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Introducing New Technology into Hospitals -
A Case Study of Pharmacy Automation
During Hospital Restructuring
by
Kathryn Lynne Momtahan

A thesis submitted to the
Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

Department of Psychology
Carleton University
Ottawa, Ontario
July, 1997

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Abstract

The process of introducing new technology into a hospital was examined from an organizational standpoint. Factors that have been identified in the literature as having an effect on the implementation of new technology include those related to the type of organization into which the new technology is introduced, employee factors such as organizational commitment, job involvement and attitude towards technology, and technological factors such as usability. The pharmacy staff and nurses from two nursing units in a 215-bed Canadian bilingual French/English acute-care hospital were interviewed and surveyed two weeks prior to the implementation of a new automated oral solids dispensing machine and six months after its implementation. Ten usability experts assessed the software interfaces of the two new computers used to control the machine.

Survey and interview data revealed an organization whose culture and climate was expected to have a negative impact on the introduction of new technology into that organization. The communication between hospital workers and the administration was generally considered poor, and there were divergences between the hospital's written philosophy and goals and what hospital workers said were the hospital's philosophy and goals. The culture of the hospital was found to be more control-oriented than flexibility-oriented. Regression analysis of the Time 2 survey data revealed a strong positive relationship between organizational climate and attitude towards technology, and a negative relationship between continuance commitment and attitude towards technology.

This thesis demonstrates that introducing new technology into a hospital environment can be viewed positively by workers despite a poor organizational climate and poor usability of the technology if the technology is viewed as useful by the workers and is not perceived as a threat to jobs. However, introducing technology that does not receive good usability ratings into a hospital with a poor organizational climate means a missed opportunity to get the best out of both the workers and the technology. The finding that workers who have a more positive attitude towards technology are also not as committed to staying with the organization bears further investigation.

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Preface

The purpose of this thesis was to study the process of introducing new technology into a hospital in order to identify some of the reasons why introducing new technology into this type of organization might fail or succeed. We live in a society that has embraced computerized technology to a point where it is now almost impossible to find an organization that has not computerized. Many large corporations that computerized a decade or two ago have since re-organized and re-computerized in a process that has become popularly known as business process reengineering (Hammer & Champy, 1993). Hospitals have also been busily computerizing in the last two decades (Hannah, 1995). However, computerization of hospitals often lags behind the computerization of large corporations and manufacturing plants due to the lack of funds for capital investment. Both the business and public sector have been reducing staff (downsizing) in the past decade. In the case of business, this is to maximize profits. In the case of hospitals, at least in Canada, downsizing has been a response to budget constraints. Although the introduction of new technology has sometimes met the goals and expectations of the purchasers of the technology, often it has not (Majchrzak & Davis, 1990). Most modern technology is driven by computers and there are often complaints that computers are not useful or usable and that the expected productivity benefits are not realized (Landauer, 1995).

The current exploratory field study investigated the introduction of new technology into a modern 215-bed Canadian bilingual French/English acute-care hospital from a human factors (ergonomic) perspective and from an organizational-behaviour perspective. The former perspective is concerned with the design of the technology, now regarded as micro-ergonomics (Salvendy, 1997). The merging of the organizational and human factors perspectives is popularly known as 'macro-ergonomics' (Hendrick, 1991, 1995; Salvendy, 1997). It was hypothesized that the degree of success realized by introducing the new technology will depend on the usability of the technology, and on the culture and climate of

the organization into which the technology is introduced. A successful technology implementation was defined in this thesis as one that does not have continued adverse effects upon workers beyond the initial adjustment period, and preferably, has some positive effects. The ideal situation is one in which the technology obtains a high usability rating from usability experts, and is being introduced into a healthy organization with a flexible culture. Indicators of a healthy organizational culture might include employees who are committed to the organization, who perceive the organization as supportive of them and who view how their work is organized (i.e. job design) in a positive manner. While technological change may ordinarily be stressful, in a positive environment for introducing new technology, it would be expected that stress levels would be back to baseline after six months of adjustment, and that job satisfaction would increase as more tedious tasks are automated.

Chapter 1 presents the organizational-behaviour perspective of introducing new technology into a hospital environment. Pharmacy and nursing staff of the hospital served as subjects. The subjects were surveyed and semi-structured interviews were conducted two weeks prior to the implementation of the new oral solids dispensing machine (Time 1) and six months after its installation (Time 2). Pharmacy staff were directly affected by the introduction of the new automated tablet dispensing system and the nurses were indirectly affected by the introduction of the new technology. Two nursing units, one medical unit and the other a surgical unit, were chosen as representative samples of the units that would be affected. The surveys sought workers' opinions regarding their organization's culture and climate, perceived organizational support, work stress, job satisfaction, organizational commitment, job motivation, job involvement, and attitude towards technology. Interview questions at Time 1 asked subjects to describe the hospital's philosophy and goals, their opinions on the reward system at their hospital, any planned changes, training, their technical experience, supervisory practices in their department, communication and relations between workers and management, and their work environment. At Time 2,

interview questions probed workers' opinions on the changes that had occurred in the previous six months and the impact they had on their work and patient care. Also, information was sought regarding changes in worker-management relations and the relations between the nursing units and the pharmacy department. The interviews served as a rich source of information regarding subjects' opinion regarding the culture and climate of the hospital and their attitudes towards changes that were occurring in the hospital, including opinions regarding technological changes. The survey data in this study was used as support for the conclusions drawn from the interview data.

During the six months between the Time 1 and the Time 2 data collection periods, there were very few organizational changes in the pharmacy department and a limited amount of downsizing on the medical nursing unit. On the surgical nursing unit during this period of time, however, major organizational changes occurred. The charge nurse was "laid off" and two surgical units were amalgamated into one. At Time 1, the hospital under study was one of the hospitals on a provincial government restructuring committee's list for possible closure. At Time 2, the hospital had been taken off the list of hospitals to be closed.

In Chapter 2, the usability assessment of the new technology is presented and discussed. Usability experts were recruited from the university and from industry to provide an independent assessment of the usability of the new pharmacy dispensing system software that the pharmacy staff navigated through in order to run the machine that does the dispensing of drugs into individual packets. A survey instrument was developed based on Nielsen's (1992, 1994) usability heuristics. The usability experts' comments and heuristic evaluation survey ratings were used as an independent expert opinion on the usability of the interfaces running the new automated dispensing machine.

Chapter 3 integrates the findings from Chapter 1 and Chapter 2, discusses the limitations of the current study, and presents suggestions for future research. This research is a case study of the process of introducing new technology into a hospital environment.

Interview and survey data obtained before and after the introduction of the new technology is integrated in order to gain some understanding of how the process of introducing new technology into a healthcare organization might be improved.

Chapter 1

Introducing New Technology into the Hospital

The Organizational Behaviour Perspective

1.1 Introduction

1.1.1 The History of the Organization of the Modern Hospital

The hospital as a refuge for the sick has existed in one form or another for thousands of years. In the latest edition (1957) of his book on hospital organization and management, MacEachern describes early Hindu, Egyptian, Greek, and Roman hospitals, some of them in operation earlier than 1000 B.C.. That the organization of work in a hospital can have a profound effect upon the care that patients receive is vividly illustrated in MacEachern's description of what happened to medical care following the Christian Church edict of 1163 forbidding clergy to perform operations which necessitated the shedding of blood. As a result, surgical operations were taken out of the control of the more well-educated monks and clerics and given to the uneducated barbers. As MacEachern points out, "Thus those who had access to the knowledge from the great Greek physicians were superseded by a class of men whose sole accomplishment was application of the leech, a therapy which was practiced with frequency" (p. 9).¹

Introduction of advanced technologies at the end of the 19th century greatly aided physicians in diagnosis. These technologies include Bergmann's introduction of steam sterilization in 1886, Roentgen's discovery of the x-ray in 1895, the clinical thermometer, the laryngoscope, and Helmholtz' ophthalmoscope. The x-ray machine had a great influence on the development of hospital organization; it marked the beginning of the use of equipment large, complex, and costly enough that individual physicians could not afford to install it, resulting in the founding of community hospitals where physicians could jointly use such equipment.

The hospital standardization movement has had a profound effect on the organization of the modern hospital. In North America, this movement was started in 1918

¹ The first British hospital, St. John's, was built in York in 1084. The first hospital in Canada was the Hotel-Dieu du Precieux-Sang established in Quebec in 1644, and the first account of a U.S. hospital is of one used for sick soldiers on Manhattan Island in 1663.

by the American College of Surgeons who published a list of approved hospitals. The function of overseeing hospital standardization was taken over by the Joint Commission on Accreditation of Hospitals in 1952, which included the American College of Physicians, the American College of Surgeons, the American Hospital Association, the American Medical Association, and the Canadian Medical Association. The Canadian Council on Hospital Accreditation became a separate entity from the Joint commission on Accreditation of Hospitals in 1958, and is now called the Canadian Council on Health Facilities Accreditation (CCHFA)².

In order to meet accreditation criteria, hospitals have to meet certain standards of care. In the first few decades of the modern hospital, there was a great deal of administrative work to be done to develop standards in order to receive accreditation. This encouraged the development of hierarchical, top-heavy organizations. It is only in the last few years that hospitals have been removing layers of management - a process that many businesses have been involved in for more than a decade (Hammer & Champy, 1993).

The governing board of the modern hospital in Canada is usually composed of volunteers from the community. The board hires, and delegates administrative authority to, the chief executive officer (CEO) of the hospital. The modern hospital is usually divided into various departments that can broadly be categorized either as clinical or business. Figure 1 presents an organizational chart of a typical acute treatment hospital.

Cost-containment has become a major concern in the healthcare industry in the last two decades. Until recently, hospitals tended to take a limited reactive approach to cost-containment. Towards the end of the fiscal year, the hospital administration would realize that the hospital's finances were not going to carry the hospital to the fiscal year end,

² The CCHFA is a voluntary body composed of representatives of the Canadian Hospital Association, the Canadian Medical Association, the Royal College of Physicians and Surgeons of Canada, the Canadian Nurses Association, and the Canadian Long Term Care Association (Crichton, Hsu & Tsang, 1994).

Figure 1

The organization of a typical acute treatment hospital.

Source: Sutherland and Fulton, 1988, p. 243

and beds were closed. This was a common-enough practice to lead R.F. McElligott, Vice-President of Medicine at Surrey Memorial Hospital to make the following statement in the University of British Columbia's HCEP Alumni Newsletter, Summer 1992 (cited in Crichton et al., 1994, p. 235):

For some years now the signs and warnings have been there for all to see ... the gravy train has departed, probably never to return. Yet each year finds many administrators and physicians taken by surprise. What often follows is an unseemly scramble, beds are closed, across-the-board cuts are made, and physicians rail at the system, which they see as putting the Canadian public at risk. The public is disquieted and recriminations abound on all sides. But does it have to be like this every year?

Since McElligott made this statement, more widespread reforms have been tried, including regional planning of hospital care, conversion of hospitals into community health centres, and closing of hospitals. Not only is there demands on hospital administrators to balance the hospital budget, but they are also under pressure to demonstrate why their hospital should not be closed. In times of restructuring, a great deal of the responsibility involved in managing the hospital during the transition period falls on the hospital board and the CEO. According to a survey by Heuerman in 1989, 70 percent of hospital CEOs reported that they relied more heavily on their boards during restructuring than in the past.

Much of the continuing re-organization of hospitals will likely include new technology, as it becomes available, in an attempt to cap spending on salaries, to keep better track of general hospital expenditures, to provide more effective care to patients, and to determine which therapies are most likely to reap benefits. Coile (1994), President of the Health Forecasting Group of Santa Clarita, California, notes that, "High technology will be a driving force in health care's future" (p. 27) and that "every hospital needs a strategic technology plan" (p. 36). There has already been a shift from inpatient to outpatient services in the U.S. and Canada. With continued improvements in laparoscopic surgical techniques, for example, many of the surgeries that would, in the past, have required hospitalization, can now be done as day-surgery. According to Coile, the emerging technological advances that will have the greatest influence in healthcare in the

90's are: automated procedures, biosensors and implants, diagnostic imaging, genetic engineering, home health/self-diagnostics, new wave surgery, office automation, superdrugs, and transplants. Another emerging trend in healthcare in the '90s is telemedicine (Gosbee, 1995). Whether or not hospitals, especially in Canada, will be able to afford these new technologies remains to be seen. The technologies most likely to be installed will be ones that improve efficiency of health delivery that can demonstrate positive effects on patient morbidity, and that can bring added revenue to the hospital. Sharing technology with other hospitals may save money. Added revenue may be generated by contracting services out to other hospitals; for instance, by dispensing unit dose drugs for pharmacy departments in other hospitals.

1.1.2. Introducing New Technology into Organizations:

The Flexibility Issue

Much of the recent literature on the introduction of new technology into organizations is concerned with the introduction of advanced manufacturing technology (AMT) into factories. Advanced technology machines are purchased and installed with the expectation that the organization into which they are placed will reap certain benefits from the change. The expected benefits often include cost-reduction either on materials or labour or both. Other expected benefits include increased flexibility in responding to customers' needs, a reduction in errors, or, less commonly, improved employee job satisfaction. Whether or not the expected benefits actually materialize is dependent on the technology itself, the type of organization into which it is introduced, how the introduction of the new technology is managed, and the attitudes of the employees that are expected to use the new technology (Clegg et al, 1996; Hendrick, 1997).

The difference between AMTs and earlier forms of automation is their ability to increase the flexibility of the manufacturing process. With AMTs, it is possible to design and produce different types of products in small volumes by changing the software (Upton, 1995). Moreover, different product lines can also be integrated through the underlying

information system. Although some authors report that companies are seeing the productivity and flexibility benefits of AMT (e.g., Bessant & Haywood, 1988; Ettlie, 1986; O'Toole, 1985), others report productivity improvements but not greater flexibility (e.g., Jaikumar, 1986; Voss, 1988a, b), and some authors report companies that have seen neither productivity nor flexibility benefits from AMT (e.g., Fleck, 1984). Productivity benefits derive from the amalgamation of routine tasks into AMT's hardware and software, which results in lower direct labour costs, rework costs, and work-in-process inventories, as well as from an increase in machine utilization. Flexibility benefits occur as a result of the integration of production processes, and from the integration of design, engineering, and manufacturing functions. This shortens the product development time and makes customization possible. It has been argued that flexible *organization* structures are required to gain the benefits of AMT (e.g., Bessant & Buckingham, 1989, Gerwin & Kolodny, 1992; Majchrzak, 1988, National Research Council, 1986). From this research, Zammuto and O'Connor (1992) argued that the culture of the organization may facilitate or hinder the implementation of an AMT.

Organizational flexibility provides workers with the opportunity to upgrade their skills. However, organizational change that takes place before or concurrently with the introduction of AMT requires retraining of workers and managers, and overcoming existing cultural norms (such as resistance to change). The barriers to achieving an organizational redesign are not usually as pronounced if the AMT is introduced into a "greenfield site"³ (Hirschhorn, 1984) and may explain why many manufacturers introduce AMTs into "greenfield sites" instead of existing plants. Upton (1995) has noted that unless the technology being considered has evolved to a point where it is possible to reap flexibility benefits, it is often possible to get greater operational flexibility by tapping the unused potential of workers rather than by adding new technology. Introducing a

³ A greenfield site refers to a new plant start-up usually in a new physical location with specially selected personnel.

computerized system into a "greenfield" hospital has been shown to have advantages over introducing a new computerized system into an existing hospital structure, particularly in terms of acceptance of the new system (Milner, 1985).

Centralization is seen as an impediment to gaining flexibility benefits from AMT. In her survey of 1,015 metalworking plants, Kelley (1990) found that "the larger and more complex the organization, the greater the pull towards centralization of control over the technology and the lower the probability that blue-collar jobs will incorporate programming responsibilities" (p. 202). She also found unionization to be positively correlated with centralization. The probability that significant programming responsibilities would be assigned to production employees was 2:1 in favour in nonunion workplaces that did not have a seniority system, decreased to 1:1 in the presence of a union, and with the presence of both a union and a seniority system, the odds were 3:1 in the opposite direction. Kelley's work links organizational structure with organizational culture.

Sherman (1993) discusses the impediments that the functional organization of modern hospitals pose to innovation and effectiveness.

Segregation is caused by the organizational structure itself. Departments and their divisions, levels, and layers act to produce distrust, paranoia, "turfism", and power plays.

Isolating specialists based on their knowledge means isolating them in their ignorance. Progress is held up as much by nurses who don't understand finance as it is by staff in Central Supply who don't see the reality of bedside care. All parties are innocently wrong, but wrong nonetheless. The chain of command unintentionally becomes the chain of communication. By restraining and slowing communication, the chain of command produces lethargy and inertia.

Decisions tend to funnel up to the apex of the hierarchy. In a rapidly changing environment more and more decisions must move up to a few decision makers, a bottleneck that means too little change processed per unit of time.

Layered organizations are poor at communicating accurately and in a timely way, with a resulting fall-off of decision-making speed and accuracy.

Quality problems are inherent when the left hand doesn't know what the right hand is doing. Departmental isolation is a repeating theme in quality errors.

Those who are considered to be lower-status feel a loss of morale and job zest and a passive dependency. Turnover and unionization are on the horizon for too many hospitals as a result.

Customer irritation and anger result when problems are left untended. As they pile up, customers wonder, "Who's on first?" (p. 139).

