# Bringing Social Worlds Together: Computers as Catalysts for New Interactions in Health Care Organizations*

CAROLYN E. AYDIN
*Cedars-Sinai Medical Center*

RONALD E. RICE
*Rutgers University*

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*In this case study, computer systems are explored as catalysts for new interactions between departments in health care organizations. Hypotheses investigated changes in the extent to which members of different departments (1) exchange information and (2) understand each other's work following implementation of an integrated medical information system. Analyses showed that communication-based forms of involvement in implementation (communicating with systems personnel and trainers, communicating about new ways to use the system, and receiving support from supervisors for doing so) were overwhelmingly more important than either general participation or computer use in predicting increases in interdepartmental interaction. Changes in tasks and roles also led to new, informal, face-to-face contacts to support computer system use, as well as greater administrative control over the organization as a whole. In addition, results of interviews and observations over the two-year study period illustrate the importance of work group identification in predicting changes accompanying computerization.*

Health care organizations adopt medical information systems to improve communication between departments, store information, control costs, and regulate the provision of health care (Packer 1985). Research has shown that the implementation of information systems in organizational settings may be accompanied by changes in both the distribution of tasks and the patterns of interaction among departments in the organization (Hirschheim 1985; Johnson and Rice 1987; Kraemer and Danziger 1990; Markus 1984; Olson and Lucas 1982). Little research, however, has addressed these potential changes in health care organizations (Counte et al. 1987).

Interdepartmental relations are particularly important in complex health care environments where few tasks can be performed without the cooperation of one or more departments or professions. Medical specialists work interdependently. Their "inputs and outputs are highly interrelated and the performance of each is always contingent on the performance of others" (Georgopoulos 1972, p. 19). Like all highly specialized organizations, the hospital's or clinic's requirements for coordination between people and departments are far greater than those of most other organizations of similar size (McCann and Galbraith 1981). The key to the effective delivery of medical care lies in communication and coordination among the organization's various departments and individuals (Cockerham 1986).

Research on the adaptation of the pharmacy and nursing departments in two hospitals to a

* Direct all correspondence to Carolyn E. Aydin, Nursing Research and Development, Cedars-Sinai Medical Center, 8700 Beverly Blvd., Los Angeles, CA 90048-0750. Bitnet: AYDIN@CSMCMVAX.

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medical information system linking the two departments showed increased task interdependence accompanied by "increased communication and cooperation required to use and maintain a common database" (Aydin 1989, pp. 174–75). In essence, the computer system itself became the topic of conversation, serving as a catalyst for increased interaction between individuals across departmental boundaries.

The present project extends this research by exploring the perceived impacts of an integrated medical information system—specifically, a centralized, mainframe-based, scheduling, medical records, and billing system—on interactions among all departments in a single health care organization. In keeping with recent theoretical approaches, the study goes beyond assessing the efficiency of the technology itself to address the complex interactions among the technology, existing organizational structures, and the actions of individual employees (e.g., Contractor and Eisenberg 1990; Dunlop and Kling 1991; Fulk and Steinfield 1990; Johnson and Rice 1987; Kraemer and Danziger 1990; Mouritsen and Bjorn-Anderson 1991; Poole and DeSanctis 1990; Sproull and Kiesler 1991). In contrast to the recent emphasis on electronic mail systems (e.g., Rice 1984; Sproull and Kiesler 1991), this project focuses on informal, face-to-face interactions developed by individual workers to support their use of a highly structured computer link between departments.

More specifically, this research focuses on changes in the extent to which members of different departments (1) exchange information and (2) understand each other's work following implementation of a computer system. The following section describes the social structure of health care organizations and potential impacts of medical information systems on interactions between departments in these organizations. We then address the ways in which involvement in the implementation process and computer use are related to individual perceptions of new interactions. We also investigate the importance of departmental social worlds, focusing on examples of both planned and unplanned changes in tasks and roles, and the ways in which these new tasks and roles affect group perceptions of new interactions. Overall we argue that the actual impact of the technology is not fixed, but depends on a number of factors such as the characteristics of the computer system itself, what the organization and its members do with the technology, and how the implementation process is managed (Hirschheim 1985; Markus 1984).

## MEDICAL INFORMATION SYSTEMS AND INTERACTIONS BETWEEN DEPARTMENTS

American hospitals and clinics are composed of numerous interdependent departments, each of which can be defined as a social world (Mauksch 1972). Some departments may be composed of members of a single occupational group (e.g., pharmacy). Other departments may include individuals from a number of different occupations (e.g., nurses, physicians, clerks) working together in a single department such as a women's health clinic. Regardless of whether the department includes individuals from one or several occupational groups, each department is a unique social world comprised of individuals who "interact regularly with one another, identify themselves as a distinct group within the organization, share a set of problems commonly defined to be the problems of all, and routinely take action on the basis of collective understandings unique to the group" (Van Maanen and Barley 1985, p. 38).

This definition of a department as a social world emphasizes the importance of communication in defining an individual's group identification (Shibutani 1967). Proximity is an important determinant of shared perceptions as employees communicate more frequently with individuals in their own department, regardless of occupational identification (March and Simon 1958; McCann and Galbraith 1981; Mintzberg 1979). Boundaries separate departments from each other, with each department typically having its own specialized vocabulary, making it necessary to recode at the boundaries (Tushman and Scanlan 1981). Departments also focus the attention of group members, blinding them to other issues by influencing perceptions, values, and beliefs (Hackman 1983; Kaplan 1987; Nelson 1990; Van de Ven 1986). In fact, day-to-day contacts and long-term membership in a work unit may be more important than occupation in defining reference groups (Barley 1986; Guy 1985; Kronus 1976).

The structural shifts that accompany technological innovation, however, can alter interac-

tional opportunities both within and between departments in the organization. The changes accompanying computerization stem from the fundamental tension between (1) the isolating capabilities of computer systems (i.e., decreases in interpersonal interaction as workers access information through remote terminals) and (2) the integrating capabilities (i.e., access to shared information) of the same systems. The altered perspectives that result from new ways of interacting can, in turn, lead to new interaction patterns, thus leading to the "demise of organizational and occupational subcultures . . . or create new ones" (Van Maanen and Barley 1985, p. 43).

