicle for intensive research interaction is research practica, semester-long one-on-one hands-on research learning opportunities taken with coursework.

Of course, coursework is also an important mode for PhD student learning. As director I have overseen the PhD Program Committee's revisions to the sequence of research methods courses and most recently, topical seminars. I've paid particular attention to the particular challenges of educating students in an inter-disciplinary program. My belief is that while the program is inter-disciplinary, students must obtain a solid base within and an identification with a particular discipline to be successful. Choosing the right level of detail for the seminars poses a particular challenge, since the more specific the focus, the more in-depth the course but the fewer the number of students for whom the course is relevant. On the other hand, a program can not be composed entirely of survey courses. Our current solution is a mix of broader seminars and more focused independent reading courses to allow a high degree of tailoring to the specific needs and interests of students. The program director has a key role to play, since she or he is the only one to participate in every student evaluation and end of coursework meeting (our equivalent of qualifying exams). An important part of my job as director is to ensure that students understand the process of the PhD program and of the profession they seek to join.

More generally, in advising students, my general philosophy is that I am there to provide advice, but not direction. Students must ultimately be responsible for their own education and I encourage them to take on this responsibility from the start. I do my best to provide useful feedback on a student's decisions, but ultimately, it is up to them to choose their direction. I let them make their own decisions, while pushing them to justify their choices.

Summary of Service Contributions

I have briefly summarized my service contributions in the accompanying tables, divided between service to the School of Information Studies and Syracuse University and service to the profession. Service at the University is time-consuming and sometimes unrewarding, but it is part of the social contact and the price we pay for control and ownership of our school. I much prefer to spend time debating the school's overall strategy or working on a program's direction than to have these decisions dictated by the powers-that-be. My most significant contribution in the School has come as director of the School's PhD program (though in some ways, my most lasting impact may have been in finding new faculty as chair of the search committee). This contribution has been discussed in more detail as part of my teaching statement. I was fortunate to take over a program that was already in good shape, and could therefore devote my attention to its enhancement. For example, Abby Goodrum and I (with help from Jana Bradley and Gisela von Dran) received a grant from the Institute for Museum and Library Studies to fund 5 fellowships for PhD students interested in librarianship. In recent years, I have also served on a few University-wide committees and was recently elected as chair of one.

Most of my service to the profession has come as a reviewer or program committee member (because of my diverse mix of interests, I review about 20–25 papers a year, not including those for the conference mini-track I organized). In the past few years, I have taken on increasing responsibilities as an Associate Editor for the journals *Information, Technology and People* and *Journal of Information Technology Theory and Applications (JITTA)*. I am also involved in the management of the IFIP Working Group 8.2 on Information Systems and Organizations, having managed its Web site for some years and organized two OASIS workshops. In the coming years, I will be extending my work on conferences, serving as panel chair for the *2nd International Conference on Open Source Software* in 2006 and as co-Program chair for the *IFIP WG 8.2 Working Conference on Organizational Virtuality and Virtualness.*

Service to the School of Information Studies and Syracuse University

School of Information Studies, Syracuse University

1997–1998	**Member, Personnel Committee**.
1997–2002	**Member, Faculty Search Committees**. **Chair** 2001–2002.
2001–	**Director, PhD Program** in Information Science and Technology (formerly, Information Transfer)**.**

Syracuse University

1999–	**Elected Member, Faculty Senate** **Senate Subcommittee on Curriculum** (1999–2003). **Subcommittee on Administrative Operations** (2003-2004). **Subcommittee on Computing Services** (2004–); Chair (2005–).

Service to the profession

Outside reviewer for *Management Science*, *Information Systems Research*, *MIS Quarterly*, *IEEE Transactions on Software Engineering*, *ACM Transactions on Information Systems*, the National Science Foundation, Science Foundation Ireland and numerous other journals and conferences.

Member of the editorial board of the *Electronic Journal of Organizational Virtualness*.

Associate Editor, *Information, Technology and People* and *Journal of Information Technology Theory and Application (JITTA)*.

Webmaster for IFIP 8.2 Working Group. (See http://www.ifipwg82.org/)

Workshops and working conferences organized:

1992	**Organizer** (with Brian Pentland), ICOS *Working Conference on Generative Theories of Organization*, January 17-19. Organized 3 day working conference for researchers interested in generative models.
1992–1993	**Organizer**, ISEF *Special interest group on Business Process Redesign*. Organized bi-annual 1 day meetings for members of industry associates group.
1994	**Organizer**, *IFIP Working Group 8.2, Oasis '94 Workshop*, Vancouver, BC, December 17. Organized half-day workshop for researchers on Information Systems and Organizations.
1994	**Organizer** (with Robert Halperin and Jin-tae Lee), CSCW Workshop, *The cobbler's children: How can and should we use CSCW tools in our own work?*, October 22. Organized 1 day workshop on CSCW support for CSCW research community.
1997	**Organizer** (with Bernard Katzy), *Workshop on Virtual Operations and Agile Organizations*, Rotterdam, The Netherlands, August 23. Organized two-day workshop for European researchers.
2001	**Organizer** (with Joe Nandhakumar and John Venable). *IFIP Working Group 8.2, Oasis 2001 Workshop*, New Orleans, LA, December 16. Organized one-day workshop for researchers on Information Systems and Organizations.
2004–2005	**Chair** (with Barbara Kwasnik). Mini-track on *Genre of Digital Documents*, HICSS 2004 & 2005.
2005–2006	**Chair** (with Hala Annabi). Mini-track on *Studies of Open Source Software Development*, HICSS 2005 & 2006.
2006	**Panels Chair** and member of organizing committee. *OSS2006 Conference*, Como, Italy, June.
2007	**Program Co-Chair**. *IFIP Working Group 8.2 Working Conference on Organizational Virtuality and Virtualness.*

Appendix: Publications and grant applications organized by topic

1. Organizational and industrial impacts of information and communications technology

1986 Crowston, K. and Treacy, M. E. Assessing the impact of information technology on enterprise level performance. In *Proceedings of the Sixth International Conference on Information Systems (**ICIS 1986**)* (pp. 299-310). Indianapolis, IN.