Flexibility in hospitals is a relatively new concept. Hospitals have been moving towards flexibility without defining it as such. There has been an increase in the volume of day-clinic and day-surgery appointments, and there is a push to treat patients at home as much as possible (Ellerton & Merriam, 1994; Grainger & Griffiths, 1994; Korttila, 1995). This is the AMT productivity equivalent of increased machine utilization; more patients are being taken care of for the same amount of time and money. Many of these operational changes in hospitals have been made possible by new technology and new skill acquisition by employees. Many more surgeons are now skilled in laser surgery, for instance, and nurses have learned how to care for patients who are using new technology at home. Hospitals around the world have been in the process of computerization for the last two decades and many of the problems encountered result directly from organizational issues in the hospital environment (e.g., Lorenzi, Ball, Riley & Douglas, 1995). For instance, Horak (1995) reported the resistance of physicians and nurses to using a new computerized hospital information system that included physician order entry, retrieval of clinical results, workload reporting, and electronic mail. The resistance resulted from a decision that was made at the top by the hospital administration to purchase the system without first seeking input from those who would be using it. Griesser (1995) lists "unnecessary secretiveness by the hospital management responsible for the HIS [hospital information system]" (p. 234) as one of the reasons for the failed attempt at implementation of a new HIS in a German hospital.

West and Anderson (1992) investigated innovation, cultural values of management teams, and the management of change in 27 British hospitals by monitoring the minutes of management meetings. Hospitals were categorized by cultural type based on Quinn and

Spreitzer's (1991) descriptions which are very similar to those of Zammuto and O'Connor's (1992) used in this thesis; both descriptions are based on the competing values model. Zammuto and O'Connor discuss organizational cultures that are classified as mainly 'hierarchical' or 'rational' as being least likely to benefit from the flexibility rewards of advanced manufacturing technology. Hierarchical and rational structures are described as being control-oriented structures; developmental and group cultures are described as flexibility-oriented structures. Control-oriented structures put access to knowledge, expertise, and decision-making power in the hands of administrators, while flexibility-oriented structures give these tools to the workers.

West and Anderson (1992) found a preponderance of rational and hierarchical culture type innovations, some developmental culture type innovations and few group culture type innovations. However, the authors state that "the innovation raters saw the latter two categories as encompassing changes which were qualitatively more radical and novel than the former two categories" (p. 305) and that "the results from this study indicate that the predominant concern amongst management teams was for control and direction rather than for flexibility" (p. 307). Due to the indirect way in which data was gathered in the West and Anderson (1992) study, more research is needed to support the conclusions drawn by the authors.

Previous research by Rosner (1968a, b) tends to support the hypothesis that hospital structure may have an effect on innovation. Rosner found that the greater the supervisory control of staff activity, the lower the rate of innovation. He also found that hospitals with greater economic orientations had fewer innovations. In terms of positive effects on innovation, he found that the greater the visibility of consequences for the hospital, the higher the rate of innovation. Rosner, therefore, concluded that administrative control in itself does not necessarily have a negative effect upon innovation if the control is control through visibility of consequences, rather than control through procedures to be followed.

1.1.3 Organizational Climate and Culture

Organizational culture is often examined in industrial/organizational research as a way of providing a basis for understanding other aspects of an organization such as its effectiveness and ability to change. Organizational culture is defined by Schein (1985) as

a pattern of basic assumptions - invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration - that has worked well enough to be considered valid and, therefore is to be taught to new members as the correct way to perceive, think and feel in relation to those problems (p. 9).

An organization's explicit values may be written in the form of mission and vision statements. The competing values model of organizational culture as developed by Quinn (Quinn, 1988; Quinn and Rohrbaugh, 1981, 1983) is an attempt to organize the literature related to organizational effectiveness. These researchers started by looking at Campbell's (1977) review of the literature on organizational effectiveness in which he lists 30 indices of organizational effectiveness. A list of these indices are found in Table 1.1. The competing values model has much in common with the categories of productivity derived by Guzzo and Bondy (1983) listed in Table 1.2.

Table 1.1

Campbell's (1977) Indices of Organizational Effectiveness.

Overall effectiveness
Productivity
Efficiency
Profit
Quality
Accidents
Growth
Absenteeism
Turnover
Job satisfaction
Motivation
Morale
Control
Conflict/cohesion
Flexibility/adaptation,
Planning and goal setting
Goal consensus
Internalization of organizational goals
Role and norm congruence
Managerial interpersonal skills
Managerial task skills
Information management and communication
Readiness
Utilization of environment
Evaluations by external entities
Stability
Value of human resources
Participation and shared influence
Training and development emphasis
Achievement emphasis

Table 1.2

Guzzo and Bondy's (1983) Categories of Organizational Productivity Indicators.

<u>Output Indicators:</u>	Quantity/rate
	Quality/accuracy
	Costs/efficiency
	Miscellaneous
 <u>Withdrawal Indicators:</u>	 Turnover
	Absenteeism
	Tardiness
	Miscellaneous
 <u>Disruption Indicators:</u>	 Accidents/safety
	Strikes
	Slowdowns
	Grievances
	Alcohol/drugs
	Miscellaneous

Quinn and Rohrbaugh used Campbell's original indices to perform a multidimensional scaling of a similarity/dissimilarity task, resulting in three dimensions. The authors interpret the first value dimension (the horizontal or x-axis) as representing organizational focus. One end represents an internal, micro emphasis on the well-being and development of people in the organization and the other end represents an external, macro emphasis on the well-being and development of the organization. The second value dimension (vertical or y-axis) is related to organizational structure, representing the contrast between an interest in stability and control versus flexibility and change. The third (depth or z-axis) value dimension relates to organizational means and ends, one end of the axis emphasizing processes such as planning and goal-setting, and the other end emphasizing final outcomes (e.g., productivity).

Zammuto and his colleagues (Zammuto & Krakower, 1991; Zammuto & O'Connor, 1992) have developed a survey instrument to test organizational culture/effectiveness based on Quinn's (1988) and Quinn and Rohrbaugh's (1981, 1983) work on the competing values model. In addition to developing a structure classification for each institution, the authors sought to develop a profile of characteristics of each type of organization (group, developmental, hierarchical, and rational).

A 'group' culture is the humanistic approach to management. This approach is internally focused and flexible. This type of culture is representative of leadership that is concerned and supportive of employees and encourages attachment to the organization, group cohesion and group morale. The 'developmental' culture type is also flexible but has an external focus and therefore, emphasizes adaptability, growth and resource acquisition whose leaders are inventive and risk-takers. The 'hierarchical' organization has an internal focus. The emphasis is on stability and control. Leaders in this type of organization are conservative and cautious. A 'rational' organization has an external focus. This type of organization has leaders who are concerned with production and efficiency, planning and

goal-setting. Both the 'hierarchical' and the 'rational' type organizations are more concerned with control than with being flexible.

Based on this work, as well as on work done by Quinn and Kimberly (1984), Zammuto and O'Connor (1992) describe the competing values model as it applies to advanced manufacturing technology. Table 1.3 presents the Zammuto and O'Connor model. Organizations are classified as having a group, a developmental, a hierarchical, a rational culture, or a combination of any or all of these types of cultures. Zammuto and O'Connor hypothesized that the greater the emphasis on flexibility-oriented values, the more likely the organization will gain the productivity and flexibility benefits of AMT.

Understanding the type of culture that characterizes an organization may highlight other potential problems in the organization. For instance, in their study of universities, Zammuto and Krakower (1991) correlated cultural type with organizational characteristics, climate, and strategy. A rational culture is significantly correlated with centralization and a hierarchical culture is significantly correlated with formalization. Trust is more often present in organizations with group and developmental cultures. In these cultures, there are fewer conflicts, morale is higher, equity of rewards more common, resistance to change less, leader credibility greater, and scapegoating occurs less often than in hierarchical or rational cultures. Rational cultures were seen as neither reactive nor proactive in terms of their organizational strategy, but group and hierarchical cultures were positively correlated with reactive strategy and negatively correlated with proactive strategy. Organizations classified as mainly developmental were strongly seen to have a proactive orientation.

Organizational climate is often referred to as the surface manifestation of organizational culture (e.g., Barley, 1983; Barley, Meyer, and Gash, 1988; Gordon, 1991; Schein, 1985, 1990). The scope of organizational climate includes work activities, decision-making, communication, information-sharing, and relations between workers and management. The idea that organizations have cultures and climates has been around

Table 1.3

The Competing Values Model: Four Value Systems and Their Characteristics.

Value Systems	Group	Developmental	Hierarchical	Rational
<i>Value Dimensions</i>				
Flexibility/Control	Flexibility	Flexibility	Control	Control
Internal/External Focus	Internal	External	Internal	External
Means	Cohesion, morale	Adaptability, readiness	Information management, communications	Planning, goal-setting
Ends	Development of human resources	Growth, resource acquisition	Stability, control	Production, efficiency
<i>Organizational Characteristics</i>				
Compliance	Affiliation	Ideology	Rules	Contract
Motivation	Attachment	Growth	Security	Competence
Leadership	Concerned, supportive	Inventive, risk-taking	Conservative, cautious	Directive, goal-oriented
Technology	Craft	Nonroutine	Routine	Engineering
Organizational Form	Clan	Adhocracy	Hierarchy	Market

since the work by Lewin, Lippitt and White (1939) on creating social climates (authoritarian, democratic, laissez-faire). Until recently (Woodman & Pasmore, 1991), culture researchers were more likely to use qualitative and case study methodologies whereas survey methodologies were most often used in climate research (Schneider, 1985).

1.1.4 Organizational Health Indicators

1.1.4.1 Perceived Organizational Support

Perceived organizational support is defined as the perception that employees have "concerning the extent to which the organization values their contributions and cares about their well-being" (Eisenberger, Huntington, Hutchison & Sowa, 1986, p. 500). From this social exchange viewpoint, the authors hypothesized that an employee's beliefs about the organization's commitment to them contributes to the employee's subsequent commitment to the organization. In support of this hypothesis, Eisenberger et al. (1986) found that perceived organizational support reduced absenteeism and Eisenberger, Fasolo and Davis-LaMastro (1990) found a positive relationship between perceived organizational support and diligence, commitment, and innovation. Jones, Flynn, and Kelloway (1995) have shown that perceived organizational support may moderate the effect of stress on job satisfaction and commitment.

1.1.4.2 Organizational Commitment

Organizational commitment is defined by Mowday, Porter and Steers (1982) as "the relative strength of an individual's identification with and involvement in a particular organization, which is characterized by belief in and acceptance of organizational goals and values, willingness to exert effort on behalf of the organization, and a desire to maintain membership in the organization" (p. 27). These authors consider commitment a global construct, and one that is likely to be stable over time. In contrast, job satisfaction is a measure of an employee's response to their job or to certain aspects of their job. Stemming

from earlier work by Becker (1960) who regarded commitment as less affective and more calculative, Meyer and Allen (1984) developed a questionnaire which separates affective commitment from continuance commitment. The affective component of organizational commitment refers to employees "emotional attachment to, identification with, and involvement in, the organization" (p. 375). The continuance component refers to "commitment based on the costs that employees associate with leaving the organization" (p. 1). The continuance commitment scale can further be divided into two highly related subscales that both reflect costs associated with leaving the organization - (1) lack of alternatives and (2) personal sacrifice (Meyer, Allen & Gellatly, 1990).

Meyer, Paunonen, Gellatly, Goffin and Jackson (1989) studied organizational commitment in first-level managers of a large food service company and found that affective commitment correlated positively and continuance commitment negatively with job performance. Job performance of these managers was rated by their immediate supervisors. Meyer et al. (1990) speculate that when commitment reflects an identification with, and involvement with, the organization, the organization may benefit by reduced turnover and superior performance. When commitment is primarily based on a recognition of the costs associated with leaving, the benefits of reduced turnover may be obtained at the price of poor performance. However, contrary to the findings of Meyer et al. (1989), Hackett, Bycio and Hausdorf (1994) found no relationship between organizational commitment and job performance. These authors did find a positive correlation between affective commitment and the MJDQ job motivation scale (.52) amongst a group of 2,301 nurses. The authors concluded that this result "reinforces the notion that, of the three commitment components, AC is most affected by the nature of one's work experiences" (p. 21).

1.1.4.3 Job Stress

In his review of the history of stress research, Lazarus (1993) states that:

The study of stress has been plagued by an inconsistent and potentially confusing use of terms to denote the variables of the stress process. In the medical tradition, for example, stress is treated as a set of psychological and physiological reactions to noxious agents; Selye used stressor to denote the agent, stress to denote the reaction; sociologists speak of stress as the disturbing agent (e.g., social disequilibrium; Smelser, 1963) and of strain as the collective reaction (e.g., a panic or riot). (p. 4).

In the context of work stress, strains can take the form of tension (Abush & Burkhead, 1984) and anxiety (Caplan & Jones, 1975). Work stress has also been linked to job dissatisfaction, absenteeism, intent to leave, and voluntary turnover (Bagozzi, 1978, 1980; Hendrix, Ovalle & Troxler, 1985; Hendrix, Steel, Leap & Summers, 1995; Ivancevich, Matteson & Preston, 1982; Jones et al., 1995). Role stress encompasses the concepts of role overload, role insufficiency, role conflict, role ambiguity, and responsibility for others. When a worker is required to play a role which conflicts with their values or is assigned roles that are in conflict with each other, role conflict can result. Role ambiguity may occur when workers are unsure of the role they are supposed to play in a work situation. Role overload occurs when workers perceive themselves as lacking the ability to manage the current demands being placed upon them by their work situation. Role overload can be the result of the amount of the work and/or the nature of the work. Role insufficiency refers to the underutilization of a worker's abilities and training by the organization.

In their comprehensive model of organizational stress, Ivancevich and Matteson (1980) identify many of the organizational stressors of concern to this thesis. At an individual level, work overload, role conflict, role ambiguity, career goal discrepancy (role insufficiency), and responsibility for people are mentioned. At the group level, lack of cohesiveness, intragroup conflict, status incongruence and group dissatisfaction are identified as stressors. Organizational climate, technology, management styles, control systems, organizational design, job design and job characteristics are organizational level

stressors identified by the authors. One way of judging the success of introducing new technology into an organization is by measuring perceived stress levels of workers before and after the introduction of the new technology.

At the organizational level, technology has been identified by Ivancevich and Matteson (1980) as a stressor. However, as with others who take the sociotechnical systems approach (Emery & Trist, 1960) to studying the effects of introducing new technology in the workplace (Langley & Truax, 1994; Perrow, 1967; Woodward, 1965; Zammuto and O'Connor, 1992), Ivancevich and Matteson view stress on individuals as resulting from technology adoption to relate only to a mismatch between the technology, task attributes, and organizational structure. It is proposed here that the introduction of new technology can be a source of stress on individuals for micro- as well as for macro-ergonomic reasons. From the macro-ergonomic perspective, it was hypothesized that organizational climate can be a source of stress for individuals. From a micro-ergonomic perspective, it was hypothesized that the technology itself and the manner in which it is introduced into the organization can have an impact on job stress for workers.

1.1.4.4 Job Motivation: Job Design and Job Satisfaction

When new technology is introduced, it has a significant effect upon how the work is accomplished, in other words, job design. A variety of approaches to job design have been developed by researchers. In their review of the job design literature, Campion and Thayer (1985) extracted nearly 700 job design rules. They classified these rules as belonging to either a motivational, mechanistic, biological, or perceptual/motor conceptualization of job design. For the purposes of this thesis, of interest is the motivational approach to job design which encompasses job autonomy, intrinsic job feedback, extrinsic job feedback, social interaction, task/goal clarity, task variety, task identity, ability/skill level requirements, task significance, growth/learning, promotion, achievement, participation, communication, pay adequacy, recognition, and job security (Campion, 1988; Campion and Thayer, 1985). Job design is associated with job

satisfaction, intrinsic motivation, job involvement and job performance. Work motivation has also been characterized by many other researchers, most notably, Hackman and Oldham (1980). The Hackman and Oldham job characteristics model identifies five motivating characteristics of jobs: skill variety, task identity, task significance, autonomy, and feedback.

Job satisfaction may be defined as a positive affective response to one's job (Locke, 1976). This definition and discussion by others such as Smith, Kendall, and Hulin (1969), and more recently, Gerhart (1987) point to the view that job satisfaction is determined by both dispositional factors (individual traits) and situational determinants. Of interest here is whether or not the introduction of new technology - a situational factor - has an impact on job satisfaction.

1.1.4.5 Attitude Towards Technology

For the past two decades, the measurement of attitudes towards technology has evolved from measuring attitudes towards office automation (e.g., Arndt, Feltes & Hanak, 1983) to measuring attitudes towards ever more complex technologies such as advanced manufacturing technology (e.g., Martin, 1988) and information systems (e.g., Compeau & Higgins, 1995; Davis, 1993). Mahling, Craven, and Croft (1995) describe work flow systems that have evolved in a decade from ways of managing the workflow of office automation to supporting process reengineering. Technology is constantly changing, and surveys that have been used in the past to measure attitudes towards technology may not continue to be valid in the future. For instance, experience with computers is becoming too broad a question. 'Experience with computers' can mean anything from using word processing to using CAD/CAM (Computer-aided Design/Computer-aided Manufacturing) software. Researchers have found that workers with experience working with computers have a more positive attitude towards them (Compeau & Higgins, 1995; Zoltan & Chapanis, 1982; Arndt et al., 1983; Kerber, 1983). Zoltan and Chapanis (1982) found that as a group, pharmacists expressed a more positive attitude towards computers than did

accountants, physicians, and lawyers. The pharmacists also expressed more interest in learning about computers and their abilities than did the other groups. Considering the rise in use of financial and accounting software compared to software for the other professional groups listed in the last 15 years, it would be interesting to see if the ordering of these professional groups in terms of attitudes towards computers has changed. Some researchers have attempted to measure the effects of both attitudes towards technology and job involvement (Martin, 1988; Rafaeli, 1986).