The following sections detail specific study hypotheses. We first predict the ways in which involvement in the implementation process and computer use are related to individual perceptions of new interactions. We then focus on examples of both planned and unplanned changes in tasks and roles, and the ways in which these new tasks and roles predict group perceptions of new interactions.

*Individual Perceptions of New Interactions*

*Involvement in Implementation.* The computer implementation process can be characterized as a series of negotiations among representatives of different departments and occupational groups. In fact, a number of theorists have characterized hospitals as "politically negotiated orders" in which the organizational structure results from conscious negotiation among subgroups (Bacharach and Lawler 1980; Lucas 1987; Strauss et al. 1963). In this view, organization personnel "are enmeshed in a complex negotiative process in order both to accomplish their individual purposes and to work—in an established division of labor—toward. . .institutional objectives" (Strauss et al. 1963, p. 167).

The computer implementation process also involves negotiations which, like Ackoff's (1981; Ackoff, Gharajedaghi, and Finnel 1984) interactive planning, emphasize interdependencies and create a felt need for coordination of roles, responsibilities, and joint decision-making related to the computer system (McCann and Galbraith 1981). Through these negotiations, members of different departmental social worlds have the opportunity to communicate with and become more knowledgeable about the work of other departments as they discuss issues such as standardized forms, terminology, and procedures across departments (Cook 1985). The process "can encourage conflict resolution by creating a shared vocabulary and basis for communication" (McCann and Galbraith 1981, p. 71). In fact, if a social world's boundaries are set by the "limits of effective communication," the implementation process has the potential to redefine organizational social worlds (Shibutani 1967, p. 113).

The present project explores the effects of involvement in the implementation process on social world boundaries by measuring the extent to which members of departments (1) exchange information and (2) understand each other's work following computerization. The importance of user participation for successful implementation is an underlying theme in computer implementation research (e.g., Franz and Robey 1986; Ives, Olson, and Baroudi 1983; Lucas 1981; Markus 1984; Papa 1990; Zmud and Cox 1979). As with any series of negotiations, however, actual change depends upon the level of individual participation (Day and Day 1977; Maines 1977). A participative organizational climate is essential to successful efforts for change (Miller and Monge 1986).

The present study focuses on two of the many aspects of participation cited in the extensive literature on the computer implementation process (Hirschheim 1985; Ives et al. 1983; Johnson and Rice 1987; Markus 1984; Papa 1990). These include (1) *level of individual involvement* in the implementation process itself, i.e., the extent to which the individual understands the system, experiences general participation in implementation, and feels that the organization supports the system by allowing him or her the time to experiment and learn more about the system; and (2) amount of *communication with others* about the new system, including interactions with system analysts and trainers, and discussions with co-workers and management about ways to apply or adapt the system. While past research predicts that both types of participation should influence employee reactions to a new computer system, the communication-related aspects of participation should be more influential in predicting increases in interaction (i.e., information exchange and understanding) between departmental social worlds.[1] Based upon these arguments, we predict that:

*Hypothesis 1*: Individuals who are involved

in the computer implementation process will interact more with other departments.

*Hypothesis 2*: Individuals who communicate with others about the system will interact more with other departments.

*Computer Use*. Use of the information system also will increase interaction between departments. As individuals in different departments share information through a common database, communication should increase concerning issues such as allocation of tasks, common terminology, and quality control (Giuliano 1982; Majchrzak 1988; Sproull and Kiesler 1991; Zuboff 1988). Simply using the new system may lead to questions about, and a greater understanding of, its uses for other departments. As individuals in different departments begin to use the information system, the increased dependence upon each other for shared information—especially salient in medical environments—should result in increased interaction among departments. Thus, we predict that:

*Hypothesis 3*: Individuals who use the computer system will interact more with other departments.

### *New Tasks and Roles*

A hospital or clinic is an "organization of roles. . ." (Gerth and Mills 1967, p. 117), many of which may be "highly elaborated and relatively stable" (March and Simon 1958, p. 4). The implementation of a computer system designed for use by all departments, however, is accompanied by both planned and unplanned changes in organizational procedures, roles, responsibilities, distribution of tasks, and patterns of interaction between departments (Gerdin-Jelger and Peterson 1985; Hirschheim 1985; Johnson and Rice 1987; Markus 1984; Olson and Lucas 1982; Peterson 1985). System planners and department managers may institute some changes. Other unanticipated changes may occur as workers adapt to new tasks, creating new work patterns that may become normative for the department as a whole.

Knowing the technology, however, "does not allow the analyst to predict what forms of social organization will develop to surround it. . ." (Van Maanan and Barley 1984, p. 346). Each group will attempt to negotiate changes beneficial to its own position in the organization (Aydin 1989). The actual effects of the system will depend on what the organization and its members do with the technology and how the implementation process is managed (Hirschheim 1985; Markus 1984). The first step in predicting organizational impacts is to identify the task and role changes occurring in the particular organizational setting under study. Thus, we first predict that:

*Hypothesis 4*: Computer implementation will be accompanied by both planned and unplanned changes in departmental tasks and roles.

### *New Tasks and Roles as Predictors of New Interactions*

Task and role changes in an organization create "task uncertainty," resulting in a greater need for coordination and feedback between departments (McCann and Galbraith 1981, p. 70; Tushman 1979). Employees faced with new tasks and roles must find ways to incorporate the changes into their daily work (Papa 1990). Role ambiguities accompanying changes in work arrangements may require re-negotiation of tasks and roles both within and between departments in the organization (Contractor and Eisenberg 1990; Fagerhaugh et al. 1980; Stryker and Statham 1985). The process also may be accompanied by a range of issues such as "cooperation, coordination, conflict, and struggles for power" (McCann and Galbraith 1981, p. 61). These needs for clarification and negotiation indicate that:

*Hypothesis 5*: Departments experiencing task changes between departments will interact more with other departments.