1988 Crowston, K. and Malone, T. W. Information technology and work organization. In M. Helander (Ed.), *Handbook of Human-Computer Interaction* (pp. 1051-1070). Amsterdam: **Elsevier Science** Publishers B.V. (North-Holland).

Reprinted in Thomas J. Allen and Michael S. Scott Morton (Eds), *Information Technology and the Corporation of the 1990s* (pp. 249–275). New York: **Oxford**, 1994.

2004 Sawyer, S. & Crowston, K. Information systems in organizations and society: Speculating on the next 25 years of research. In **IFIP WG 8.2** Conference on "Relevant Theory and Informed Practice: Looking Forward from a 20-year Perspective on IS Research", Manchester, UK, July.

2004 Crowston, K. & Myers, M. D. Information technology and the transformation of industries: Three research perspectives. ***Journal of Strategic Information Systems***, *13*(1), 5–28.

1.1 ICT in real estate

1999 Crowston, K. and Wigand, R. Real estate war in cyberspace: An emerging electronic market? ***International Journal of Electronic Markets***, 9(1–2), 1–8.

2000 Sawyer, S., Crowston, K., Allbritton, M. and Wigand, R. How do information and communication technologies reshape work? Evidence from the residential real estate industry. Research-in-progress paper, *International Conference on Information Systems (**ICIS 2000**)*, Brisbane, Australia, December 10–13.

2001 Crowston, K., Sawyer, S. and Wigand, R. Investigating the interplay between structure and technology in the real estate industry. ***Information, Technology and People***, *15*(2).

2001 Wigand, R., Allbritton, M., Crowston, K. & Sawyer, S. Information and communication technologies in the real estate industry: Results of a pilot survey. In *European Conference on Information Systems (**ECIS 2001**)*, Bled, Slovenia, 27-29 June.

2003 Sawyer, S., Crowston, K., Wigand, R., and Allbritton, M. The social embeddedness of transactions: Evidence from the residential real estate industry. ***The Information Society***, *19*(2), 135–154.

2004 Myers, M. D. & Crowston, K. Will real estate agents survive? The transformation of the real estate industry by information technology, ***University of Auckland Business Review***, *6*(1), 1–13.

2005 Sawyer, S., Wigand, R. & Crowston, K. Redefining access: Uses and roles of information and communication technologies in the US residential real estate industry from 1995 to 2005. ***Journal of Information Technology***, *20*(4).

Grant applications:

NSF IIS Grant 97-32799, 1998–1999, $70,000 for A multi-method multi-level pilot study of the use of information technology in real estate (with R. Wigand and S. Sawyer).

NSF IIS Grant 00–00178, 2000–2002, $269,969, for Towards Friction-Free Work: A Multi-method Study of the Use of Information Technology In the Real Estate Industry (with R. Wigand and S. Sawyer), 2001–.

Unfunded NSF Grant IIS–0105966, ITR/PE: Strength in the middle: Contrasting models of intermediation and the uses of information technology across industries (with R. Wigand and S. Sawyer).

2. Analysis and modelling of organizational processes

2005 Scozzi, B., Garavelli, C. & Crowston, K. Methods for modeling and supporting innovation processes in SMEs. ***European Journal of Innovation Management***, *8*(1), 120–137.

2.1 Object-oriented process models

1987 Crowston, K., Malone, T. W., and Lin, F. Cognitive science and organizational design: A case study of computer conferencing. ***Human Computer Interaction***, 3, 59-85.

Originally appeared in Proceedings of the Conference on Computer Supported Cooperative Work (pp. 43–61). Austin, TX: ACM, 1986.

Reprinted in I. Grief (Ed.) *Computer-supported cooperative work: A book of readings* (pp. 713–740). San Mateo, CA: Morgan Kaufmann, 1988.

1991 Crowston, K. Modelling coordination in organizations. In M. Masuch and G. Massimo (Eds.), *Artificial Intelligence in Organization and Management Theory* (pp. 215–234). Amsterdam: **Elsevier**.

2.2 Coordination theory and processes

1991 Crowston, K. *Towards a Coordination Cookbook: Recipes for Multi-Agent Action*. Unpublished doctoral dissertation, MIT Sloan School of Management.

1994 Malone, T. W. and Crowston, K. The interdisciplinary theory of coordination. ***ACM Computing Surveys*****,** 26(1), 87–119.

1997 Crowston, K. A coordination theory approach to organizational process design. ***Organization Science***, 8(2), 157–175.

1998 Crowston, K. and Kammerer, E. E. Coordination and collective mind in software requirements analysis. ***IBM Systems Journal***, 37(2), 227–245.

2000 Crowston, K. Processes as theory in information systems research. In *Proceedings of the **IFIP WG8.2** International Working Conference* (pp. 149–166), Jun 9–11, Arlborg, Denmark. Boston: Kluwer Academic.

Reprinted in Malone, T. W., Crowston, K. & Herman, G. (Eds.) *Tools for Organizing Business Knowledge: The MIT Process Handbook*. Cambridge, MA: **MIT Press**, 2003, pp. 177–190.

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