1.1.4.6 Job Involvement

Rafaeli (1986) found that job involvement moderated the relationship between computer experience and attitudes amongst white-collar non-managerial employees from three manufacturing organizations; those workers with higher job involvement held more favourable attitudes towards working with computers. Martin (1988) developed two short surveys to measure attitudes towards technology and job involvement. These instruments were used to test these two constructs on 115 employees from a large microelectronics company. The groups were divided into four independent groups: manual-unskilled, manual-skilled, computer-unskilled, and computer-skilled. Consistent with other research, Martin found that employees who worked with computers had more favourable attitudes towards AMT than those who did not. Martin's results also support Rafaeli's finding that the most favourable attitudes towards AMT are held by employees who work with computers and also have high job involvement.

The impetus for the current research was the introduction of a new oral solids dispensing machine into the pharmacy department of a bilingual French-English acute-care hospital. The intention of this thesis was to explore the dynamics between the organization, the job characteristics, and the technology. The hospital in which the present research was conducted is a 215-bed university-affiliated community hospital. The working language of hospital employees was predominantly French. The hospital has an annual budget of approximately \$41,000,000 and employs about 800 people (Canadian

Hospital Association, 1995). The organization of this hospital is much the same as the organization of the hospital in Figure 1. The various departments could be broadly categorized as either clinical or business. The clinical areas were grouped according to specialty (e.g., medicine, surgery, etc.), and the professions were segregated. For instance, nurses were grouped under the nursing department, pharmacists and pharmacy technicians were grouped together in the pharmacy department, and physiotherapists were lodged in the physiotherapy department.

The locus of this research was the pharmacy department of this hospital since this department was about to purchase a new piece of technology to dispense oral solid medications, providing an opportunity to collect data before and after the implementation of the technology. Two nursing units (one medical and one surgical) were chosen to also participate in this study. These two units were accessible and were representative of nursing units that would receive benefits from the changes occurring in the pharmacy department. The nurses could therefore be considered the clients of the pharmacy department. In addition, since there were no plans to introduce any new technology into these nursing units during the time that the oral solids dispensing machine was being introduced into the pharmacy department, these units were useful for comparative purposes.

Before the introduction of the oral solids dispensing machine, the pharmacy department of the hospital under study received orders for patients' medications through a hospital-wide information system which was text-based. Labels for the medications were printed from this computer, but the drugs themselves were dispensed by pharmacy staff manually for a seven day period, although updates were processed daily. With the introduction of the new technology, the patient and medication lists are generated by the original computer system and transferred to an intermediary computer. The intermediary computer provides the computer that runs the machine with a list of patients and drugs to be dispensed, and a list of remaining drugs to be dispensed manually by pharmacy staff is

printed. The machine has about 200 canisters of various drugs that it dispenses into single doses for each patient on a daily basis.

This thesis examines the dynamics of introducing new technology in relation to the culture and climate of the organization, worker's perceived organizational support, commitment to the organization, perceived stress, job design, job satisfaction, job involvement, attitudes toward technology, and usability of the technology. Data collection occurred two weeks prior to the implementation of the new technology and six months after its implementation. It is hypothesized that the effects of introducing new technology into the hospital environment will depend on the usability of the technology as well as the organizational climate and culture.

1.2 Method

1.2.1 Subjects

Pharmacy and nursing staff of this 215-bed bilingual French/English acute-care hospital served as subjects for this study. Pharmacy staff were the workers directly affected by the introduction of the new automated tablet dispensing system and the nurses in the hospital were indirectly affected by the introduction of the new technology. Two nursing units were chosen as representative samples of the units that would be affected. One of the nursing units was a medical unit - referred to in this document as Nursing Unit 1. The other nursing unit was a surgical unit - referred to as Nursing Unit 2. All of the subjects were women with the exception of the one male pharmacist (who left the hospital for another position two months after the Time 1 data collection).

Eight out of ten of the pharmacy staff filled out survey forms and nine staff members were interviewed at Time 1, for a response rate of 80% for the surveys and 90% for the interviews. At Time 2, one of the pharmacists had left but the other seven pharmacy staff members again completed the set of surveys and were interviewed. The Time 1 data collection occurred two weeks before installation of the new oral solids dispensing machine

into the pharmacy department. The Time 2 data collection occurred six months after its installation.

At Time 1, eight of the 22 medical nurses completed surveys for a response rate of 36%. At Time 2, eight of the 20 medical nurses completed surveys for a response rate of 40%. All of the eight medical nurses who completed surveys and were interviewed at Time 1 also completed Time 2 surveys and gave interviews. One additional medical nurse gave an interview at Time 1.

At Time 1 on the surgical ward, 13 of the 40 nurses on staff completed surveys for a response rate of 33%. All but one of them were interviewed. One additional surgical nurse who did not fill in a survey gave an interview. At Time 2, 13 of the 28 nurses completed surveys - a response rate of 46%. Eight of these nurses had completed Time 1 survey forms. Eleven of the surgical nurses who filled in surveys also gave interviews, eight of them being from the Time 1 sample. Eight additional nurses volunteered to be interviewed at Time 2 bringing the response rate for interviews at Time 2 for surgical nurses to 68%.

Demographic characteristics of the hospital sample are presented in Table 1.4. Of note in these statistics are the differences in length of tenure with the present employer between employees in the pharmacy department and the nurses. In addition, the length of tenure in the hospital and the total number of years practicing as a nurse increased on Nursing Unit 2 between the Time 1 sample period and the Time 2 sample period due to the bumping of nurses during the period of time between the two sampling periods. Nurses with less tenure were the ones that lost their positions first. Pharmacy technicians were ten years younger than the overall average of the nurses.

1.2.2 Procedure

Copies of both French and English survey forms with stamped return envelopes were left in the pharmacy department and in the nursing units at both sampling periods for subjects who were interested in volunteering to fill out and return them. Numbers of the researchers involved and the chair of the ethics committee at the university were given on the instruction sheets in case subjects had any questions. The English surveys were translated into French by Canadian federal government translators. Two-thirds of the returned survey forms were in French. Some subjects filled-in survey forms in one language at Time 1 and in the other language at Time 2. Each set of pre-implementation surveys was assigned a number and subjects were asked to retain this number so that they could place it on their post-implementation surveys and also give it to the interviewer.

Two-thirds of the interviews were conducted in French (subjects were given a choice of which language the interview would be conducted in). A bilingual graduate student conducted all of the French interviews and half of the English ones, the remaining English interviews were conducted by the primary researcher. Interviews were conducted privately in a room close to each of the units and they were taped with the subject's permission. Interviews were conducted during all shifts (day, evening and night) in order to obtain as many interviews as possible.

The Time 1 data collection occurred two weeks prior to the introduction of the new oral solids dispensing machine in the pharmacy department and the pharmacy department embarking on a limited version of the planned CIVA (Centralized Intravenous Additives) program - taking over the function of adding medications to intravenous fluids from the nurses. The pharmacy manager decided to postpone the full implementation of the CIVA program since it was felt that staff had already undergone enough change during that six-month period. The Time 2 data collection occurred six months after the introduction of the new technology into the pharmacy department and the subsequent unit dose system on the nursing units. At the Time 2 data collection, one pharmacist had already left and

another one was in the process of leaving. In addition, time-savings anticipated by the introduction of the oral solids dispensing machine were not realized to the extent anticipated.

During the six months between the Time 1 and the Time 2 data collection periods, there were very few organizational changes in the pharmacy department and a limited amount of downsizing with the "bumping"⁴ of nurses on the medical nursing unit. "Bumping" means being given an option of having a position somewhere else in the hospital or of being "laid off". On the surgical nursing unit during this period of time, however, there were major organizational changes occurring. The charge nurse was "laid off" and two surgical units were amalgamated into one. The Time 1 surgical unit was a general surgery unit. At Time 2, this general surgery unit had been amalgamated with the orthopedic surgery unit and between the two units, over half of the nursing staff were "bumped" and a new charge nurse was installed.

1.2.2.1 Description of the Surveys

Organizational Culture

Zammuto and Krakower's (1991) competing values survey was used to measure organizational culture. According to the competing values classification system, it was expected that the hospital and departments would mainly be classified as hierarchical or rational by the staff filling out the survey, and that this would have a negative impact on the implementation of the technological changes at the hospital. The coefficient alpha for each of the four value system scales of the competing values survey, according to the authors, are: group: .82, developmental: .83, hierarchical: .76, and rational: .78.

⁴ The nurses used the term "bumped" to indicate the practice of keeping more senior staff and moving less senior staff to other areas of the hospital and/or to other less desirable shifts.

Organizational Climate

Organizational climate was measured using Taylor and Bowers' (1972) survey of organizations. These authors subscribe to Tagiuri's (1968) definition of organizational climate:

Organizational climate is a relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior and (c) can be described in terms of the values of a particular set of characteristics (or attributes) of the organization (1968, p. 27).

The survey uses 5-point Likert items. The 12 items on the scale may be regarded as meaning organizational openness and innovativeness. Cronbach's alpha for the scale has been reported as .87 (Jones, Berwald, Catano and Hackett, 1992).

Organizational Commitment

Organizational commitment is defined by Brooke, Russell and Price (1988) as "the relative strength of an individual's identification with and involvement in a particular organization, which is characterized by belief in and acceptance of organizational goals and values, willingness to exert effort on behalf of the organization, and a desire to maintain membership in the organization". The survey questionnaire used was developed by Allen and Meyer (1990). Two of the three of their constructs were measured, measuring affective commitment and continuance commitment. There are eight Likert-like survey items for each construct, the responses ranging from 1, strongly disagree to 7, strongly agree. Internal consistency for the scales (Cronbach's alpha) has been reported as .87 and .75 respectively (Allen & Meyer, 1990).

Perceived Organizational Support

Perceived organizational support is defined as the perception that employees have "concerning the extent to which the organization values their contribution and cares about their well-being" (Eisenberger et. al., 1990, p. 51). Eisenberger et al. (1986) found that perceived organizational support reduces absenteeism. Eisenberger et al. (1990) found a positive relationship between perceived organizational support and diligence, commitment,

and innovation. Jones et al. (1995) have shown that perceived organizational support moderates the effect of stress on job satisfaction and commitment, and found Cronbach's alpha for this scale to be .93.

Stress

Work stress was measured using Osipow and Spokane's (1983) Occupational Environment Scale (OES), a 60-item Likert-type questionnaire. In order to keep the time required to fill out questionnaires to a minimum, 10 of the items on this questionnaire were dropped as these 10 items were seen to be least important for the purposes of this research. These 10 dropped items deal with the physical work environment. The 50-items that were used are composed of 10 items each dealing with: role load, role insufficiency, role ambiguity, role conflict, and responsibility for others. The psychometric properties of this scale include an internal consistency for the total scale of .89 (Cronbach's alpha); the internal consistency for the subscales range between .71 and .90. The two week test-retest reliability is $r = .90$ (Osipow & Spokane, 1983).

Job satisfaction

Job satisfaction was measured using the Job Descriptive Index (Smith et al., 1969) work scale. The correlation of random split-halves as a measure of internal consistency is reported to be .73. This correlation improves to .84 when corrected to full length by the Spearman-Brown formula. This scale presents subjects with adjectives to describe their job and asks them to think of their job in general, and asks them what it is like most of the time. The subjects can answer 'Yes', 'No', or ? (if they cannot decide) when asked if the adjective describes their job most of the time.

Job Design

Job design was measured using the motivational scale of Campion's (1988) Multimethod Job Design Questionnaire (MJDQ). The items are intended to measure autonomy, intrinsic job feedback, extrinsic job feedback, social interaction, task/goal clarity, task variety, task identity, ability/skill level requirements, task significance, growth/learning, promotion, achievement, participation, communication, pay adequacy, recognition, and job security. This scale has a reported internal consistency rating of .87 (Campion, 1988).

Job Involvement

Rafaeli (1986) found that amongst white collar employees, positive attitudes towards AMT were not simply due to computer usage but due to a combination of computer usage and high job involvement. Martin's (1988) eight items (slightly adapted for the hospital environment) were used to measure job involvement. The anchors for this 5-point scale were 'never' and 'all the time'. The alpha coefficient for this scale is reported by Martin (1988) as .74.

Attitude Towards Technology

There is evidence that workers who have had experience working with new technology have a more positive attitude towards advanced technology than those workers without such experience (.e.g., Hiltz & Turoff, 1981; Zoltan & Chapanis, 1982; Arndt et al, 1983; Kerber, 1983; Arndt, Clevenger, & Meiskey, 1985; Rafaeli, 1986). The Likert-like 5-point scale used to measure attitude towards technology has seven items, adapted for the hospital environment. Martin (1988) divides the 7 items into two constructs. The first construct, referred to as *Techprod* contains three items, accounted for 35 percent of the variance and is reported as having a coefficient alpha of .71. The second construct, referred to as *Techjob*, contains four items, accounted for 24.5 percent of the variance, and has a coefficient alpha of .72. The *Techprod* items involve questions regarding the

productivity benefits of technology and the *Techjob* items seek workers' opinions on the effects of technology on their jobs. Martin's anchors were 'I strongly agree' and 'I disagree alot'. Translated to the hospital environment, the anchors 'to a very little extent' and 'to a very great extent' were used.

1.2.2.2 Description of the Interviews

Interview questions were designed to gather more detailed information regarding the culture and climate of the hospital from the employees' point of view. During the Time 1 interviews, subjects were asked about the hospital's philosophy and goals, and these were compared with the hospital's written statements in order to determine the degree of goal congruence between workers and administration. Opinions regarding the effectiveness of communication between administration and workers in the hospital were sought. Subjects were also asked questions regarding the rewards they received for their work, in terms of pay and status. Workers were asked to describe any changes that were planned for their department and who they thought would benefit from these changes. They were asked questions regarding how training was usually handled on their unit and what technical experience they had. Subjects were asked to describe their idea of the ideal worker and the ideal supervisor. They were asked questions about their work environment and whether they thought that their work was valued by the hospital, by their supervisor, and by their colleagues. Questions were asked regarding how problems were solved on their unit. Finally, the subjects were asked questions regarding worker-management relations in the hospital.

The Time 2 interviews were shorter for the nurses than they were for the pharmacy staff. This was partly due to the fact that more questions needed to be asked in the pharmacy department regarding the staff's opinions on the new technology but also partly due to the fact that the workload had increased on the nursing units. Both nurses and pharmacy staff were asked to describe any changes that had occurred in their unit in the previous six months, and how the changes had affected their job and their work

environment. Both nurses and pharmacy staff were asked about any changes in relations between the nurses and pharmacy staff since the introduction of the Unidose system and the CIVA program. Then specific questions were asked to elicit opinions on the new Unidose system and on the CIVA program regarding their effectiveness on patient care and their work. Subjects were also asked about any changes in relations between workers and management since the Time 1 interviews.

1.3 Results

1.3.1 Questionnaire Results

Cronbach's alpha (Cronbach, 1951) was used as a measure of internal consistency of each of the scales. The results of this analysis are presented in Table 1.5. Descriptive statistics for the surveys are presented in Tables 1.6 and 1.7. Stress scores for the current sample are presented with Osipow and Spokane's (1983) normative values in Table 1.8. Table 1.9 contains the a matrix of correlations amongst the various measures. Factors that were significantly different in paired t-tests for the core group of subjects who filled in surveys at both Time 1 and Time 2 are presented in Table 1.10.

Table 1.5

Reliability Analysis (Cronbach's Alpha) for Survey Scales at Time 1 and Time 2

Variable	Time 1	Time 2	# Items
Organizational (Hospital) Culture			
Type:			
Group Culture	.68	.74	4
Developmental Culture	.58	.58	4
Hierarchical Culture	.61	.27	4
Rational Culture	.58	.42	4
Organizational Climate			
Survey of Organizations	.92	.88	12
Perceived Organizational Support	.91	.89	16
Organizational Commitment			
Affective Commitment	.87	.87	8
Continuance Commitment	.77	.77	8
Job Attitude			
Job Satisfaction	.91	.92	17
Job Design	.76	.81	19
Job Involvement	.70	.80	8
Stress			
Role Load	.70	.69	10
Role Insufficiency	.63	.63	10
Role Ambiguity	.70	.74	10
Role Conflict	.78	.74	10
Responsibility for People	.62	.47	10
Attitude Towards Technology	.68	.62	7

Table 1.6

Mean Number of Points Assigned to Each of the Culture Types

Variable	Pharmacy		Nursing Unit 1		Nursing Unit 2	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Hospital Culture						
Group	62	63	98	125	68	76
Developmental	93	63	58	84	68	68
Hierarchical	120	120	110	83	120	130
Rational	120	150	140	110	140	130

Table 1.7

Means and Standard Deviations of the Sum of the Items for Each Survey.(The possible ranges for each of the surveys appear in brackets)

Variable	Pharmacy		Nursing Unit 1		Nursing Unit 2	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Organizational Climate						
Survey of Organizations (12 - 60)						
Mean	35.1	35.1	26.4	31.5	24.1	30.3
Standard deviation	6.3	5.2	7.3	7.0	6.2	6.5
Perceived Organizational Support (16 - 112)						
Mean	64.5	62.7	61.2	65.4	43.1	57.0
Standard deviation	12.4	9.6	14.6	14.1	9.5	15.1
Organizational Commitment						
Affective Commitment (8 - 56)						
Mean	30.3	29.6	36.6	36.6	32.5	33.8
Standard deviation	11.0	7.0	8.9	9.1	10.0	10.3
Continuance Commitment (8 - 56)						
Mean	35.8	37.1	43.1	42.8	40.5	41.2
Standard deviation	6.5	5.0	9.9	7.0	6.3	8.9
Job Attitude						
Job Satisfaction (0 - 34)						
Mean	27.3	27.4	27.7	27.2	22.5	23.5
Standard deviation	5.1	5.6	6.7	7.7	8.7	8.4
Job Design (19 - 95)						
Mean	63.3	61.8	61.8	64.8	61.0	63.0
Standard deviation	9.8	8.3	7.8	8.4	5.7	9.7

Table 1.7 con't

Variable	Pharmacy		Nursing Unit 1		Nursing Unit 2	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Job Involvement (8 - 40)						
Mean	30.8	31.6	32.4	33.3	32.6	33.5
Standard deviation	2.5	1.9	3.3	2.7	3.1	3.5
Attitude Towards Technology (7 - 35)						
Mean	23.1	24.3	20.7	23.6	23.3	22.0
Standard deviation	3.5	2.6	3.0	4.2	4.3	3.6
Stress						
Role Load (10 -50)						
Mean	23.8	24.0	25.2	25.0	28.0	29.5
Standard deviation	5.3	3.4	4.7	5.8	5.5	4.3
Role Insufficiency (10 -50)						
Mean	21.5	22.0	25.3	23.6	25.7	24.2
Standard deviation	5.7	4.9	6.3	7.3	4.3	4.2
Role Ambiguity (10 -50)						
Mean	23.3	23.3	18.8	19.7	19.3	18.4
Standard deviation	5.5	4.9	6.4	5.0	3.9	4.6
Role Conflict (10 -50)						
Mean	20.3	19.9	20.1	21.9	24.0	22.7
Standard deviation	5.3	5.6	7.6	7.5	7.1	5.8
Responsibility for Others (10 -50)						
Mean	21.6	20.7	23.5	24.9	23.2	22.9
Standard deviation	5.4	5.1	4.5	5.4	6.7	5.5

Table 1.8

Comparison of Median Stress Scores with Normative Female Samples from Osipow & Spokane (1985) *

Stress Subscales	Norms	Pharmacy		Nursing Unit 1		Nursing Unit 2	
		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Role Load	23	23	24	27	24	28	31
Role Insufficiency	27	22	22	25	24	25	23
Role Ambiguity	19	22	22	18	19	19	24
Role Conflict	22	22	23	20	22	24	23
Responsibility for Others	24	20	20	25	27	22	22

* Only normative values for females are shown as all but one of the subjects in the current sample were females.