In addition to identifying with a departmental social world, however, individuals also share tasks and values with other employees throughout the organization based on a common professional orientation (Anderson 1985; Kronus 1976; Lundsgaarde, Fischer, and Steele 1981; March and Simon 1958; Merton, Reader, and Kendall 1957). These occupational groups also may be affected by role changes accompanying computer implementation (e.g., nursing, pharmacy; Aydin 1989). One measure of the power of an occupation is the "relative ability of the occupation to protect its task domain from

encroachment" and/or the ability to encroach upon others (Kronus 1976, p. 5). In the present setting, most departments using the system were clinics composed of individuals in a number of different occupations. Thus, we also might expect groups such as nurses or physicians to increase their communication with their counterparts in other departments as they attempt to control the "definition, conduct, and evaluation of their work" (Child and Fulk 1982, p. 155), leading to the following hypothesis:

*Hypothesis 6*: Occupational groups experiencing role and/or task changes will interact more with other departments.

## METHODS

### *The Setting and the System*

The present case study is part of a longitudinal research project on the impacts of an information system on the Student Health Service (SHS) of a major urban university (Aydin and Rice 1991; Rice and Aydin 1991). SHS employs approximately 110 full- and part-time employees as well as seasonal student workers. SHS implemented a mainframe-based, multi-application medical records information system that had been developed by an external vendor and adopted by similar clinics. System planners adapted the system to approximate the paper and pencil system previously used in each SHS clinic to handle administrative, scheduling, billing, and data analysis activities, with the most immediate and pressing problem being patient scheduling. SHS's implementation strategy included hiring a system analyst and assigning the medical records administrator (also a credentialed teacher) as the system coordinator/trainer. A committee composed of the executive director, a system analyst, and the coordinator/trainer made most decisions relating to system implementation.

One year after the first system module was implemented, many system functions were operating to: (1) schedule appointments and generate encounter forms (which were printed out by the computer system for each patient's visit, and served as "triggers" for most other SHS activities), (2) enter codes for diagnoses and services performed, (3) reconcile written encounter forms with data entered in the computer, and (4) generate reports. Based upon priorities set by SHS administrators, however, the focus of the system was almost entirely on administrative functions, delaying the implementation of the medical functions such as computerized reporting of lab test results until an undefined future date.

### *Research Design*

The research design included questionnaires, interviews, and observations at three time periods over two years: (Time 1 [T1]) several months before implementation, (Time 2 [T2]) after implementation of the system in several departments, and (Time 3 [T3]) more than one year after the second survey. Questionnaires were distributed at staff meetings and respondents sealed and mailed the completed questionnaires to a university department outside of the medical center. Researchers followed up non-respondents by letter or personal telephone call. Of the 111 employees at SHS at T1 (some were seasonal or part-time, so the figure of 111 overstates the number of relevant respondents), 88 were still employed at T3; 74 of these 88 employees (84%) completed both T1 and T3 questionnaires and represent the sample used in the present research.

### *Measurement*

Items on the T3 questionnaire addressed the hypotheses in the present study, supplying cross-sectional information about individual perceptions of changes in interdepartmental interactions related to computer implementation. In addition, interviews and observations at all three time periods provided longitudinal information on task shifts between departments, new information system roles, and changing employee perceptions of the impacts of the system.

Both questionnaire and interview findings are based upon employee perceptions rather than actual counts of specific types of interactions. While further research using actual interaction data would be useful, both organization and implementation research has focused on the importance of employee *perceptions* in determining organizational outcomes (March and Simon 1958; McCann and Galbraith 1981). As noted by Schneider, Parkington, and Buxton (1980, p. 254),

"member perceptions of organizational practices and procedures are the critical data in understanding organizational behavior." In the present study, observations of SHS personnel at work also validated changes reported by employees.

*Departments and Occupations*. Respondents belonged to 11 departments and five occupations. The majority came from the seven largest departments: Primary Care, Women's Health, Specialty Clinics, Finance and Personnel, Medical Records, Laboratory, and Health Education (four other departments had a few members each). Occupations included administrators, office/clerical workers, physicians, nurses, and other medical workers.

*Changes in Interdepartmental Interactions*. On the T3 questionnaire, each employee reviewed a list of all 11 SHS departments and rated the "extent to which understanding or exchanging information with each of the following SHS departments has increased or decreased" because of the system. The scale ranged from 1 = "significantly increased" to 7 = "significantly decreased." (Values were reversed for analysis so that a higher value indicated an increase.) Respondents were instructed that "By exchanging information, we mean any type of information exchanged in any way (such as from the computer, in person, by telephone, memos, meetings, etc.). By understanding, we mean understanding the work each department does (including problems, procedures, decisions, information needed, etc.)." An overall perceived *Change in Information Exchange* score and an overall perceived *Change in Understanding Work* score were created for each respondent, averaged across all departments other than the respondents' own.

These two variables were used as the dependent variables in regression analyses to determine influences on individual perceptions of change. In addition, perceptions of change were compared across both departments and occupations, using the mean perceptions of change of a department or occupations's members about all other SHS departments. The validity of aggregating data from individuals to form departmental or occupational scores is supported by analyses of variance indicating significant differences between both departments and occupations in attitudes toward the computer system at SHS (Aydin and Rice 1991).

The following five variables were created for individual-level bivariate and multivariate statistical analyses.

*Involvement in the Implementation Process*. Two involvement variables, *Relations with Computer Staff* and *Knowledge and/or Involvement in Implementation*, were measured using items developed by Ives et al. (1983) for their User Information Satisfaction Scale (see Table 1).[2]

Participants also responded to items representing two other aspects of individual involvement in the implementation process. *Work Group Communication* items measured the extent to which the work group supported and discussed the development of new computer procedures, while *Organizational Support* items measured organizational support for employees learning and experimenting with new computer procedures (see Table 2).[3]

*Computer Use*. The 6-point *Computer Use* scale was created as follows: A "O" indicated that the respondent had never used information or reports from the system, never provided information for the system, and never used the computer terminals. Respondents who indicated that they had used the system in at least one of these three ways then specified their level of terminal use ("1 = never," "2 = once a week," "3 = once a day," "4 = several times a day," and "5 = most of the day").