Table 1.9

Intercorrelation Matrix of Variables at Time 1 (top row for each variable) and Time 2 (bottom row for each variable)

	2	3	4	5	6	7	8	9	10	11	12	13
	Job Sat	SOO	POS	A Com	C Com	MJDQ	Job Inv	ATT	Hosp A	Hosp B	Hosp C	Hosp D
1 Stress	-.62 ***	-.59 ***	-.40 **	-.43 **	-.21	-.43 **	-.17	-.30	-.36 *	-.23	.10	.37 *
2 Job Satisfaction (Job Sat)	-.53 ***	-.55 ***	-.43 **	-.34 *	.13	-.51 **	-.34 *	-.47 **	-.21	.02	-.05	.30
3 Survey of Organizations (SOO)		.50 **	.59 ***	.52 ***	.07	.65 ***	.21	.11	.47 **	.13	-.38 *	-.33
		.56 ***	.40 *	.52 ***	-.08	.52 ***	.38 *	.48 **	.28	.04	-.15	-.25
4 Perceived Organizational Support (POS)			.62 ***	.44 **	.00	.45 **	.12	.39 *	.10	.30	.06	-.33
			.77 ***	.58 ***	-.47 **	.55 ***	.11	.75 ***	.39 *	.13	.04	-.57 ***
5 Affective Commitment (A Com)				.35 *	-.23	.55 ***	.10	.17	.16	-.05	.15	-.31
				.55 ***	-.15	.56 ***	.13	.78 ***	.49 **	.13	.09	-.74 ***
6 Continuance Commitment (C Com)					.09	.38 *	.32	.11	.64 ***	.22	-.33	-.45 **
					-.05	.47 **	.13	.47 **	.61 ***	.34 *	-.35 *	-.68 ***
7 Job Design (MJDQ)						.04	.13	-.16	.09	.09	-.02	-.36 *
						-.12	.27	-.47 **	.11	-.25	.12	.00
8 Job Involvement (Job Inv)							.25	.33	.31	.10	.13	-.53 ***
							.33	.60 ***	.33	.08	.17	-.54 ***
9 Attitude Towards Technology (ATT)								.39 *	.39 *	-.10	-.05	-.29
								.11	.19	-.24	.16	-.13
10 Hospital 'A' (Hosp A)									-.03	.09	.27	-.09
									.26	.27	.03	-.51 **
11 Hospital 'B' (Hosp B)										.11	-.56 ***	-.62 ***
										-.17	-.36 *	-.76 ***
12 Hospital 'C' (Hosp C)											-.25	-.37 *
											-.44 **	-.15
												.02
												.01

* p < .05

** p < .01

*** p < .001

Table 1.10

Paired t-tests with Significant Differences Between Ratings from Subjects who
Answered Surveys Both at Time 1 and at Time 2

Variable	Pharmacy (N = 7)	Nursing Unit 1 (N = 8)	Nursing Unit 2 (N = 8)
Organizational Climate			
Mean at Time 1		26.43	23.00
Mean at Time 2		32.08	28.93
p <		.01	.04
ω^2		.56	.39
Attitude Towards Technology			
Mean at Time 1	22.57	20.65	23.25
Mean at Time 2	24.29	23.63	21.02
p <	.03	.03	.03
ω^2	.50	.46	.43

Data Reduction

Principal components analysis with varimax rotation was performed on nine scales in order to determine, along with the information from the table of intercorrelations, if the number of factors to be entered into the regression analysis could be reduced. The results of the factor analysis for the Time 1 data collection are presented in Table 1.11 and the results of the factor analysis for the Time 2 data collection are presented in Table 1.12.

Multiple Regression Analysis

A multiple regression analysis was performed on both the Time 1 and Time 2 data with 'attitude towards technology' as the dependent measure. In order to decrease the number of independent measures entered into the regression analyses, the survey of organizations and the perceived organizational support survey were combined into a single factor called 'organizational climate'. The correlation between these two measures was .62 at Time 1 and .77 at Time 2. The job satisfaction survey and the job design survey were combined into one factor called 'job motivation'. The correlation between these two factors was .65 at Time 1 and .52 at Time 2. The result of the multiple regression analysis on the Time 1 data, which was not significant, is presented in Table 1.13. The result of the multiple regression analysis on the Time 2 data, which was significant, is presented in Table 1.14.

Table 1.11

Factor Analysis at Time 1 DataRotated Factor Matrix

	Factor 1	Factor 2	Factor 3
Job Satisfaction	.87		
Perceived Organizational Support	.78		
Organizational Climate	.77		
Stress	-.75		
Job Design	.73		
Affective Organizational Commitment	.64		
Continuance Commitment			.90
Job Involvement		.81	
Attitude Towards Technology		.82	

Table 1.12

Factor Analysis at Time 2 DataRotated Factor Matrix

	Factor 1	Factor 2
Organizational Climate	.87	
Attitude Towards Technology	.84	
Perceived Organizational Support	.81	
Job Design	.78	
Job Satisfaction	.74	
Stress	-.71	
Affective Organizational Commitment	.70	
Continuance Commitment		.78
Job Involvement		.74

Table 1.13

Multiple Regression Analysis on the Time 1 Data

Dependent Variable: Attitude Towards Technology

Adjusted R Square .11

F(6,22) = 1.58, NS

Variables in the Equation	T	Sig T	Beta
Organizational Climate (Survey of Organizations+ Perceived Org.Support)	.41	NS	.10
Affective Organizational Commitment	-.82	NS	-.18
Continuance Commitment	-1.26	NS	-.24
Job Motivation (Job Satisfaction + Job Design)	-.02	NS	-.01
Job Involvement	2.20	NS	.42
Stress	-1.28	NS	-.30
(Constant)	1.31	NS	

Table 1.14

Multiple Regression Analysis on the Time 2 Data

Dependent Variable: Attitude Towards Technology

Adjusted R Square .71

$F(6,22) = 12.16, p < .0001$

Variables in the Equation	T	Sig T	Beta
Organizational Climate (Survey of Organizations+ Perceived Org.Support)	4.18	.0004	.62
Affective Organizational Commitment	-.35	NS	-.05
Continuance Commitment	-2.51	.02	-.29
Job Motivation (Job Satisfaction + Job Design)	1.39	NS	.22
Job Involvement	.20	NS	.02
Stress	-.04	NS	-.00
(Constant)	1.46	NS	

1.3.2 Interview Results

The Time 1 and Time 2 taped interviews were first transcribed verbatim into text. At Time 1, a coding scheme for the purposes of classifying comments made by subjects was developed. At Time 1, two raters coded the interviews using this coding scheme. Inter-rater reliability was very high ($r > .85$) and therefore, only one of the raters coded the comments at Time 2. The percentages listed below are the percentage of comments in the designated category made by the total number of staff interviewed. Where there were marked differences in the pattern of responses in each unit, the percentages for each unit are reported separately. A list of percentage of comments for each unit is listed in the appendix. For the pre-implementation interviews, $n = 9$ for the pharmacy department and Nursing Unit 1, and $n = 13$ for Nursing Unit 2. For the post-implementation interviews, $n = 7$ for the pharmacy department, $n = 8$ for Nursing Unit 1, and $n = 19$ for Nursing Unit 2.

1.3.2.1 Time 1 (Pre-implementation)

Goals and Values

The hospital had a written management philosophy, statement of values, vision statement, and mission (primary goal) statement. Although 92% of subjects stated that the hospital had a philosophy and goals, only 64% percent of the workers were able to articulate what they were. Only 21% of the subjects also mentioned efficiency, one of the written goals of the hospital, as being one of the hospital goals. Many of the statements mentioned by the hospital administration as being part of the hospital philosophy and goals were never mentioned by the subjects; notably those related to team work, participation of personnel in decision-making, frank and open communication, the shared responsibility of the hospital and its workers in continuing education, and the value the hospital management placed on creativity and innovation.

Communication

Flow of communication in the hospital was considered poor by the workers, but flow of communication in their units/departments was considered good. Fifty-eight percent

of the workers rated the flow of communication in the hospital as not very good or poor, and another 25% rated it as fair. Fifty-five percent of the staff commented that the hospital could do a better job and that communication from the senior level could be improved. In contrast to opinion on the flow of communication between workers and the hospital, 64% of subjects rated the flow of communication in their department as good or excellent.

Worker-Management Relations

Fifty percent of the hospital staff sampled described relations between workers and hospital management as poor or not very good. This was true for the pharmacy department as well as the nursing units. In contrast to the generally poor relations between hospital management and workers, relations between management and workers within each unit was considered good. All of the nurses on Nursing Unit 1 described relations between management and workers on their unit as good or excellent. Sixty-nine percent of the nurses on Nursing Unit 2 considered relations between workers and management on their unit to be good. This was in contrast with the pharmacy department where 50% of the workers considered relations between workers and management in their department to be poor or not very good and 30% of workers considered relations to be good.

Supervisory practices

The qualities considered most important in the ideal supervisor by 85% of the staff were that they be supportive and considerate. Competence and knowledge were mentioned by 15% of the staff, the ability to set structure by 22%, and the desire to promote the department to others outside the department was mentioned by 17% of the nurses only. There was less agreement on the qualities needed by the ideal worker. In rank order by the number of comments received and the percentage of staff who mentioned them are: pleasant/cheerful/open (67% of nurses and no pharmacy workers), competent/knowledgeable (27%), and is adaptable (27%).

Problem-Solving

With regards to problems with their supervisors, 33% of the nurses on Nursing Unit 1 and 31% of nurses on Nursing Unit 2 had had a problem with the distribution of work assignments or lack of new work opportunities. Twenty-two percent of the nurses on Nursing Unit 1 mentioned that their supervisor had difficulties listening to new ideas as did 40% of the pharmacy department staff. Thirty percent of the pharmacy staff thought that their supervisor was too abrupt when dealing with staff. Fifty percent of the subjects said that problems were usually solved by discussion between individuals and the rest of the comments were that problems were solved at meetings and that the supervisor got to solve them.

When asked if they had any problems with their co-workers, the answers were similar for all units, including pharmacy - 37% of the workers said that there had been no problems. Problems that were listed included communication problems (mentioned by 13% of the subjects who were interviewed), personality issues (10%), and competence/responsibility issues (17%). Problems were usually resolved by discussion between individuals (50%), in meetings (23%), and/or the supervisor got to solve them (20%). Sometimes problems were not resolved (10%).

Work Environment

When asked what the least desirable aspect of their job was, most of the comments from Nursing Unit 1 concerned workload issues (56%), while the majority of the comments from Nursing Unit 2 were related to a lack of appreciation and respect (31%). Thirty percent of the pharmacy staff comments regarding the least desirable aspect of their job were related to workload issues followed by role insufficiency (20%).

For the nurses, the most desirable aspect of their work was patient contact (83%). Contact with colleagues was mentioned by 54% of the nurses on Nursing Unit 2 and by 22% of the nurses on Nursing Unit 1. For the pharmacy department staff, work interest and challenge were the most desirable aspects of their job (70%) followed by contact with

colleagues (20%). When asked which aspect of their job recently helped them to do their best work, helpful colleagues was most often mentioned (36%), and technology was mentioned by 40% of pharmacy staff and 31% of the nurses on Nursing Unit 2.

When asked what aspect of their jobs had recently impeded them from doing their best work, comments from the pharmacy department staff included working in a stressful department (40%) and problems with their supervisor or colleagues (40%). There were few comments to this question from nurses on Unit 1 but the most common answer from the nurses on Unit 2 was increased workload (38%).

Most workers felt that their work was valued by their supervisors (60%) and by their department (65%). The percentage of positive responses in those two categories were the same for all units. However, when hospital staff were asked if they felt their work was valued by their hospital, 50% of the pharmacy staff said 'yes' as did 44% of the Unit 1 nurses. None of the nurses on Nursing Unit 2 answered 'yes' to this question, and in fact, 77% of them answered 'no'. The remaining 23% said that they were unsure as to whether their work was valued by their hospital. Fifty-six percent of the nurses on Nursing Unit 1 were also unsure as to whether their work was valued by the hospital.

Opinions on Planned Change

The overwhelming number of answers regarding upcoming changes planned for their departments was 'implementation of the Unidose system' for pharmacy (90%) which was also mentioned by 56% of the Nursing Unit 1 nurses. Amalgamation of departments (54%), budget cuts (31%) and loss of jobs (23%) were the comments most often made by the Unit 2 nurses. Forty-four percent of the Nursing Unit 1 nurses also mentioned loss of jobs as a planned hospital change.

Since the planned hospital changes most likely to directly affect the nurses were nursing department restructuring and layoffs, those were the changes that they had in mind when they were answering the questions regarding the impact of the impending changes. There were no impending layoffs facing the pharmacy department staff. Therefore, their

opinions regarding the impact of the impending changes were related to the new technology being introduced into their department and the CIVA program.

The majority of pharmacy staff felt that the changes were being introduced to improve patient care (70%), save money (50%), and provide a more interesting work environment for employees (30%), whereas the majority of the nurses felt that the hospital changes were not being introduced to improve patient care (59%) or to provide a more interesting work environment for employees (83%) but to save money (85% of Nursing Unit 2 nurses and 67% of Nursing Unit 1 nurses). In addition to these negative comments by the nurses, 85% of the nurses on Nursing Unit 2 commented that the changes were being introduced to decrease the number of staff members compared to 33% of the nurses on the other unit who felt this way. In a similar vein, the majority of pharmacy staff felt that patients, pharmacy staff and nurses would benefit from the changes whereas the majority of nurses on Unit 2 felt that the hospital administration would benefit from the changes on their unit and the Unit 1 nurses' responses were split between patients, administration and pharmacy department staff. Everyone felt that the changes would affect how they, and the other people in their departments, carry out their work.

Regarding how the changes would affect their departments, the main comments from pharmacy staff were that the way the work was organized would change (40%) and that there would be an increase in stress (40%). On Nursing Unit 2, it was felt that there would be a decline in the level of health care provided patients (54%). The comments from the Unit 1 nurses were slightly less negative than those of the Unit 2 nurses but the message was similar in that they felt that the way the work was organized would change (22%) and that they would be spending less time with patients and more time doing non-nursing tasks (11%).

Some of the staff in the units were aware of impending changes in other units. Nursing department restructuring was mentioned by 40% of the pharmacy staff and the implementation of the Unidose system and the CIVA program was mentioned by some of

the nurses (14%). Some of the other impending changes mentioned included workload measurement systems, the possibility of care maps for the nurses, computers in all departments, and the hospital purchase of an M.R.I. (magnetic resonant imaging) machine.

Training

When training was done, it was usually done by a designated hospital person or by the buddy system. For the new machine in the pharmacy department, two of the technicians were chosen to travel to the company's training centre for two days. Training of other pharmacists and pharmacy technicians was done by the pharmacy manager and the two technicians sent on course.

With regards to the various impending changes on their units, 40% of the pharmacy department staff, 56% of the Nursing Unit 1 staff, and 92% of the Nursing Unit 2 staff expected that the training provided to them and their co-workers would not be enough. The 'buddy system' was mentioned as the usual method of training in the pharmacy department (78%). 'Internal training by a designated hospital person' was the usual method of training most often mentioned by nurses (81%). When the question regarding training was specifically asking about the usual process of training and not who does it, subjects still answered the question by stating who did the training and not how it was done.

Technical Experience

As a group, the pharmacy staff had more exposure to computers at work and at home and used them for more types of tasks than did the nurses. Nurses used the computers at work to get patient information to or from other departments whereas pharmacy staff also used them to input prescriptions and for word-processing. All but one pharmacy staff member had a computer at home compared to a third of the nurses on Nursing Unit 1 and a quarter of the nurses on Nursing Unit 2.