Table 3 provides descriptive statistics and correlations among the summary variables.

### *Qualitative Methods*

Interviews were conducted with representatives of all departments and occupations from all levels of the organization (ranging from the director to a student clerk working in the lab) at all three time periods. Researchers also observed individuals using both the pencil and paper system and the computer system during the course of their daily work.

At T1 (before system implementation), members of the research team spent several days at SHS, interviewing approximately 20 employees and observing in each department. All interviews were open-ended and conversational, lasting approximately one-half to one hour. Respondents were asked to describe their department's current operations and their expectations for the computer system. Responses were categorized by topic, and

**TABLE 1. Factor Loadings and Descriptive Statistics for Relations with Computer Staff and Knowledge/Involvement**

| Variables | Factor Loadings | | Statistics | |
|---|---|---|---|---|
| | 1 | 2 | M | S.D. |
| *Relations with Computer Staff* | | | 5.11 | 1.27 |
| Relationships with system analysts/trainers: | | | | |
| dissonant/harmonious | .86 | .18 | 5.21 | 1.37 |
| bad/good | .86 | .13 | 5.20 | 1.38 |
| Attitude of system analysts/trainers: | | | | |
| belligerent/cooperative | .85 | .26 | 5.09 | 1.58 |
| negative/positive | .86 | .31 | 5.11 | 1.47 |
| Communications with analysts/trainers: | | | | |
| dissonant/harmonious | .81 | .28 | 5.16 | 1.40 |
| destructive/productive | .79 | .21 | 5.00 | 1.40 |
| *Knowledge/Involvement* | | | 4.06 | 1.69 |
| Understanding of the system: | | | | |
| insufficient/sufficient | .15 | .91 | 4.16 | 1.73 |
| incomplete/complete | .10 | .90 | 3.78 | 1.51 |
| Feeling of participation in implementation: | | | | |
| negative/positive | .44 | .80 | 4.12 | 2.00 |
| insufficient/sufficient | .43 | .79 | 4.12 | 1.94 |
| Eigenvalue | 6.11 | 1.76 | | |
| Percent variance | .61 | .18 | | |
| Alpha for underlined variables | .95 | .91 | | |

*Note:* Three other factors in the full Ives et al. User Information Satisfaction Scale (1983) were not relevant to the present research. Mean scales (as suggested by Ives et al. 1983) were used in the analyses.
Original scale: 1 = most positive response, 7 = most negative response. Scale reversed for analysis.

information concerning interdepartmental relations and new tasks and roles was used for the present study.

Interviews were conducted with 13 employees eight months later at T2. Some were already using the system while others represented departments in which the system was not yet in use. Respondents were again asked to describe their jobs, involvement with the computer system, effects of the system on

**TABLE 2. Factor Loadings and Descriptive Statistics for Work Group Communication and Organizational Support**

| Variables | Factor Loadings | | Statistics | |
|---|---|---|---|---|
| | 1 | 2 | M | S.D. |
| *Work Group Communication re Computer* | | | .00 | 1.00 |
| Praise for new procedures | | | | |
| from supervisor | .82 | −.24 | 3.59 | 1.70 |
| from co-workers | .85 | −.14 | 3.48 | 1.70 |
| Talk about new procedures | | | | |
| with supervisor | .86 | −.03 | 3.85 | 1.88 |
| with co-workers | .87 | −.12 | 3.81 | 1.82 |
| Develop new procedures | .72 | −.26 | 3.32 | 1.87 |
| Attend regular meetings | .48 | −.42 | 2.77 | 1.93 |
| *Organizational Support for Implementation* | | | .00 | 1.00 |
| Policies discourage new procedures | −.12 | .74 | 3.42 | 1.67 |
| No time to learn/develop new procedures | −.06 | .73 | 4.58 | 1.91 |
| Others do not encourage me to experiment | −.22 | .76 | 3.95 | 1.77 |
| Eigenvalue | 4.25 | 1.43 | | |
| Percent variance | .47 | .16 | | |
| Alpha for underlined variables | .88 | .61 | | |

*Note:* Factor scores created by the regression method were used in the analyses (Johnson and Rice 1987; Rice 1991). Scale values: 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = agree, 7 = strongly agree.

their jobs, and opinions about the implementation process (e.g., "What do you do in your job?" "How does your job involve the information system?" "Has it changed your job?"). At T3 (15 months after the T2 interviews), researchers again spent several days at SHS observing employees at work using the computer system. Approximately 23 employees were interviewed, with interviews focusing on the computer system and its effects on (1) their jobs, (2) interactions between departments, and (3) SHS operations overall.

In addition to the interviews conducted at the three time periods, informal conversations with system implementers continued throughout the two-year period concerning progress and problems accompanying implementation. Open-ended responses on all three questionnaires also were categorized by department and occupation and analyzed for information on interdepartmental interactions and changes in work patterns.

## RESULTS

### *Individual Perceptions of New Interactions*

Hierarchical multiple regression analyses were used to test the simultaneous influence of general involvement in the implementation process, communication-based forms of involvement, and computer use in predicting average overall *Change in Information Exchange* and *Understanding Work*. Because involvement in the implementation process was expected to predict the greatest increases in interaction, the measures of involvement were entered first in a single step, followed by the *Computer Use* scale in a separate step (see Table 4).

Table 4 shows that the final equations explained 39 percent of the variance in overall perceived change in information exchange and 37 percent of the variance in understanding work. Both dependent variables were predicted only by *Relations with Computer Staff* and by *Work Group Communication*. Neither of the other two involvement variables (*Knowledge/Involvement, Organizational Support*), nor *Computer Use*, independently contributed to the variance explained. *Knowledge/Involvement* and *Computer Use* did, however, have statistically significant bivariate correlations with the dependent variables (see Table 3).