Reward System

All of the nurses on Nursing Unit 1 thought that their positions were given adequate recognition in terms of money compared to 54% of the nurses on Nursing Unit 2 and 40% of the pharmacy department staff. More nurses on Nursing Unit 1 were satisfied with the status they received (67%) compared to the nurses on Nursing Unit 2 (46%) and the pharmacy staff (40%). Forty percent of pharmacy staff felt that compared to other departments, their status was better. Otherwise, there was no indication that there were perceived inequalities between departments with regards to salary or status amongst the subjects interviewed.

1.3.2.2 Time 2 (Post-Implementation)

Changes Over the Last Six Months

When asked what changes had occurred on their units since the pre-implementation interview, the answers were similar to the ones the subjects gave regarding impending changes during the pre-implementation interviews. The majority of the answers from the pharmacy department staff concerned the new oral solids dispensing machine (mentioned by 71% of the pharmacy staff) and the CIVA program (57%). The additional amount of work generated by the CIVA program caused little disruption for pharmacy department staff since preparation of intravenous fluids had always been done to a limited extent by the pharmacy department. However, the introduction of the new oral solids dispensing machine had not been as pain-free for staff. All of the pharmacy staff mentioned that there was more work, frustration, and difficulty adapting to the new system of dispensing oral drugs.

The theme of the majority of the answers from the nursing units concerned the restructuring of the nursing department - namely the amalgamation of the general surgery unit (Unit 2 in this study) with the orthopedic surgery unit (74%). Downsizing occurred in both Nursing Unit 1 and Nursing Unit 2 but the restructuring of Nursing Unit 1 was minor compared to the restructuring that occurred on Nursing Unit 2.

On Nursing Unit 1, the nurse manager temporarily moved into a new post to manage the implementation of a computerized nursing workload measurement system. One of the nurses in the pre-implementation sample then became the acting nurse manager for Unit 1. One part-time nursing position and one full-time nursing position were eliminated. The daytime orderly position was eliminated as was the nursing assistant position on evenings.

On the Unit 2 nursing unit, however, the restructuring changes were dramatic. The nurse manager was "laid off" and one level of nursing management was eliminated. Instead of two nursing managers on each of the surgical units, there was now one department head. Whereas there were 28 beds in the previous Unit 2, there were now 50 beds. Previously, there were 22 nurses on the general surgery unit with 28 beds and 18 nurses on the orthopedic surgery unit with 22 beds. Now there were a total of 50 beds on the newly formed combined surgical unit and the number of nurses had decreased from 40 to 28. This meant that 12 nurses were "bumped". One ward clerk was "bumped" and the 4 orderly positions were eliminated.

The CIVA Program

The nurses tended to be very positive about the CIVA program. They felt that it saved them time (89%) and improved their effectiveness as nurses (75%). They also felt that patients had benefited (49%) but that the nurses had benefited more (80%). Although the majority of nurses on Unit 2 felt that the CIVA program had resulted in fewer medication errors (63%), fewer nurses on Unit 1 thought so (38%). Fifty percent felt that there was no change in the number of intravenous medication errors. Of all the nurses, only one felt that there were more medication errors as a result of the CIVA program.

The CIVA program expansion was not expected to save pharmacy workers time. It was initiated as a service for the nurses in order to save the nurses time. However, the new oral solids dispensing machine was expected to result in a decrease in the amount of time to dispense oral drugs and this time-saving could then be shifted to the CIVA

program. However, at the six-month post-implementation period, most of the pharmacy staff felt that these time-savings had not been fully realized yet (71%) and as a result, the CIVIA program had to be scaled back from the original target.

The Unidose System

A major problem with the new automated dispensing system was that it relied on the compiled list of patient information and new drug orders assembled by the hospital mainframe computer. How quickly this list was available to the pharmacy staff to dispense that day's drug file list varied greatly but was often not available until mid-afternoon. Drug carts were expected on the wards before three o'clock. If the hospital mainframe was able to process the day's drug list within a reasonable amount of time, the oral solids dispensing machine could have had the drugs dispensed by lunchtime. The slowness of the overall process resulted in the nurses complaining that drugs were often late in arriving on the ward (63% of Nursing Unit 1 nurses and 22% of Nursing Unit 2 nurses mentioned this). However, the majority of the nurses liked the new Unidose system (78%) and they felt that it resulted in fewer medication errors. In addition to comments regarding the late arrival of the medications of the wards, 50% of Nursing Unit 1 nurses and 32% of Nursing Unit 2 nurses mentioned that sometimes the Unidose packets did not have tablets in them (i.e. they were missing).

Communication

There was a fifty-fifty split in opinion regarding whether the relations between the nursing units and the pharmacy department were good or bad as judged by pharmacy department staff and Nursing Unit 1. However, 84% of the nurses on Unit 2 thought that the relations between their nursing staff and the pharmacy department staff were good. There was similar disagreement over whether these relations had improved over the last six months or not. More of the pharmacy staff (43%) than the nurses (21% on Unit 2 and none on Unit 1) believed that relations had worsened over the last six months. In general, nurses felt that there had been no change (53%). Although 49% of the nurses felt that

neither the Unidose system nor the CIVA program had influenced these relations, 20% of the nurses , and 43% of the pharmacy staff felt that the CIVA program had a positive effect on the relations between the pharmacy staff and nurses, and that the Unidose system had a negative effect (25% of Nursing Unit 1 nurses and 57% of pharmacy staff).

Worker-Management Relations (Pharmacy staff only)

In terms of worker-management relations, 86% of the pharmacy staff felt that there had been no change over the six previous months. There was some feeling, however, that the Unidose system had had a negative impact upon relations between co-workers (29%). All of the pharmacy staff felt that their supervisor pushed them too hard and did not take into account the knowledge-base and abilities of employees. Eighty-three percent of them felt that their supervisor should have allowed more employee input and adjustment time to the new changes (83%).

Work Environment (Pharmacy staff only)

Regarding work environment, there was a split in opinion about whether pharmacy staff enjoyed their work more (29%), less (43%), or the same amount (29%) compared to the previous six months. However, more of the workers enjoyed it less rather than more. Most of the pharmacy staff (83%) felt that their productivity level had not changed over the last six months.

1.4. Discussion

The organizational culture of the hospital studied was in transition. The hospital administration was under a great deal of pressure to prove its operational efficiency in an attempt to avoid closure. This attempt included the restructuring of departments and the purchasing of new equipment. The emphasis on efficiency is changing the culture of hospitals. This has been the case for many hospital cultures since the mid-80s (Bopp & Fisher, 1995; Brown, 1992). Hospitals of the past were hierarchical and procedure-driven (Miyake & Trostler, 1987). Occasional budget cuts were usually handled by temporarily closing beds (Crichton et al., 1994). In line with recent restructuring initiatives, hospitals

are trying to maintain their caring image at the same time that employees are "laid off" or "bumped" to other units, have their efficiency measured by workload measurement systems, and with very little training, are expected to become computer proficient. In the current study, employees viewed their hospital as being control-oriented rather than being flexibility-oriented. Twice as many points were assigned to the control-oriented 'hierarchical' and 'rational' group cultures as were assigned to the flexibility-oriented 'group' and 'developmental' culture types. This control-orientation was reflected in the way in which the decision was made by the pharmacy director to purchase the new oral solids dispensing machine.

As hospital equipment is often purchased by people who are not likely to have any background in usability testing or human factors, the equipment purchased has usually not been assessed in terms of its usability and employees are expected to 'manage', sometimes without adequate training. As one of the nurses made the following comment:

In regards to the subject of introducing new technology into the work environment, I would like to pose the question, "Do you think that someone could be expected to learn a new language in 1/2 hour to 1 hour?" Personally, I don't think it's possible. So why is one only given 1/2 h - 1 h to learn the functioning and usage of a computer?

In a special health care issue of the journal *Human Factors*, Obradovich and Woods (1996) capture the essence of this problem in the title of their article "Users As Designers: How People Cope with Poor HCI Design in Computer-Based Medical Devices". These researchers investigated the use of computer-based infusion devices by nurses who were in charge of evaluating whether or not a patient was able to operate the pump sufficiently to manage it at home. "Several classic human-computer interaction deficiencies" were found with the device: "lack of feedback on device state and behaviour, complex and arbitrary sequences of operation, ambiguous alarms, and multiple operating modes intended for different contexts" (p. 587). However, several strategies were devised by the nurses in order to insulate themselves from failure. They bypassed certain procedures that were deemed unimportant and confusing to patients, and modified others. They had the patients

call them daily with information on the computer screen so that the nurse could verify that the medication dosage order was what was received. The nurses developed a patient guide, and used paper clips to close the pages of the manufacturer's documentation that discussed the medication delivery mode that was not used by them. Several system tailoring and task tailoring behaviours amongst anesthesiologists were also observed by Cook and Woods (1996) in their investigation of the introduction of a new, integrated monitoring system for use in cardiac anesthesia.

These studies raise the issue regarding the extent of participation of hospital workers' regarding equipment purchases. In the current study, the hospital administration's desire for worker participation in decision-making was written in the statement of the hospital's philosophy, yet there was no indication that this written philosophy had been put into practice.

Organizational climate reflects workers' perceptions of work activities and how they are organized, organizational decision-making, communication and information-sharing, and relations between workers and management. In this study, the results of the surveys and interviews indicated that the organizational climate was poor but relatively stable in the pharmacy department. The organizational climate on the nursing units was particularly poor, especially at the Time 1 data collection period when many of the nurses were waiting for news of whether they were going to be "laid-off" or "bumped" to other units. In addition to the survey of organizations (SOO) questionnaire (Taylor & Bowers, 1972) designed to measure organizational climate, the perceived organizational support (POS) questionnaire is a good indicator of organizational climate. The responses from these two scales were therefore combined into a global organizational climate factor. In the current study, the SOO and POS were correlated at .62. Hospital staff perceived the hospital administration as being more concerned with cost savings than with patient care. Fifty-eight percent of the hospital staff rated the flow of communication in their hospital as poor or not very good. Fifty-four percent of the nurses on Nursing Unit 2 rated relations

between workers and the hospital management as poor or not very good as did 44% of the nurses on the other unit and 50% of pharmacy staff.

In a poor organizational climate, attitude towards technology may also be expected to be poor. At Time 2, there was a strongly positive correlation between organizational climate and attitude towards technology. The pattern of correlations suggest that an organization with an unhealthy climate can be detected in various ways as the SOO and POS are negatively correlated with stress (SOO: $-.59$ at Time 1 and $-.55$ at Time 2; POS: $-.40$ at Time 1 and $-.43$ at Time 2).

The workers in this study did not believe that the hospital was supportive of them. This was particularly true of the nurses on the surgical unit who, at Time 1, were facing impending layoffs. In fact, the POS mean score for this group at Time 1 was 43.1 (or, $43.1/16$ items = 2.69) which is below the 2.88 mean score of postal clerks in the Eisenberger et al. (1990) sample. This was the lowest score reported for a work group by these researchers. Fifty-four percent of the nurses on Nursing Unit 2 rated relations between workers and hospital management as poor or not very good and another 31 percent rated it as fair. One of the nurses made the following comment:

The administration does not listen to the nurses - in regards to the organization of the units or anything else. It is important for administration to have a sense of the direction we envision and to know what we need in order to accomplish that vision. It is not possible to develop a direction without talking with personnel.

As with previous research (Eisenberger et al., 1990; Jones et al., 1995), perceived organizational support was negatively correlated with stress ($-.40$ and $-.43$) and positively correlated with job satisfaction ($.59$ and $.40$,) as well as affective organizational commitment ($.35$ and $.55$). In addition, in the current study, POS was strongly correlated with organizational climate ($.62$ and $.77$) which was not surprising since POS is itself an indicator of organizational climate. POS in this sample was also positively correlated with

job motivation (.55 and .56), attitude towards technology (.78), and hospital 'group' culture (.49) while being negatively correlated with hospital 'rational' culture type (-.74).

The accumulated evidence indicates that hospital administrators should ensure that they communicate to employees that they value the employees' contributions to the organization, and that they care about employees' well-being. This lack of organizational support for staff at the hospital under study was demonstrated by the fact that when many of the hospital staff were facing layoffs, there was no attempt to provide career counselling nor was there any additional training made available to staff who were being forced into other areas. The hospital administration's restructuring of the nursing units was motivated by a desire to improve productivity and cut spending in order to prove to the provincial government that they were operating efficiently and should not be closed. Improved communication between the hospital administration and their employees however, could help in meeting these efficiency goals. Perceived organizational support has been shown to be strongly related to productivity. Eisenberger et al. (1986) have shown that POS is negatively correlated with absenteeism (-.28). Jones et al. (1992) found that groups within the same manufacturing plant that differed in terms of their productivity could be discriminated by their levels of perceived organizational support. This suggests that hospitals could improve the productivity of their workforce by improving relations between the administration and employees so that the employees perceive the organization as being supportive of them.

As with previous studies (Meyer & Allen, 1984; McGee & Ford, 1987), the correlation between continuance commitment and affective commitment was near zero (.09 and -.05). Affective commitment correlated negatively with stress (-.43 and -.34,) and hospital 'rational' culture type (-.45 and -.68) but correlated positively with job satisfaction (.52 and .52), organizational climate (.44 and .58), perceived organizational support (.35 and .55), job motivation (.38 and .47), attitude towards technology (.47 at Time 2) and hospital 'group' culture type (.64 and .61). In contrast, continuance commitment showed

no correlation with stress, job satisfaction, perceived organizational support or job motivation. However, it was negatively correlated with organizational climate (-.47), and attitude towards technology (-.47) at Time 2.

In this study, stress has been shown to be significantly negatively correlated with job satisfaction (-.62 and -.53), organizational climate (-.59 and -.55), job design (-.43 and -.51), perceived organizational support (-.40 and -.43), affective organizational commitment (-.43 and -.34), and attitude towards technology (-.47 at Time 2). Organizational climate is listed as an organizational level stressor in Ivancevich and Matteson's (1980) stress model and as an environment-related stressor in a stress model proposed by Marshall and Cooper (1979). The results of the current study support this viewpoint. Organizational climate, composed of the combination of the survey of organizations and perceived organizational support, was negatively correlated with stress at Time 1 (-.51,) and at Time 2 (-.49) . The link between organizational climate and stress was demonstrated in the following quote by a nurse on Nursing Unit 2 at the Time 2 interview regarding the changes that had occurred:

The work is more stressful. It's more frustrating because you're having to do work that you shouldn't be doing. You're not doing 'R.N.' work, you're doing inhalation therapy work, you're doing physio work, you're doing orderly work. You're doing everything including your own work.

Another nurse on this unit at Time 2 mentioned that "Patient care isn't as good as it was. Can't be. We feel bad. Some patients complain."

Of all the results obtained from the various survey scales used for this study, the only results that were reflective of 'healthy attitudes' in the sampled population were those of job involvement and job satisfaction. This reflects a population of workers who find their work intrinsically satisfying despite the organizational ills reflected in the low scores for organizational climate and perceived organizational support. There was no decline in job satisfaction amongst the pharmacy staff or nurses from Time 1 to Time 2.

Job satisfaction was found to be positively correlated with organizational climate (.50 and .56), perceived organizational support (.59 and .40), affective commitment (.52

and .52), job motivation (.65 and .52), job involvement (.38 at Time 2), attitude towards technology (.48 at Time 2) and hospital 'group' culture type (.47 at Time 1). Job satisfaction was negatively correlated with stress (-.62 and -.53), and hospital 'hierarchical' culture type (-.38 at Time 1).

Job design was found to be positively correlated with job satisfaction (.65 and .52), organizational climate (.45 and .55), perceived organizational support (.55 and .56), affective commitment (.38 and .47), and attitude towards technology (.60 at Time 2). Job design was negatively correlated with stress (-.43 and -.51) and hospital 'rational' culture type (-.53 and -.54). There was almost no difference in mean attitudes toward job design from the Time 1 and Time 2 sample periods. Job design in this hospital setting is more constrained by professional boundaries than by boundaries imposed by the organization. For instance, nurses would not be permitted to do the work of a pharmacist and vice versa, even though there is a great deal of overlap between the two professions in a hospital context.

The source of work motivation for the employees in this study differed along professional lines. Seventy-seven percent of the nurses on Unit 2 mentioned patient contact as the most desirable aspect of their work as did 89% of the nurses on Unit 1. Patient contact was not mentioned by any of the pharmacy staff. Seventy percent of the pharmacy staff mentioned work interest or challenges as being the most desirable aspect of their work.

Attitude towards technology was found to be modestly positively related to job involvement at Time 1 (.39) but was not significantly related at Time 2 (.11). There was a significant regression between attitude towards technology and organizational climate found at Time 2. Improved attitude towards technology is shown by the pharmacy department and Nursing Unit 1 from paired t-tests compared with a decline in attitude towards technology by the nurses on Nursing Unit 2 between Time 1 and Time 2. This is indicative

of the impact that organizational climate can have on attitudes toward technology. In the case of Nursing Unit 1, there was no new technology introduced between Time 1 and Time 2.

In the case of the pharmacy department, the technology introduced was deemed useful by staff but the user interfaces received less than favourable ratings from the ten usability experts who evaluated them. Therefore, it was either the usefulness of the technology or the stable organizational climate in the pharmacy department that accounted for the improved attitude towards technology, or both. Paired t-tests showed a significant improvement in organizational climate on both nursing units between Time 1 and Time 2. This is explained by the fact that at Time 1, the restructuring of the nursing units was imminent. The Time 2 sample of nurses was composed of those nurses who had survived the restructuring (i.e. they had neither been "laid off" nor "bumped"). As Upton (1995, p. 84) points out in his article on flexibility in factories: "Designing the right mix of machines, computer systems, and people, and figuring out the most effective way to orchestrate them are hard work. But turning only to machines, hardware, and software as the solution will not suffice."