### *Changes in Departmental Tasks and Roles*

The interviews and observations of employees at work at all three time periods illustrate the types of changes that occurred in departmental tasks and roles. The most striking changes involved three departments: Medical Records, Finance/Personnel, and the Laboratory. Table 5 cites examples and classifies each according to its association with an increase, decrease, or no change in interdepartmental interaction, and whether the change was planned or not. Examples are described in greater detail in the following sections.

*Medical Records*. Medical Records experienced a number of changes in interactions with other departments. One planned change stemmed from the traditional Medical Records task of coding diagnoses entered by clinicians in patients' medical records (file folders). With the new computer system, Medical Records clerks were assigned to enter these codes into the computer. The codes then were used to produce computerized reports by diagnostic category. Although no increase in interdepartmen-

**TABLE 3. Correlations Among Summary Variables[a]**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | M | S.D |
|---|---|---|---|---|---|---|---|---|---|
| 1. Change in Information Exchange | — | .89** | .43** | .41** | .54** | −.13 | .29* | 4.54 | .70 |
| 2. Change in Understanding Work | | — | .40** | .35** | .42** | −.14 | .33** | 4.51 | .66 |
| 3. Relations with Computer Staff | | | — | .59** | .10 | −.15 | .36** | 5.11 | 1.27 |
| 4. Knowledge/Involvement | | | | — | .38** | −.28** | .41** | 4.06 | 1.69 |
| 5. Work Group Communication | | | | | — | .16 | .37** | −.08 | 1.01 |
| 6. Organizational Support | | | | | | — | .07 | −.05 | 1.02 |
| 7. Computer Use | | | | | | | — | 2.35 | 1.84 |

[a] n = 74

* p≤.05; **p≤.01.

**TABLE 4. Hierarchical Multiple Regressions of Perceived Change in Information Exchange and Understanding Work on Involvement in Implementation Process**

| | Dependent Variables | |
|---|---|---|
| | Perceived Change in: | |
| Independent Variables | Information Exchange | Understanding Work |
| Relations with Computer Staff | .35*** | .37*** |
| Work Group Communication | .53*** | .46** |
| Adjusted $R^2$ | .39 | .37 |
| F-ratio | (2,42) = 15.30*** | (2,42) = 12.13*** |

*Note:* Other involvement variables, computer use scale, and interaction between the computer use scale and work group communication, were not statistically significant. Values are beta coefficients.
* p≤.05; ** p≤.01; *** ≤p.001.

tal interaction was anticipated with this planned change, interview respondents in some departments reported feeling the need to consult with Medical Records about some "gray areas" in coding to ensure that the new computer reports would meet their needs.

The appointment of the Medical Records administrator as the computer system coordinator/trainer, another planned change, also produced unanticipated changes in the roles of other Medical Records personnel. The administrator's personal style led her to conduct most initial computer instruction on a one-on-one basis, fostering personal relationships with individuals throughout the organization. Other Medical Records employees followed her lead as they became experienced on the computer and began to help users in other departments.

In contrast to these examples of increased interaction with Medical Records, however, respondents throughout SHS also emphasized their new independence from Medical Records. They were now able to retrieve student information such as telephone numbers through the computer terminal without calling or going to Med-

**TABLE 5. Examples of Observed Changes in Departmental Tasks and Roles**

| Type of Change: | Direction of Change in Interdepartmental Interaction: Increase | No Change | Decrease |
|---|---|---|---|
| Planned | New role of *Medical Records* in entering data (e.g., diagnosis) for computerized studies for all departments. | *All departments* enter own data in computer. | *All departments* retrieve information (e.g., student telephone numbers) through computer terminal |
| | *Medical Records* . Administrator-appointed computer Coordinator/Trainer. | | *Lab* generates own computerized report form, no longer depends on form sent from clinics to report results. |
| | New role of *Finance/Personnel* in tracking operations and monitoring data entry from all departments. | | |
| Unplanned | New Role of *Medical Records* personnel as informal "gurus" to computer users in other departments. | | |
| | Evolving role of *Finance/Personnel* as computer "gurus" through role in monitoring data entry from all departments. | | |

ical Records personally to look up the information.

*Finance/Personnel.* Finance/Personnel's planned new role involved tracking SHS operations, including reconciling the "activity codes" that each department entered into the computer with the handwritten information on the encounter forms documenting each student visit. Computer procedures specified that each department enter the codes for their own activities from the encounter forms into the computer. Thus Laboratory employees entered records of lab tests performed, employees in the different clinics entered information about patient visits and injections, etc. An employee from Finance/Personnel went to each department daily to collect departmental copies of the encounter forms. Finance/Personnel employees then reconciled the copies with computer data entered by the departments and generated "follow-up reports" that were returned to each department indicating errors in computer entry that required correction.

*Laboratory.* Observations and interviews with Laboratory employees highlighted another type of change—a planned task shift in which the Laboratory was assigned to generate a computerized reporting form for each lab test. Prior to computerization, clinical assistants in the different clinics (e.g., Women's Health, Primary Care) completed lab order forms that indicated which lab tests were ordered by clinicians. Lab employees then wrote the results on the same form. With the computer system, however, clinical assistants were no longer involved in this interaction. Instead, the physician or nurse practitioner checked off the required tests on the student's encounter form. Lab employees then entered the information from the encounter form into the computer to generate a test reporting form.

### *Group Perceptions of New Interactions*

*Departmental Perceptions.* Table 6 compares perceptions of changes in interdepartmental interactions across SHS departments. Results of the F-test for differences between the departmental means were statistically significant for changes in understanding work, but not significant for information exchange. A posteriori Duncan multiple range tests showed that Medical Records differed significantly from each other department except Finance/Personnel.

*Occupational Perceptions.* Table 7 compares perceptions of changes in interdepartmental interactions across occupational groups. Results indicated that non-medical workers were significantly more likely to perceive increased interaction. Physicians, on the other hand, perceived no change in interaction, while nurses and other medical employees perceived only very slight increases. A posteriori Duncan multiple range tests showed that Office/Clerical employees differed significantly from MDs and Other Medical workers.

**TABLE 6. Average Perceived Change in Information Exchange and Understanding Work with All Other SHS Departments by Department**

| | Information Exchange | | | Understanding Work | | |
|---|---|---|---|---|---|---|
| Comparison | n | M | S.D. | n | M | S.D. |
| *Department*[a] | | | | | | |
| Medical Records | 6 | 5.33 | .80 | 7 | 5.33 | .78 |
| Finance/Personnel | 8 | 4.75 | .75 | 8 | 4.59 | .66 |
| Primary Care | 13 | 4.43 | .66 | 14 | 4.44 | .65 |
| Specialty Clinics | 5 | 4.42 | 1.00 | 5 | 4.54 | .99 |
| Health Education | 5 | 4.36 | .41 | 5 | 4.36 | .42 |
| Lab | 4 | 4.23 | .29 | 5 | 4.14 | .31 |
| Women's Health | 9 | 4.21 | .42 | 9 | 4.20 | .41 |
| ANOVA[b] | | F(6,43) = 2.26 ns | | | F(6,46) = 2.67 * | |

[a] Average change with all departments except the respondent's own department. Includes only responses from members of departments with at least five employees responding to both T1 and T3 questionnaires.

[b] A posteriori Duncan multiple range tests comparing pairs of means showed that Medical Records differed significantly ($p<.01$) from each other department except Finance/Personnel.

* $p \leq .05$.

**TABLE 7. Average Perceived Change in Information Exchange and Understanding Work with All Other SHS Departments by Occupation**

| Comparison | Information Exchange | | | Understanding Work | | |
|---|---|---|---|---|---|---|
| | n | M | S.D. | n | M | S.D. |
| *Medical/Non-Medical*[a] | | | | | | |
| Medical | 29 | 4.25 | .47 | 31 | 4.27 | .46 |
| Non-Medical | 28 | 4.82 | .79 | 29 | 4.74 | .76 |
| T-test | | $t$ (44) = 3.42** | | | $t$ (45) = 2.98** | |
| *Occupation*[a] | | | | | | |
| MDs | 4 | 3.98 | .13 | 4 | 3.98 | .13 |
| RNs | 10 | 4.32 | .51 | 11 | 4.42 | .50 |
| Other Medical | 15 | 4.28 | .49 | 16 | 4.25 | .45 |
| Office/Clerical | 22 | 4.80 | .81 | 23 | 4.80 | .81 |
| Administrators | 6 | 4.90 | .80 | 6 | 4.50 | .54 |
| ANOVA[b] | | F (4,52) = 2.87* | | | F (4,55) = 2.79* | |

[a] Average change with all departments except the respondent's own department.
[b] A posteriori Duncan multiple range tests comparing pairs of means showed that Office/Clerical employees differed significantly from MDs and Other Medical on both Information Exchange and Understanding Work.
* $p \leq .05$; ** $p \leq .01$.

## DISCUSSION

### *Involvement in Implementation and Computer Use*

Hypotheses 1, 2, and 3 predicted that general involvement in the implementation process, communication-based forms of involvement in particular, and computer use would influence new interactions between departments. Based upon the results of the regression analyses (Table 4), Hypotheses 1 and 2 were confirmed, while Hypothesis 3 was rejected. Communication-based forms of involvement in implementation (communicating with systems personnel and trainers, communicating about new ways to use the system, and receiving support from supervisors for doing so) were overwhelmingly more important than either general participation in the implementation process or computer use in predicting changes in interdepartmental interaction, when all the tested influences were considered simultaneously.

The arguments leading to Hypotheses 1 and 2 characterized the computer implementation process as a series of negotiations providing new opportunities for communication between departments and occupational groups. Study findings support the importance of these new communication opportunities in altering normative patterns of interaction between departments. The following sections describe some of the actual negotiations that occurred at SHS during computer implementation.

Hypothesis 3 (computer use) was based upon the predicted communication needs of individuals sharing a common database. The medical applications of the system anticipated by clinicians were never implemented, however, and most employees used only the scheduling functions, with little need for other elements of the database. Thus the need for shared information upon which the prediction was based never materialized, possibly contributing to the lack of support for Hypothesis 3.

### *Planned and Unplanned Change*

Hypothesis 4 predicted that computerization would be accompanied by both planned and unplanned changes in departmental tasks and roles. Interviews and observations over the study period document these changes and trace the development of new norms for interaction between departmental social worlds resulting from these changes. The findings in the following sections also provide a glimpse of the inner world of health care and the seldom studied interactions between occupational groups in health care settings (Fox 1985; Freidson 1986).

*New Norms for Informal Interaction.* In Medical Records, the computer implementation process resulted in a new and unantici-

pated role for all of the department's employees. The nature of the computer coordinator/trainer's involvement with the computer system and with computer users in all departments established a new informal norm for similar involvement on the part of other Medical Records employees. Because of their proximity and loyalty to their department head, as well as their understanding of their own computer tasks, they became knowledgeable about the system and adopted her informal one-on-one style. Individual employees from other departments throughout SHS described taking time to visit the Medical Records department to discuss computer problems or share new ways to accomplish computer tasks. Indeed, the importance of the Relations with Computer Staff and the Work Group Communication variables in predicting increased interdepartmental information exchange and understanding work (see the regression results described above) undoubtedly reflects these new interactions.

*Task Shifts Between Departments.* The Lab's new task assignment, on the other hand, resulted in decreased communication with other departments. When Laboratory employees learned that they would be expected to generate their own computerized report form, they anticipated confusion and an increased need for communication with the clinics to clarify clinician orders for test. At T3, however, interview respondents from the Lab still complained about the additional work, but noted that the system was working well and no additional communication had been needed to clarify orders. In fact, communication was actually simplified, with clinical assistants no longer involved in interpreting clinician orders for the Laboratory.

*Increased Administrative Control.* In the case of Finance/Personnel, the most striking example of increased interaction with other departmental social worlds evolved from the department's new formal role in tracking the operations of all SHS departments. This new role had its roots in the desire of SHS administrators for increased tracking and control of SHS operations. The negotiation of the role, however, occasioned ongoing exchanges between Finance/Personnel and other SHS departments, both to accomplish the task and to gain acceptance from other departments of the new role.