Chapter 2

Introducing New Technology into the Hospital

The Human Factors Perspective

2.1 Introduction

Usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 1994, p. 2). The ISO (International Organization for Standardization) draft standard for usability from which this definition has been taken is an attempt to operationalize a concept that is easy to define but difficult to evaluate. Although this draft standard provides a framework for evaluation, there is not enough detail for the usability standard to be of practical value. There are no criteria against which to judge the usability of an interface, for instance. However, comprehensive usability evaluation methods that are compatible with the ISO 9241-11 standard have recently been developed (e.g., Bevan & MacLeod, 1994; Reiterer & Oppermann, 1993). These evaluation tools have been developed too recently for researchers to be able to demonstrate whether or not they have any advantages over the more conventional usability evaluation techniques.

The current 'gold standard' of usability assessment is user testing (Landauer, 1995). User testing involves developing a set of tasks for users to try with a system while the tester watches, notes errors and times the process. Users are usually asked to engage in a monologue as they think their way through the task. Heuristic evaluation is referred to by Landauer as 'a good second best' in terms of usability testing. Heuristic evaluation is a usability inspection method (Nielsen, 1992) that uses usability experts to perform an analysis of a computer interface. The usability experts use their knowledge and experience and a set of written usability guidelines, called 'heuristics' to guide them in their evaluation. The heuristic evaluation method (Nielson & Molich, 1990; Nielsen, 1992) was chosen as the usability method to be used in this study because it is effective, if not as effective as user testing, and it was possible to achieve. Nielson and Mack (1994) recommend 3 to 5 evaluators as little additional information is gained from a larger number. The following is a set of usability principles derived from a factor analysis of 249 usability problems (Nielsen, 1994).

1. *Visibility of system status:* The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
2. *Match between system and the real world:* The system should speak the users' language, with words, phrases, and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
3. *User control and freedom.* Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. *Consistency and standards:* Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
5. *Error prevention:* Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
6. *Recognition rather than recall:* Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.
7. *Flexibility and efficiency of use:* Accelerators - unseen by the novice user - may often speed up the interaction for the expert user to such an extent that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
8. *Aesthetic and minimalist design:* Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
9. *Help users recognize, diagnose, and recover from errors:* Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

10. *Help and documentation:* Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

The usability concepts outlined above are very similar to the concepts that have been highlighted by Lowery and Martin (1990) as being important to the evaluation of healthcare software. However, neither Nielsen (1992, 1994) nor Lowery and Martin rank these concepts by level of importance.

Various researchers have studied the effects of computers on work stress (Ballance & Ballance, 1996; Hudiburg, 1995; Seppala, 1995; Wastell & Newman, 1996; Zapf, 1995). Wastell and Newman studied the effects of the introduction of a computerized command-and-control system in an ambulance service in the U.K. on workers' performance and stress. The new system replaced the old paper documentation. They found that systolic blood pressure during high workload periods was lower with the computerized versus the paper-based system and self-reports of anxiety and fatigue were similarly lower during high workload periods. In terms of performance, the National Health Service targets that specify that an ambulance should arrive on the scene within 8 minutes of a call for 50% of incidents improved from 55.4% to 64.4% despite an increase of monthly incidents from 14,000 to 16,500. Wastell and Newman attribute these positive findings to the support the new system gave operators by enhancing their degree of control which in turn enabled them to better cope with a demanding work environment. The weakness in the conclusion that the improvement in performance and stress was due to a 'well-designed computer system', is that there was no formal usability evaluation of the system. Although there were significantly more positive than negative ratings from ambulance despatchers regarding the usability of the system, there is no evidence that these workers have any knowledge of usability issues. Therefore, an opportunity for greater effectiveness of the technology may have been missed.

The Wastell and Newman study was inspired by the work of Karasek (1979) and Turner and Karasek (1984). Karasek (1979) developed and tested a stress-management model of job strain and tested this model with national survey data from Sweden and the United States. He found that the combination of low decision latitude and heavy job demands were associated with mental strain and job dissatisfaction. Turner and Karasek (1984) discuss the evidence that "operating characteristics of computer application systems, in addition to physical characteristics of display units (CRTs) are the cause of many observed effects on operator health and task effectiveness" (p. 663). These authors, then, link computer application design parameters and task characteristics to operator effectiveness and health. The Wastell and Newman (1996) study gives support to the Turner and Karasek viewpoint that a well-designed computer system can enhance worker performance and lower stress.

2.2 Method

2.2.1 Subjects

Usability experts were recruited from the university and from industry to provide an independent assessment of the usability of the new pharmacy dispensing system software that the pharmacy staff navigate through in order to run the machine that does the dispensing of drugs into individual packets. There are two computers to run the system. One computer controls the dispensing machine (referred to in this thesis as the System 2 computer). The other computer (referred to as the System 1 computer) captures the patient and prescription information from the hospital mainframe and transcribes this information into a format that can be used by the System 2 computer.

Of the 13 usability experts who volunteered to complete the assessment, 10 of them returned the assessments completed over a 7-month period. The job titles of the usability experts and their number of years of doing usability testing is listed in Table 2.1. The average length of time it took experts to perform the evaluation was 7.5 hours. Five of the 10 experts had previous experience performing heuristic evaluations and 2 others stated that

Table 2.1

Description of the Usability Experts and Their Length of Experience

Job Title	Number of Years of Usability Testing Experience
Professor	12
Professor	10
Medical student	2.5
User Research Consultant	3
User Interface Designer	1
User Needs Assessment [Researcher]	2
Researcher: User Needs Assessment (contract)	1
Lead Consulting for Computer Consulting [Firm] specializing in Management Information Systems	5
User Interface Designer	3
Software Engineer	1

they were familiar with the technique. Previous experience with heuristic evaluation for the evaluators who answered this question was mainly with management, military and telecommunications systems. The way that each of the experts proceeded through the material was similar to the suggestions given in the instructions. Two of the usability experts designed their own worksheets, and added comments to them.

2.2.2 Procedure

Opinions regarding the usability of the new technology were sought from usability experts at the university and in industry in order to provide an independent source of information. Since it was impossible to have usability experts manipulate the software that runs the equipment, a document was developed with screen pictures and a description of how pharmacy staff navigate through the software in order to accomplish their daily automated dispensing of drugs. The document with screen pictures describing the navigation process was edited by the main technician running the machine and the pharmacy manager. This document is currently being used to train new staff in the pharmacy department. A survey instrument was developed using Nielsen's (1992, 1994) usability heuristics as a guideline. Usability heuristics are usability concepts to guide the usability expert when evaluating software. These heuristics are usually used in order to drive improvements in the development of a product. They were used in this study in order to have an independent assessment of the usability of the software that drives the new oral solids dispensing machine in the pharmacy department. This document, the heuristic evaluation survey and supporting documents given to the usability experts are found in the appendix. Section A of the developed survey asked questions related to the System 1 computer, Section B asked questions related to the System 2 computer, and Section C asked questions related to the ease of learning and ease of operating the systems based on functional groupings of the screens. The System 2 computer controls the functions of the dispensing machine and the System 1 computer connects the System 2 computer with the hospital mainframe.

2.3 Results

The main comment regarding difficulties with doing the evaluation was that it was time-consuming - this was mentioned by all but one evaluator who did not answer the question. The second most prevalent comment was that some aspects of the systems (mainly error management, especially of System 1) were difficult to assess using a paper interface. This was mentioned by six of the 10 evaluators. Three of the 10 usability experts mentioned the difficulty they had with keeping the assessment of the two systems separate since they are both working toward a common goal. The reliability of the usability survey, as measured by Cronbach's alpha, was .83 for Section A, .87 for Section B and .84 for Section C. Reliabilities and descriptive statistics are found in Table 2.2.

Section A surveyed experts' opinions on the usability of the System 1 software, Section B concerned the System 2 computer and Section C surveyed experts' opinions on the ease of learning and ease of operating the systems once they were learned. The comments given by the usability experts are presented in the appendix. The System 1 software was Windows-based and ran on a PC. The worst problems with the System 1 software according to the usability experts was that the main menu names and icons were confusing, the interface screen contained non-functional information, there was no indication of how to complete tasks (the system should guide the user through the task) and there were unclear error prevention tactics. The worst problems listed for the System 2 software which was DOS-based and ran on a PC were that it was too hierarchical, poorly organized, had poor labels for menus and function keys, and lacked error prevention opportunities.

Table 2.2

Usability Survey Results: Reliability Measures (Cronbach's Alpha) and Descriptive Statistics. Possible Range of Values for Means and Medians for that Section in Brackets.

	Alpha	# Items	Mean	SD
Usability Total (42 - 210)	.91	42	110.3	20.0
Section A (13 - 65) (System 1 computer software)	.83	13	35.4	6.8
Section B (17 - 85) (System 2 computer software)	.87	17	39.0	9.8
Section C (12 - 60) (Ease of learning and operating)	.84	12	36.0	7.2
Ease of Learning (6 - 30)	.77	6	15.3	3.4
Ease of Operating (6 - 30)	.66	6	20.7	4.2

Other problems with the new automated dispensing system included the dependency requirement on the hospital mainframe which resulted in the need for an intermediary computer between the hospital mainframe and the computer that operated the dispensing machine. Pharmacy staff and nurses alike complained about the length of time it took to get medications to the nursing units. This problem existed because the hospital mainframe took several hours to process the new drug list for the day, even if pharmacy staff put the day's new drug orders into the mainframe computer before 8 a.m..

2.4 Discussion

The usability of the software interfaces of the computer programs that run the oral solids dispensing machine received mediocre marks . Listed as a percentage of total points that could have been awarded, the Windows-based System 1 interface received a grade of 54% and the DOS-based System 2 computer received a grade of 46%. The ease of learning to navigate through both systems in order to execute the process of dispensing drugs received a grade of 50% and the ease of operating the software once learned received a grade of 70%. Overall, the usability of the two systems software interfaces received a grade of 52%. This relatively poor grade for usability lends support to the conclusion that it is unlikely that the usability of the system accounts for the improved attitude towards technology of the pharmacy staff six months after the machine had been installed.

According to the usability experts, the main problems with the System 1 computer interface were:

- the main menu names and icons were confusing
- the interface screen contained non-functional information
- there was no indication of how to complete tasks, and
- there were no error prevention tactics

The System 2 software was considered:

- too hierarchical
- poorly organized

to have poor labels for menus and function keys, and
lacking in error prevention opportunities

In the context of the way in which the pharmacy staff operated the system, many of them were able to avoid the systems' shortcomings by leaving the operation of the system to one of the technicians who had attended the training course. The workers who did not go on the training course used a step-by-step approach to memorize the sequence of screens and functions necessary to operate the oral solids dispensing machine, and they never deviated from this sequence. Whenever a problem occurred, the technician most familiar with the system or the pharmacy manager were asked to troubleshoot.

Chapter 3

General Discussion and Conclusions

General Discussion and Conclusions

It was expected that a favourable outcome of introducing new technology into an organization would depend on several organizational and technological factors. The ideal situation was defined as one where the technology being introduced obtained a high usability rating from usability experts, and was being introduced into an healthy organization with a flexible culture. Such a culture was defined as having a positive climate where employees were committed to the organization, perceived the organization as being supportive of them, and who viewed how their work was organized in a positive manner. In such a positive environment for introducing new technology, stress levels would be back to baseline after six months of adjustment, and that job satisfaction would increase with more of the tedious tasks automated. These positive outcomes would especially be expected in a setting where the introduction of new technology did not result in job losses.

In the current study, the technology received a mediocre usability rating from usability experts. Moreover, it was introduced into a control-oriented organization with an unfavourable climate. In spite of these drawbacks, the introduction of the new technology into the pharmacy department could be considered successful. This can be attributed to the following:

1. The usefulness of the technology.
2. The new unit dose system was viewed positively by the nurses.
3. All of the pharmacy staff had previous computer experience.
4. Some time saved allowed for improved services to the nursing units in the form of:
 - (a) Expansion of the CIVA program that supplies nurses with pre-mixed intravenous solutions.
 - (b) Pharmacist availability.
5. No job losses occurred as a result of the introduction of the new technology.

The successful implementation of the new technology was demonstrated in the improved attitude towards technology as measured by the attitude towards technology

survey instrument, stress levels that were not significantly different six months after the implementation of the new technology than they were before the technology was introduced, and the generally favourable comments towards the new technology made by pharmacy staff. However, although there was no difference in the pharmacy group's mean score for job satisfaction between Time 1 and Time 2, opinion was mixed in regards to whether they enjoyed their job more, less, or about the same six months after the installation of the new technology compared with the period two weeks before its installation. Two of the pharmacists said that they enjoyed their job more because there was more time for clinical-related work. Two of the technicians stated that their enjoyment of their job was about the same over the two time periods. One pharmacist and two technicians said that they enjoyed their job less at Time 2 than at Time 1. The reasons given for this change in job enjoyment was that they were not impressed with the new methods used to do the work and that the environment had degenerated.

The problems in organizational climate that existed in the pharmacy may partly be attributed to the inflexible structure of the hospital. Bright, productive pharmacy technicians, for instance, have nothing to aspire to as there are no promotional opportunities for them and there is a ceiling on salary and benefits that can be attained. The workers in the pharmacy department view their immediate manager as autocratic and unreceptive to ideas coming from staff. Item 7 of the survey of organizations asks, "How receptive are people above your supervisor to ideas and suggestions coming from your work group?" One of the pharmacy staff circled 'work group' and wrote, "doesn't exist - unfortunately, ideas come from Pharmacy Director only."

There was also no change in the opinions of pharmacy staff regarding organizational climate between those two periods of time based on the surveys. The problems in group dynamics and tension between the workers and their immediate supervisor that existed before the introduction of the new technology remained afterwards. At Time 2, one of the pharmacy staff made the following comment:

I hope that you don't think that we feel as negatively towards the new dispensing machine as we seem. The frustration we have with our manager seems to come out as negative comments about the new dispensing machine.

Between the Time 1 and Time 2 data collection periods, the nursing department was restructured. On both of the nursing units, the organizational climate improved between the Time 1 and Time 2 sample periods. This can be explained by the fact that restructuring of the nursing department was imminent at Time 1, leaving nurses with a great deal of uncertainty. At the Time 2 sampling period, the nurses who were "laid off" or "bumped" were gone and those who were left were relieved not to have been "bumped" or "laid off". On the nursing unit that went through dramatic restructuring, the attitude towards technology at Time 2 was less positive than it had been at Time 1. This is in contrast to the nursing unit where fewer changes had occurred - their attitude towards technology improved from Time 1 to Time 2. No new technology had been introduced into either of those nursing units during this time period although a new computerized nursing workload measurement system was soon to be installed. In regards to the introduction of the Unidose system onto the nursing units, one of the nurses on the amalgamated surgical unit stated that:

I don't think that the Unidose system is the problem. I think it just went through without really being noticed that it went through. Almost like a normal process of things to be.

In reply to the question about the relations between the nurses and the pharmacy department, a senior nurse made the following comment:

Relations are very strained. Not because of unit dose, though. It's strained because everybody's strained.

Another nurse on this unit stated that:

When there are a lot of changes happening at once, you get people saying, "It's not going to work anyway".

The combination human factors/organizational behaviour approach to evaluating the introduction of new technology into hospitals appears to be a useful one. In terms of managerial practice, the results from this study suggest that investigating the climate and

culture of the hospital prior to the introduction of new technology is an important first step. Ensuring that the technology is being introduced into a "healthy organization" might eliminate negative reactions to the technology that could be attributed to organizational factors such as a poor organizational climate. In combination with the interview material, the analysis of the survey data (i.e., the pattern of correlations, the factor analysis, regression analysis, and the scale means for each of the units, especially at Time 2) indicates that there are hospital workers who have a negative attitude toward the organization and are less technologically skilled than some of their co-workers, but they are committed to staying with the organization because of the high personal cost of leaving it. When introducing new technology into an organization, these are the workers who are likely to provide the most challenge to their managers and co-workers.

Smith and Carayon (1995) recommend the following guidelines for organizations that are introducing new technology:

1. Involve employees in the decision process of selection and implementation of the new technology.
2. Maintain an ongoing process of employee participation in the production process.
3. Develop ways of increasing employee control over their own work activities.
4. Establish a supervision process that is helpful and problem-solving rather than monitoring and coercive.
5. Provide employee learning and growth throughout a career.
6. Design jobs that provide employee self-esteem and self-worth. (p. 104).

Even in an ideal organizational climate and culture, the usefulness and usability of the technology, and how well it is integrated into the organizational structure of the hospital, will determine its effectiveness. A positive culture and climate for introducing new technology implies an organization that values flexibility and innovation. Such an organization would therefore foster a 'socially-centred design' (Stanney, Maxey & Salvendy, 1997) style of introducing new technology, and would include workers in

technology-related decision-making - called participatory ergonomics (Smith & Carayon, 1995; Wilson & Haines, 1997).

Although the implementation of the new technology in the pharmacy department could be considered a success for the reasons listed above, the pharmacy department's clients (the nurses) were more positive about the expansion of the CIVA program than they were about the introduction of the Unidose system. The expansion of the CIVA program had nothing to do with automation and everything to do with the increased effort exerted by the pharmacy staff and its manager to improve pharmacy services.

There are many areas where macro-ergonomics and micro-ergonomics meet in the context of introducing new technology into organizations that were not investigated here. Some of the important areas of research from both a theoretical and a practical standpoint are research into mental models (Norman, 1983; Liu, 1997; Wickens & Carswell, 1997), task analysis (Gilbreth, 1914; Luczak, 1997), and allocation of functions (Fitts, 1951; Sharit, 1997). New technology, particularly computerization or re-computerization of entire hospitals, provides hospital administrators with an opportunity to re-design how tasks are accomplished and by whom. It also provides an opportunity to reassess how information such as clinical records, is organized.