During the early stages of computer implementation, fully 40 percent of the encounter forms did not match the data entered into the computer by the departments. Finance/Personnel's feedback to the various departments and clinics concerning errors and missing encounter forms was met with resentment at first, especially from physicians in the clinics. In fact, the enlarged role of Finance/Personnel elicited different reactions from employees in different departments. Most interview respondents simply noted that someone from Finance/Personnel picked up their copies of the encounter forms and worked with them to resolve the errors. One respondent, however, vehemently described the Finance/Personnel representative as someone who "does nothing else but analyze errors and circulate graphs showing the errors of all departments for everyone to see."

In general, employees in Finance/Personnel seemed sensitive to the possibility that their new role might threaten some employees. Finance/Personnel's weekly report back to each department, for example, referred to errors as "follow-ups" rather than as errors, although the report did compare error percentages by department. According to both Finance/Personnel employees and members of other departments, computerization also highlighted operational problems and made the need for explicit policies and procedures obvious, a need not felt before the computer system was implemented. As one respondent noted, the system "forces you to articulate things" and understand how tasks are related. Before computerization, departments had different procedures; "now it's necessary to know the proper way."

By T3, over a year later, much of the conflict engendered by Finance/Personnel's enlarged responsibilities had been resolved. The interactions between Finance/Personnel and other SHS departments had become a mechanism through which employees in other departments improved their understanding of the computer system and of data entry procedures. In return, employees in Finance/Personnel also learned more about the tasks performed by other departments. By T3, Finance/Personnel employees were beginning to resemble Medical Records personnel as informal "gurus" for computer users throughout SHS.

Overall, these examples illustrate both planned and unplanned changes in departmen-

tal tasks and roles, confirming Hypothesis 4 and providing further support for both Hypotheses 1 and 2 as well. In planning for the computer system, implementors used both the remote access and integrative capabilities of the computer, setting the stage for both *increases* and *decreases* in interactions between the organization's departmental social worlds. The unplanned changes initiated informally by SHS employees also underscore the importance of everyday actions in shaping organizational change. Both of the unplanned changes listed in Table 5 increased interdepartmental interactions, negating at least some of the increased isolation possibly associated with the remote access capabilities of computers and softening the impact of the increased administrative control that accompanied computerization.

*New Tasks and New Interactions*

Hypothesis 5 proposed that individuals working in departments that experience either task shifts between departments or role changes related to the implementation of the computer system will perceive increased interaction with other departments. Based upon the task and role changes described above, we would expect employees in Medical Records, Finance/Personnel, and the Lab to be involved in increased interactions with other departments. Results (see Table 6) indicated that, as predicted, employees in Medical Records and Finance/Personnel perceived the greatest increases in understanding the work of other departments. The Lab, however, experienced task changes, but did not report any increase in interactions. Thus, Hypothesis 5 was partially confirmed. Assigning the Lab to a task once performed in the clinics did not result in increased interaction, although Lab employees actually anticipated such an increase prior to implementation. The new roles for Medical Records and Finance/Personnel, however, created new patterns of interaction with other SHS departments that were eventually accepted by the organization as a whole.

Hypothesis 6 proposed that occupational groups experiencing role or task changes would report increased interaction based on their need to discuss occupational issues with their counterparts in other departments. Interviews with physicians in fact indicated that at the beginning of the implementation period physicians did discuss the system in their meetings, but the subject was dropped when system implementation began to focus exclusively on administrative functions. Physicians became disenchanted with the system which, in their view, did nothing to support their professional role.

System use by nurses and other medical occupations varied by department. Rather than enhancing their jobs, many medical employees expressed concern that learning and using the computer was an inappropriate use of their time, which, they felt, might be better spent in their traditional task of patient care. In fact, nurse practitioners in the Primary Care Clinic negotiated a task arrangement in which only office/clerical staff used the computer. Nurses in the Women's Health Clinic, on the other hand, used the system extensively, but indicated that their system applications were specific to women's health concerns and maintained that it would "seem like bragging" to share their system projects at organization-wide meetings with other nurses.

Based upon these interview results and the statistical analyses detailed in Table 7, Hypothesis 6 was rejected. While the individuals most likely to report increased interaction (SHS administrators and office/clerical workers) had experienced role/task changes, their new interactions were not based on occupational concerns as predicted by Hypothesis 6. Rather, their interactions focused on the daily tasks surrounding the computer system and its use.

*Departmental Social Worlds*

The findings for Hypotheses 5 and 6 underscore the importance of membership in departmental social worlds, as well as occupational identification, in influencing reactions to change. While researchers often emphasize occupational issues and norms, employees must operate within "circumstances that are shaped by the structure of the organization in which they work. . ." (Freidson 1986, p. 155). At SHS, for example, nurses in Primary Care had always had different work arrangements and, during computer implementation, negotiated different computer tasks than did nurses in Women's Health. While physicians were

more inclined to view the system as a common concern, nurses clearly found departmental issues more significant as they faced the task changes accompanying the new computer system.

## SUMMARY AND CONCLUSIONS

### *What Didn't Happen*

Before considering the significance of the changes observed and reported at SHS, we examine possible changes that did not occur. SHS's informal implementation arrangement, for example, precluded the formal meetings between representatives of different departmental social worlds that frequently occur during computer implementation (Johnson and Rice 1987; Markus 1984). In contrast, the SHS implementation process was characterized by informal interpersonal sharing of computer problems and ideas sandwiched into a busy work schedule. Individuals often selected their own contacts to discuss the computer system, and employees in Medical Records and Finance/Personnel assumed the role of computer "guru" for workers in a number of departments. Such implementation-oriented communication is important to the success of an information system, but is rarely studied and is seldom supported and rewarded by management (Johnson and Rice 1987; Kraemer and Danziger 1990; Papa 1990). "Gurus" frequently burn out or become resentful, while others decide not to contribute, and the system and the organization suffer.