From a human resource perspective, in addition to the lack of attention to job design and function allocation between humans and machines, career development of hospital personnel has been a neglected area. The lowest-rated item in the MJDQ survey of job design, "There are opportunities for advancement to higher level jobs", received a mean rating of 1.93 out of a possible 5 at Time 1 and 2.38 at Time 2. Other items that received particularly low ratings were, "People on this job have high job security" (2.24 at both Time 1 and Time 2), and "The job allows freedom, independence, or discretion in work scheduling, sequence, methods, quality control, or other decision-making" (2.11 at Time 1 and 2.52 at Time 2). There is a great deal of work to be done in job re-design in hospitals if they are to move from being control-oriented to being flexibility-oriented. Although jobs

in hospitals are necessarily constrained along professional lines, there is still a great deal of latitude that is currently not being exercised in terms of how tasks and goals are accomplished, and how information is collated and shared.

With a larger sample size, a path analytical model could be used to generate quantitative modelling of linkages between the various factors involved in the current study. In addition, there is some indication from the interviews and culture surveys that each functional unit in a hospital has its own, distinct micro-culture and climate that co-exists with the larger organizational culture. This may affect how successful the introduction of new technology is for particular units. For instance, introducing the same computerized system into one nursing unit may meet with more resistance and be under-utilized when compared with another nursing unit. The differences in opinions of managers versus other workers was only briefly covered by this thesis. However, there is every reason to expect that leadership style can be measured and may have an impact on the introduction of new technology.

This thesis has demonstrated that the climate and culture of a hospital can affect attitudes towards technology. The modified usability assessment method of heuristic evaluation that was developed, suggested that it is possible to evaluate a human-computer interface based on a document containing screen pictures of the interface in conjunction with a description of how workers currently navigate through the system. This method has the advantage of producing a document that can be used for training. The additional advantage of this methodology is that it is not overly disruptive to the routine of the hospital. The problem with this methodology is that it does not allow usability experts the freedom to navigate through the system themselves. Ideally, the knowledge of usability issues will permeate into the hospital environment so that hospital workers or at least their managers will become their own usability experts. They have the advantage of already being domain experts.

Although the positive correlation between organizational climate and attitude towards technology was larger than the negative correlation between continuance commitment and attitude towards technology, the former finding is less surprising than the latter. The former finding requires further study in order to determine whether hospitals that introduce new technology onto units that have a poor climate find resistance to the new technology. The latter finding that there was a significant negative correlation between attitude towards technology and continuance commitment, identifies a potentially larger problem for hospitals. If the workers who have a less positive attitude towards technology are the workers who do not intend to leave because leaving the organization would be too costly for them, then the workers who are likely to leave are the ones that you most want to keep; these are the workers with the most positive attitude towards technology.

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Appendix A

The Hospital's Written Goals and Philosophy

Vision Statement

The ***Hospital*** is a community-oriented centre of excellence whose quality of highly personalized care measures to the satisfaction of its clientele.

Its ability to adapt to change is wholly derived from its ***employees'*** spirit of innovation, their participation and loyalty.

The ***Hospital*** is a leader in community health care and, as such, its presence can be felt beyond its regional boundaries.

Management Philosophy

In order to realize its mission and assume leadership in the community, the management unit of the ***Hospital*** supports these actions through the principles of continuous quality improvement in order to satisfy our internal and external clients and to attain optimal performance with the resources at our disposal.

To this end, the ***hospital*** promotes and respects a management philosophy based on the following principles:

- ***Collective leadership*** permits articulation of a vision and a direction that rallies and motivates all new employees to the organization.
- ***Team work*** constitutes a fundamental approach to attain common goals and our employees demonstrate consideration and fairness towards others.
- ***Open and frank communication*** encourages dialogue, confidence, and collaboration.
- ***Participation of personnel*** enriches decision-making.
- ***Creativity*** contributes to the development of a dynamic organization.
- ***Continuing education*** is essential and it represents a shared responsibility between the hospital and its employees.
- ***Changes*** represent an opportunity for individual and collective growth.
- ***Optimal utilization*** of resources assures efficient services in a climate of financial responsibility.

Statement of Values

In seeking to fulfil our mission, while remaining true to our vision, we are guided by three great fundamental values, namely;

- ***Human dignity***: we preserve the trust of others by showing them the utmost respect.
- ***Solidarity***: we achieve through unfailing team spirit and professionalism.
- ***Commitment to excellence***: we stake our reputation on the quality of our services.

Hospital' Mission (Primary Goal)

An establishment which offers its services in both official languages, this hospital has gained distinction because of its francophone culture, its deep commitment to the community and its academic role.

This hospital is unwavering in its continuous quest to achieve excellence in health care. Supported by professional and technical resources, equipped with the latest technology and operating in recently modernized facilities, the hospital takes great care in ensuring the welfare and the well-being of its clients. Its commitment to the community is deeply rooted in a spirit that fosters partnership and dedication.

In accordance with the province's key health care goals, the hospital promotes the development of innovative programs in ambulatory care services in both the hospital and its community clinics. Moreover, the hospital ensures that both health care in general and its services are adapted to the changing needs of its community.

Its profound respect of three key fundamental values have enabled the hospital to remain true to its purpose and primary goal. Through its compassion, its human solidarity and an approach that promotes personalized care, the hospital offers health care that is respectful of each person's dignity.

Appendix B: Organizational Culture Survey

Instructions:

1. The first part of this questionnaire (Part A) relates to the type of organization that your hospital is most like. Each of these items contains four descriptions of institutions (for example, hospitals). Please distribute 100 points among the four descriptions depending on how similar the description is to your hospital. None of the descriptions is any better than the others; they are just different. For each question, please use all 100 points.

For example: In question 1, if Hospital A seems very similar to mine, B seems somewhat similar, and C and D do not seem similar at all, I might give 70 points to A and the remaining 30 points to B.

The Hospital

1. Hospital Character (Please distribute 100 points)

- _____ Hospital A is a very *personal place*. It is a lot like an extended family. People seem to share a lot of themselves.
- _____ Hospital B is a very *dynamic and entrepreneurial place*. People are willing to stick their necks out and take risks.
- _____ Hospital C is a very *formalized and structured place*. Bureaucratic procedures generally govern what people do.
- _____ Hospital D is very *production-oriented*. A major concern is with getting the job done. People aren't very personally involved.

2. Hospital Leader (Please distribute 100 points)

- _____ The head of Hospital A is generally considered to be a *mentor, a sage, or a father or mother figure*.
- _____ The head of Hospital B is generally considered to be an *entrepreneur, an innovator, or a risk taker*.
- _____ The head of Hospital C is generally considered to be a *coordinator, an organizer, or an administrator*.
- _____ The head of Hospital D is generally considered to be a *producer, a technician, or a hard driver*.

3. Hospital "Glue" (Please distribute 100 points)

- _____ The glue that holds Hospital A together is *loyalty and tradition*. Commitment to this hospital runs high.
- _____ The glue that holds Hospital B together is *commitment to innovation and development*. There is an emphasis on being first.
- _____ The glue that holds Hospital C together is *formal rules and policies*. Maintaining a smooth running operation is important here.
- _____ The glue that holds Hospital D together is the emphasis on *tasks and goal accomplishment*. A production orientation is commonly shared.

4. Hospital Emphases (Please distribute 100 points)

- _____ Hospital A emphasizes *human resources*. High cohesion and morale in the hospital are important.
- _____ Hospital B emphasizes *growth and acquiring new resources*. Readiness to meet new challenges is important.
- _____ Hospital C emphasizes *permanence and stability*. Efficient, smooth operations are important.
- _____ Hospital D emphasizes *competitive actions and achievement*. Measurable goals are important.

Organizational Culture Survey (French Translation)

Instructions

La première partie de ce questionnaire (partie A) porte sur le genre d'organisation qui se rapproche le plus de votre hôpital. Dans chacune de ces parties, vous trouverez quatre descriptions d'organisation (par exemple, pour la partie A, les hôpitaux). Veuillez répartir 100 points entre les quatre descriptions selon la mesure dans laquelle chaque description correspond à votre hôpital. Aucune description n'est meilleure que les autres; elles sont seulement différentes. Pour chaque question, veuillez attribuer les 100 points alloués.

Exemple : À la question 1, si l'hôpital A est très similaire à mon hôpital et que l'hôpital B est quelque peu similaire alors que les hôpitaux C et D ne le sont pas du tout, je pourrais accorder 70 points à l'hôpital A et 30 points à l'hôpital B.

Partie A : L'hôpital

1. La nature de l'hôpital (veuillez répartir 100 points)

- _____ L'hôpital A est un endroit très chaleureux. C'est comme une grande famille. Les gens semblent donner beaucoup d'eux-mêmes.
- _____ L'hôpital B est très dynamique et animé de l'esprit d'entreprise. Les gens sont prêts à «se mouiller» et à prendre des risques.
- _____ L'hôpital C est très organisé et hiérarchisé. En général, ce que les gens doivent faire est régi par les procédures bureaucratiques.
- _____ L'hôpital D est très centré sur le rendement. La grande préoccupation est que le travail soit fait. Les gens ne sont pas très engagés personnellement.

2. Le directeur ou la directrice de l'hôpital (veuillez répartir 100 points)

- _____ Le directeur ou la directrice de l'hôpital A est généralement considéré(e) comme un guide, un sage, un père ou une mère.
- _____ Le directeur ou la directrice de l'hôpital B est généralement considéré(e) comme un entrepreneur, un innovateur ou quelqu'un qui prend des risques.
- _____ Le directeur ou la directrice de l'hôpital C est généralement considéré(e) comme un coordonnateur, un organisateur ou un administrateur.
- _____ Le directeur ou la directrice de l'hôpital D est généralement considéré(e) comme un producteur, un technicien ou quelqu'un qui mène son personnel «à la baguette».

3. L'élément de cohésion de l'hôpital (veuillez répartir 100 points)

- _____ L'élément qui assure la cohésion de l'hôpital A est la loyauté et la tradition. L'engagement envers l'hôpital est élevé.
- _____ L'élément qui assure la cohésion de l'hôpital B est l'engagement envers l'innovation et le développement. Il est important d'être les premiers.
- _____ L'élément qui assure la cohésion de l'hôpital C est l'application de règles et de lignes directrices rigoureuses. Il importe de maintenir le bon fonctionnement de l'hôpital.
- _____ L'élément qui assure la cohésion de l'hôpital D est la réalisation des tâches et l'atteinte des objectifs. Tout le monde vise le rendement.

4. Valeurs préconisées par l'hôpital (veuillez répartir 100 points)

- _____ L'hôpital A met l'accent sur les ressources humaines. Il est important qu'une forte cohésion et qu'un bon moral règnent au sein de l'hôpital.
- _____ L'hôpital B met l'accent sur la croissance et l'acquisition de nouvelles ressources. Il est important d'être prêt à relever de nouveaux défis.
- _____ L'hôpital C met l'accent sur la permanence et la stabilité. Il est important que tout fonctionne efficacement et sans heurts.
- _____ L'hôpital D met l'accent sur la concurrence et les réalisations. Il est important que des objectifs quantifiables soient établis.

Appendix C: Survey of Organizational Climate

INSTRUCTIONS

Answer each of the following 12 questions by circling the number of the answer you want to give.

	1	2	3	4	5
	"To a very little extent"	"To a little extent"	"To some extent"	"To a great extent"	"To a very great extent"
1. To what extent is the organization generally quick to use improved work methods?	1	2	3	4	5
2. To what extent does this organization both clear and reasonable?	1	2	3	4	5
3. To what extent are work activities sensibly organized in this organization?	1	2	3	4	5
4. In this organization, to what extent are decisions made at levels where the most adequate and accurate information is available?	1	2	3	4	5
5. How adequate is the information your work group gets about what is going on in other departments or units?	1	2	3	4	5
6. To what extent does this organization tell your work group what it needs to know to do the best possible job?	1	2	3	4	5
7. How receptive are people <u>above your supervisor</u> to ideas and suggestions coming from your work group.	1	2	3	4	5

1	2	3	4	5				
"To a very little extent"	"To a little extent"	"To some extent"	"To a great extent"	"To a very great extent"				
8.	To what extent does this organization have a real interest in the welfare and overall satisfaction of those who work here?			1	2	3	4	5
9.	How much does this organization try to improve working conditions?			1	2	3	4	5
10.	To what extent are there things about working here (such as policies, practices, or conditions) that encourage you to work hard.			1	2	3	4	5
11.	When decisions are being made, to what extent are the persons affected asked for their ideas?			1	2	3	4	5
12.	People at all levels of an organization usually have know-how that could be of use to decision makers. To what extent is information widely shared in this organization so that those who make decisions have access to such knowledge?			1	2	3	4	5

Survey of Organizational Climate (French Translation)

INSTRUCTIONS

Répondez à chacune des 12 questions suivantes en encerclant le chiffre correspondant à la réponse que vous voulez donner.

	1	2	3	4	5
	Dans une très faible mesure	Dans une faible mesure	Dans une certaine mesure	Dans une grande mesure	Dans une très grande mesure
1. En général, dans quelle mesure l'organisation est-elle prête à adopter rapidement des méthodes de travail améliorées?				1	2 3 4 5
2. Dans quelle mesure l'organisation a-t-elle des buts et des objectifs à la fois clairs et raisonnables?				1	2 3 4 5
3. Dans quelle mesure les activités professionnelles sont-elles bien structurées au sein de l'organisation?				1	2 3 4 5
4. Dans l'organisation, dans quelle mesure les décisions sont-elles prises aux niveaux où l'information la plus adéquate et la plus exacte est accessible?				1	2 3 4 5
5. Dans quelle mesure l'information que votre groupe de travail obtient au sujet de ce qui se passe dans les autres services ou unités est-elle adéquate?				1	2 3 4 5
6. Dans quelle mesure l'organisation dit-elle à votre groupe de travail ce qu'il a besoin de savoir pour faire le meilleur travail possible?				1	2 3 4 5

	1	2	3	4	5
	Dans une très faible mesure	Dans une faible mesure	Dans une certaine mesure	Dans une grande mesure	Dans une très grande mesure
7. Dans quelle mesure les <u>supérieurs de votre surveillant</u> sont-ils ouverts aux idées et aux suggestions formulées par votre groupe de travail?				1	2 3 4 5
8. Dans quelle mesure l'organisation s'intéresse-t-elle vraiment aux bien-être et à la satisfaction générale de ses employés?				1	2 3 4 5
9. Dans quelle mesure l'organisation s'efforce-t-elle d'améliorer les conditions de travail?				1	2 3 4 5
10. Dans quelle mesure certaines choses (comme des politiques, des pratiques ou des conditions de travail) vous encouragent-elles à travailler plus fort?				1	2 3 4 5
11. Lorsqu'il y a des décisions à prendre, dans quelle mesure les personnes touchées sont-elles consultées?				1	2 3 4 5
12. À tous les niveaux d'une organisation, il y a habituellement des personnes ayant certaines connaissances qui pourraient être utiles aux décideurs. Dans quelle mesure l'information est-elle échangée au sein de l'organisation de sorte que les personnes qui prennent des décisions aient accès à ces connaissances?				1	2 3 4 5

Appendix D: Perceived Organizational Support

INSTRUCTIONS

On the following pages you will see a number of statements about the organization for which you work, each of which you may agree or disagree with depending on your own personal evaluation. Please indicate the degree of agreement and disagreement with each statement by circling a number from 1 to 7 according to the following scale.

	1	2	3	4	5	6	7
	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree nor Disagree	Mildly Agree	Agree	Strongly Agree
1. The organization values my contribution to its well-being.	1	2	3	4	5	6	7
2. If the organization could hire someone to replace me at a lower salary it would do so.	1	2	3	4	5	6	7
3. The organization fails to appreciate any extra effort from me.	1	2	3	4	5	6	7
4. The organization strongly considers my goals and values.	1	2	3	4	5	6	7
5. The organization would ignore any complaint from me.	1	2	3	4	5	6	7
6. The organization disregards my best interests when it makes decisions which affect me.	1	2	3	4	5	6	7
7. Help is available from the organization when I have a problem.	1	2	3	4	5	6	7

	1	2	3	4	5	6	7
	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree nor Disagree	Mildly Agree	Agree	Strongly Agree
8. The organization really cares about my well-being.	1	2	3	4	5	6	7
9. Even if I did the best job possible, the organization would fail to notice.	1	2	3	4	5	6	7
10. The organization is willing to help me when I need a special favour.	1	2	3	4	5	6	7
11. The organization cares about my general satisfaction at work.	1	2	3	4	5	6	7
12. If given the opportunity, the organization would take advantage of me.	1	2	3	4	5	6	7
13. The organization shows very little concern for me.	1	2	3	4	5	6	7
14. The organization cares about my opinions.	1	2	3	4	5	6	7
15. The organization takes pride in my accomplishments at work.	1	2	3	4	5	6	7
16. The organization tries to make my job as interesting as possible.	1	2	3	4	5	6	7

Perceived Organizational Support (French Translation)

INSTRUCTIONS

Aux pages suivantes, vous trouverez un certain nombre d'énoncés concernant l'organisation pour laquelle vous travaillez, avec lesquels vous pouvez être plus ou moins d'accord. Pour chaque énoncé, veuillez indiquer dans quelle mesure vous êtes d'accord ou non en encerclant un chiffre de 1 à 7 selon l'échelle suivante.