The SHS computer implementation also differed from other implementation contexts in the level of departmental dependence on the system. Dependence varied by department, but was minimal for many departments, at least by the end of the two-year study period. Previous research has focused on hospital systems in which maintenance of the computerized database became a compelling goal for all of the groups involved (Aydin 1989; Sherif and Sherif 1969, p. 255; Worchel 1986). With the exception of the scheduling functions, most SHS departments had little need for much of the data. Consequently, the implementation process did not really involve negotiation among departments about an information resource upon which they all depended.

### *Creating New Interactions to Support System Use*

The present study offers important insights into both planned and unplanned changes in communication between departments that may accompany computerization. Studies of operational systems that are not explicitly communicative frequently ignore the communication implications of these systems, focusing solely on employee acceptance and system efficiency. The present research shows that the new tasks and roles associated with a new, highly structured computer link between departments may lead employees to develop their own informal, face-to-face contacts to support system use. Despite the lack of formal interdepartmental meetings and limited dependence on the system in most departments, individuals *did* create new interactions to discuss the computer.

The results of this project also provide insights into the importance of work group identification in predicting changes accompanying a new computer system (Aydin and Rice 1991; Nelson 1990). For health care organizations in particular, the present findings illustrate the importance of going beyond the traditional focus on occupations to recognize the significance of departmental issues in predicting role changes and ambiguities that may accompany computerization. At SHS, for example, existing work arrangements in Women's Health resulted in extensive computer use by nurse practitioners, including new contacts with Medical Records to discuss computer projects and problems. In contrast, nurse practitioners in Primary Care refused to use the system and were not involved in any new interactions.

The focus on work group issues also supports and extends recent research that links employee communication networks with performance on a new computer system. According to Papa (1990), the more coworkers an employee talks to about the new technology and the more frequently he or she talks about the new computer, the more productive the employee will be on the new system. The present project extends these individual-level findings by focusing on how departmental norms may either encourage or discourage employees from developing new contacts with other departments to talk about the computer system. Administrators need to anticipate at least some of these issues in their

own organizations in order to encourage and facilitate the interpersonal interactions essential to effective implementation.

### *Extensions to Other Settings*

The present findings support previous research in that the computer system itself became the topic of conversation, acting as a catalyst for new interactions between departments (Aydin 1989). Different outcomes might be expected, however, under different circumstances. In large organizations, for example, increased information exchange between departments may involve very few individuals. On the other hand, greater dependence on the computer database and formal interdepartmental meetings may lead to greater increases in information exchange. Further research is essential to determine the limiting assumptions and conditions under which specific results might be expected (McGuire 1983).

### *Conclusions*

The effective delivery of medical care depends largely on coordination between the interdependent social worlds in health care organizations. Increased interdepartmental interaction occasioned by the computer implementation process has the potential to change communication in broad ways that go beyond the contacts related to the computer system. Ideally, new interactions can smooth relations and facilitate the flow of information between departments, with positive effects on the organization as a whole.

Computerization, however, also can lead to increased workloads, task shifts, and new roles accompanied by conflict between groups. The new interdependencies occasioned by medical information systems may create a need for additional coordination and control strategies (McCann and Galbraith 1981). Although health care organizations remain loosely coordinated (Starr 1982), increased coordination and control are associated with higher quality of care (Flood and Scott 1987). At SHS, the information system was accompanied by greater administrative control over all groups, enhancing the potential for long-term improvements in the quality of care.

It is also important to note that a strong inverse relationship may exist between intragroup and intergroup interactions. "Removing barriers to obtain gains in intergroup interactions may also reduce intragroup cohesion," with unintended effects for the individual departments in the organization (McCann and Galbraith 1981, p. 72; Mintzberg 1979.) For example, Laboratory employees who alter their work patterns to speed the communication of test results to other departments also must continue to adhere to departmental procedures that ensure the accuracy of the results they report. While on balance, increased communication and coordination may have positive effects on the overall functioning of health care organizations, the impact on work performed within the individual departments has not yet been explored.

In summary, system planners and managers should understand that a new information system can serve as a catalyst for changes in interactions between the social worlds that make up the organization. These changes stem from complex interactions among the technology, existing organizational structures, and the actions of individual employees. Using both the isolating and integrating capabilities of computer systems, managers plan changes in the roles of both departments and individuals. Other unanticipated changes occur as workers adapt to new tasks, creating new communication patterns that may become normative for the department as a whole. Even a highly structured operational system that is not explicitly communicative may lead employees to develop their own informal, face-to-face contacts to support system use. Managers who recognize the importance of these new contacts will develop strategies to facilitate new interpersonal interactions that smooth the flow of information between departments and improve the delivery of medical care.

## NOTES

1. There are, of course, other indicators of departmental interaction, such as cooperation, conflict, shared input to specific tasks, organization-wide commitment, etc. However, the present study focuses on the level of information exchange and understanding of other departments' work.
2. The User Information Satisfaction Scale used a semantic differential technique in which two

pairs of 7-point bi-polar adjectives were provided for each item, and multiple items indicated each dimension of user information satisfaction. Factor analysis of the complete User Information Satisfaction scale produced five factors closely related to those identified by Ives et al. (1983). Only the two factors relevant to involvement in the implementation process were included in the present study. Mean scores (replicating Ives et al.'s scoring technique) of scale items for individuals who had no more than two of these items missing were included in each of the two overall scales to maintain the sample size.

3. Items were developed by Taylor and Bowers (1972) as part of a standardized measure and have been used to assess responses to implementation efforts in previous information system studies (Johnson and Rice 1987; Rice 1991). Factor scores, computed via the regression method for varimax-iterated principal components (replicating Johnson and Rice's scoring technique), were used.

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**Carolyn E. Aydin** is research associate, Nursing Research and Development, Cedars-Sinar Medical Center. Her research interests include communication patterns in health care organizations, organizational change, and the implementation of medical information systems.

**Ronald E. Rice** is associate professor, School of Communication, Information and Library Studies, Rutgers University. His primary research interest is the implementation, management, use, and outcomes of organizational information and communication systems.