	1	2	3	4	5	6	7
	Tout à fait en désaccord	En désaccord	Plus ou moins en désaccord	Indif- férent(e)	Plus ou moins d'accord	D'accord	Tout à fait d'accord
1. L'organisation apprécie ma contribution à son bien-être.	1	2	3	4	5	6	7
2. Si l'organisation pouvait me remplacer par quelqu'un touchant un salaire moins élevé, elle le ferait.	1	2	3	4	5	6	7
3. L'organisation ne se rend pas compte des efforts supplémentaires que je fournis.	1	2	3	4	5	6	7
4. L'organisation tient compte de mes objectifs et de mes valeurs.	1	2	3	4	5	6	7
5. L'organisation ne tiendrait aucun compte des plaintes que je pourrais formuler.	1	2	3	4	5	6	7
6. L'organisation fait peu de cas de mes intérêts lorsqu'elle prend des décisions me concernant.	1	2	3	4	5	6	7
7. Lorsque j'ai un problème, l'organisation me vient en aide.	1	2	3	4	5	6	7

	1	2	3	4	5	6			7			
	Tout à fait en désaccord	En désaccord	Plus ou moins en désaccord	Indif- férent(e)	Plus ou moins d'accord	D'accord			Tout à fait d'accord			
8.	L'organisation se soucie vraiment de mon bien-être.					1	2	3	4	5	6	7
9.	Même si je faisais le meilleur travail possible, l'organisation ne le remarquerait pas.					1	2	3	4	5	6	7
10.	L'organisation est prête à m'aider lorsque j'ai besoin d'une faveur spéciale.					1	2	3	4	5	6	7
11.	L'organisation accorde de l'importance à ma satisfaction générale au travail.					1	2	3	4	5	6	7
12.	Si elle en avait la possibilité, l'organisation profiterait de moi.					1	2	3	4	5	6	7
13.	L'organisation se soucie très peu de moi.					1	2	3	4	5	6	7
14.	L'organisation tient compte de mes opinions.					1	2	3	4	5	6	7
15.	L'organisation est fière de mes réalisations au travail.					1	2	3	4	5	6	7
16.	L'organisation s'efforce de rendre mon travail le plus intéressant possible.					1	2	3	4	5	6	7

Appendix E: Organizational Commitment Survey

(Items 1 - 8, Affective Commitment; Items 9 - 16, Continuance Commitment)

INSTRUCTIONS

Below are a number of statements about the organization for which you work, each of which you may agree or disagree with depending on your own personal evaluation. Please indicate the degree of agreement and disagreement with each statement by circling a number from 1 to 7 according to the following scale.

	1	2	3	4	5	6	7
	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree nor Disagree	Mildly Agree	Agree	Strongly Agree
1. I do not feel a strong sense of belonging to my organization.	1	2	3	4	5	6	7
2. I do not feel emotionally attached to this organization.	1	2	3	4	5	6	7
3. This organization has a great deal of personal meaning for me.	1	2	3	4	5	6	7
4. I do not feel like 'part of the family' at my organization.	1	2	3	4	5	6	7
5. I would be very happy to spend the rest of my career with this organization.	1	2	3	4	5	6	7
6. I enjoy discussing my organization with people outside it.	1	2	3	4	5	6	7
7. I really feel as if this organization's problems are my own.	1	2	3	4	5	6	7
8. I think I could easily become as attached to another organization as I am to this one.	1	2	3	4	5	6	7

	1	2	3	4	5	6	7
	Strongly Disagree	Disagree	Mildly Disagree	Neither Agree nor Disagree	Mildly Agree	Agree	Strongly Agree
9. Right now, staying with my organization is a matter of necessity as much as desire.	1	2	3	4	5	6	7
10. One of the major reasons I continue to work for this organization is that leaving would require considerable personal sacrifice - another organization may not match the overall benefits I have here.	1	2	3	4	5	6	7
11. I feel that I have too few options to consider leaving this organization.	1	2	3	4	5	6	7
12. One of the few negative consequences of leaving this organization would be the scarcity of available alternatives.	1	2	3	4	5	6	7
13. It would be very hard for me to leave my organization right now, even if I wanted to.	1	2	3	4	5	6	7
14. Too much in my life would be disrupted if I decided I wanted to leave my organization now.	1	2	3	4	5	6	7
15. It wouldn't be too costly for me to leave my organization now.	1	2	3	4	5	6	7
16. I am not afraid of what might happen if I quit my job without having another lined up.	1	2	3	4	5	6	7

Organizational Commitment Survey (French Translation)

(Items 1 - 8, Affective Commitment; Items 9 - 16, Continuance Commitment)

INSTRUCTIONS

Voici un certain nombre d'énoncés concernant l'organisation pour laquelle vous travaillez, avec lesquels vous pouvez être plus ou moins d'accord. Pour chaque énoncé, veuillez indiquer dans quelle mesure vous êtes d'accord ou non en encerclant un chiffre de 1 à 7 selon l'échelle suivante.

	1	2	3	4	5	6	7
	Tout à fait en désaccord	En désaccord	Plus ou moins en désaccord	Indif- férent(e)	Plus ou moins d'accord	D'accord	Tout à fait d'accord
1. Je n'éprouve pas un fort sentiment d'appartenance à cette organisation.	1	2	3	4	5	6	7
2. Je n'éprouve pas d'attachement pour cette organisation.	1	2	3	4	5	6	7
3. Cette organisation a pour moi une grande importance sur le plan personnel.	1	2	3	4	5	6	7
4. Dans cette organisation, je n'ai pas l'impression de «faire partie de la famille».	1	2	3	4	5	6	7
5. Je serais très heureux(euse) de travailler dans cette organisation jusqu'à ma retraite.	1	2	3	4	5	6	7
6. J'aime bien parler de mon organisation avec des gens qui n'y travaillent pas.	1	2	3	4	5	6	7
7. J'ai vraiment l'impression que les problèmes de cette organisation sont également les miens.	1	2	3	4	5	6	7
8. Je pense que je pourrais facilement m'attacher à une autre organisation autant que je suis attaché(e) à celle-ci.	1	2	3	4	5	6	7

	1	2	3	4	5	6	7				
	Tout à fait en désaccord	En désaccord	Plus ou moins en désaccord	Indif- férent(e)	Plus ou moins d'accord	D'accord	Tout à fait d'accord				
9. Actuellement, je reste avec cette organisation autant parce que c'est nécessaire que parce que j'en ai envie.					1	2	3	4	5	6	7
10. L'une des principales raisons pour lesquelles je continue de travailler pour cette organisation est que partir constituerait un sacrifice personnel considérable; dans une autre organisation, je n'aurais peut-être pas les mêmes avantages qu'ici.					1	2	3	4	5	6	7
11. Je pense n'avoir pas assez d'options pour envisager de quitter cette organisation.					1	2	3	4	5	6	7
12. Si je quittais cette organisation, l'une des conséquences négatives serait que très peu de solutions de rechange s'offriraient à moi.					1	2	3	4	5	6	7
13. Ce serait très difficile pour moi de quitter cette organisation maintenant, même si je le voulais.					1	2	3	4	5	6	7
14. Si je décidais de quitter cette organisation maintenant, cela entraînerait trop de bouleversements dans ma vie.					1	2	3	4	5	6	7
15. Ce ne serait pas trop coûteux pour moi de quitter cette organisation présentement.					1	2	3	4	5	6	7
16. Je ne crains pas ce qui pourrait arriver si je quittais mon emploi sans avoir trouvé un autre travail.					1	2	3	4	5	6	7

Appendix F: Stress Survey

INSTRUCTIONS

The 50 following statements are designed to measure the kinds of stress that people experience in their work. Read each statement and circle the answer which seems to fit you best for each statement according to the following scale.

	1 "Rarely or Never"	2 "Occasionally"	3 "Often"	4 "Usually"	5 "Most of the Time"
1. At work I am expected to do too many different tasks in too little time.	1	2	3	4	5
2. I feel that my job responsibilities are increasing.	1	2	3	4	5
3. I am expected to perform tasks on my job for which I have never been trained.	1	2	3	4	5
4. I have to take work home with me.	1	2	3	4	5
5. I have the resources to get my job done.	1	2	3	4	5
6. I feel competent in what I do.	1	2	3	4	5
7. I work under tight time deadlines.	1	2	3	4	5
8. I wish that I had more help to deal with the demands placed upon me at work.	1	2	3	4	5
9. My job requires me to work in several equally important areas at once.	1	2	3	4	5
10. I am expected to do more work than is reasonable.	1	2	3	4	5

	1 "Rarely or Never"	2 "Occasionally"	3 "Often"	4 "Usually"	5 "Most of the Time"
11. I feel that my career is progressing about as I had hoped it would.				1 2 3 4 5	
12. I feel that my job fits my skills and interests.				1 2 3 4 5	
13. I am bored with my job.				1 2 3 4 5	
14. I feel I have enough responsibility on my job.				1 2 3 4 5	
15. I feel my talents are being used on my job.				1 2 3 4 5	
16. I feel my job has a good future.				1 2 3 4 5	
17. I am able to satisfy my needs for success and recognition in my job.				1 2 3 4 5	
18. I feel overqualified for my job.				1 2 3 4 5	
19. I learn new skills in my work.				1 2 3 4 5	
20. I have to perform tasks that are beneath my ability.				1 2 3 4 5	

	1 "Rarely or Never"	2 "Occasionally"	3 "Often"	4 "Usually"	5 "Most of the Time"
21. My supervisor provides me with useful feedback about my performance.	1	2	3	4	5
22. It is clear to me what I have to do to get ahead.	1	2	3	4	5
23. I am uncertain about what I am supposed to accomplish in my work.	1	2	3	4	5
24. When faced with several tasks I know which should be done first.	1	2	3	4	5
25. I know where to begin a new project when it is assigned to me.	1	2	3	4	5
26. My supervisor asks for one thing but really wants another.	1	2	3	4	5
27. I understand what is acceptable personal behaviour on my job (e.g. dress, interpersonal relations etc.)	1	2	3	4	5
28. The priorities of my job are clear to me.	1	2	3	4	5
29. I have a clear understanding of how my boss wants me to spend my time.	1	2	3	4	5
30. I know the basis on which I am evaluated.	1	2	3	4	5

	1 "Rarely or Never"	2 "Occasionally"	3 "Often"	4 "Usually"	5 "Most of the Time"
31. I feel conflict between what my employer expects me to do and what I think is right or proper.				1 2 3	4 5
32. I feel caught between factions at work.				1 2 3	4 5
33. I have more than one person telling me what to do.				1 2 3	4 5
34. I feel I have a stake in the success of my organization.				1 2 3	4 5
35. I feel good about the work I do.				1 2 3	4 5
36. My supervisors have conflicting ideas about what I should be doing.				1 2 3	4 5
37. I am proud of what I do for a living.				1 2 3	4 5
38. It is clear who really runs things where I work.				1 2 3	4 5
39. I have divided loyalties on my job.				1 2 3	4 5
40. The work I do has as much payoff for me as for my employer.				1 2 3	4 5

	1 "Rarely or Never"	2 "Occasionally"	3 "Often"	4 "Usually"	5 "Most of the Time"
41. I feel I deal with more people during the day than I prefer.			1 2 3	4 5	
42. I spend time concerned with the problems others at work bring to me.			1 2 3	4 5	
43. I am responsible for the welfare of subordinates.			1 2 3	4 5	
44. People on the job look to me for leadership.			1 2 3	4 5	
45. I have on the job responsibility for the activities of others.			1 2 3	4 5	
46. I worry about whether the people who work for/with me will get things done properly.			1 2 3	4 5	
47. People who work for/with me are really hard to deal with.			1 2 3	4 5	
48. If I make a mistake in my work, the consequences for others can be pretty bad.			1 2 3	4 5	
49. My job demands that I handle an angry public.			1 2 3	4 5	
50. I like the people I work with.			1 2 3	4 5	

Stress Survey (French Translation)

INSTRUCTIONS

Les 50 énoncés ci-après visent à mesurer les différentes formes de tension que les gens peuvent ressentir au travail. Lisez chaque énoncé et encerclez la réponse qui s'applique le mieux à vous selon l'échelle ci-dessous.

	1	2	3	4	5
	Rarement ou jamais	À l'occasion	Souvent	Habituellement	La plupart du temps
1. Au travail, on s'attend à ce que je fasse un trop grand nombre de tâches différentes en trop peu de temps.				1 2 3 4 5	
2. J'ai l'impression que mes responsabilités au travail augmentent.				1 2 3 4 5	
3. Dans le cadre de mon travail, on s'attend à ce que je remplisse des tâches pour lesquelles je n'ai pas reçu de formation.				1 2 3 4 5	
4. Je dois apporter du travail à la maison.				1 2 3 4 5	
5. J'ai les ressources nécessaires pour faire mon travail.				1 2 3 4 5	
6. Je me sens compétent(e) dans mon travail.				1 2 3 4 5	
7. J'ai des délais très serrés à respecter dans mon travail.				1 2 3 4 5	
8. J'aimerais que l'on m'aide davantage à faire face aux exigences de mon travail.				1 2 3 4 5	
9. Mon emploi exige que je travaille en même temps dans plusieurs domaines tout aussi importants.				1 2 3 4 5	
10. La charge de travail qu'on exige de moi n'est pas raisonnable.				1 2 3 4 5	

	1	2	3	4	5
	Rarement ou jamais	À l'occasion	Souvent	Habituellement	La plupart du temps
11. J'ai l'impression que ma carrière progresse à peu près comme je l'avais espéré.				1 2 3 4 5	
12. J'ai le sentiment que mon travail correspond à mes intérêts et à mes compétences.				1 2 3 4 5	
13. Mon travail m'ennuie.				1 2 3 4 5	
14. J'ai l'impression d'avoir suffisamment de responsabilité dans le cadre de mon travail.				1 2 3 4 5	
15. Je pense que mes talents sont mis à profit dans le cadre de mon travail.				1 2 3 4 5	
16. Je pense que mon emploi est un emploi d'avenir.				1 2 3 4 5	
17. Mon travail répond à mon besoin de réussir et d'être reconnu(e).				1 2 3 4 5	
18. J'ai l'impression d'être trop qualifié(e) pour le travail que je fais.				1 2 3 4 5	
19. J'acquiers de nouvelles compétences dans le cadre de mon travail.				1 2 3 4 5	
20. Je dois remplir des tâches qui dépassent mon niveau de compétence.				1 2 3 4 5	

	1	2	3	4	5
	Rarement ou jamais	À l'occasion	Souvent	Habituellement	La plupart du temps
21. Mon surveillant me fait part de commentaires utiles sur mon rendement.				1 2 3 4 5	
22. Je sais exactement ce que je dois faire pour progresser.				1 2 3 4 5	
23. Je ne suis pas certain(e) de ce que je suis censé(e) faire dans le cadre de mon travail.				1 2 3 4 5	
24. Quand je me trouve face à plusieurs tâches en même temps, je sais laquelle doit être remplie en premier.				1 2 3 4 5	
25. Je sais par quoi commencer lorsqu'un nouveau projet m'est confié.				1 2 3 4 5	
26. Mon surveillant me demande quelque chose mais, en fait, il veut autre chose.				1 2 3 4 5	
27. Je comprends ce que constitue un comportement acceptable au travail (p. ex., tenue vestimentaire, relations avec les autres, etc.).				1 2 3 4 5	
28. J'ai une idée claire des priorités dans mon travail.				1 2 3 4 5	
29. Je sais très bien comment mon patron veut que j'emploie mon temps.				1 2 3 4 5	
30. Je sais sur quoi je suis évalué(e).				1 2 3 4 5	

	1	2	3	4	5
	Rarement ou jamais	À l'occasion	Souvent	Habituellement	La plupart du temps
31. Je sens une divergence entre ce que mon employeur attend de moi et ce que je crois être approprié ou indiqué de faire.				1 2 3 4 5	
32. Je me sens coincé(e) entre des «cliques» au travail.				1 2 3 4 5	
33. Je reçois des directives de plus d'une personne sur ce que je dois faire.				1 2 3 4 5	
34. J'ai l'impression de contribuer au succès de mon organisation.				1 2 3 4 5	
35. Je me sens bien dans le travail que je fais.				1 2 3 4 5	
36. Mes supérieurs ne s'entendent pas sur le travail que je devrais faire.				1 2 3 4 5	
37. Je suis fier(ère) de ce que je fais pour gagner ma vie.				1 2 3 4 5	
38. À l'endroit où je travaille, on sait exactement qui dirige réellement.				1 2 3 4 5	
39. Au travail, ma loyauté est partagée.				1 2 3 4 5	
40. Le travail que je fais bénéficie autant à moi qu'à mon employeur.				1 2 3 4 5	

	1	2	3	4	5
	Rarement ou jamais	À l'occasion	Souvent	Habituellement	La plupart du temps
41. Au cours de la journée, j'ai l'impression d'avoir affaire à trop de personnes.				1 2 3 4 5	
42. Je passe du temps à régler des problèmes que d'autres personnes me soumettent.				1 2 3 4 5	
43. Je suis responsable du bien-être de mes subalternes.				1 2 3 4 5	
44. Au travail, les gens attendent de moi que je joue le rôle de chef.				1 2 3 4 5	
45. Je suis responsable du travail d'autres personnes.				1 2 3 4 5	
46. Je me préoccupe de la qualité du travail des personnes qui travaillent pour moi ou avec moi.				1 2 3 4 5	
47. J'ai beaucoup de mal à m'entendre avec les gens qui travaillent pour moi ou avec moi.				1 2 3 4 5	
48. Si je commets une erreur dans mon travail, les conséquences peuvent être très fâcheuses pour les autres.				1 2 3 4 5	
49. Mon travail exige que je traite avec des gens en colère.				1 2 3 4 5	
50. J'aime les gens avec qui je travaille.				1 2 3 4 5	

Appendix G: Job Design Survey

INSTRUCTIONS

Below are a number of statements about the organization for which you work, each of which you may agree or disagree with depending on your own personal evaluation. Please indicate the degree of agreement and disagreement with each statement by circling a number from 1 to 5 according to the following scale.

	1	2	3	4	5
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1. The job allows freedom, independence, or discretion in work scheduling, sequence, methods, quality control, or other decision making.	1	2	3	4	5
2. The work activities themselves provide direct and clear information as to the effectiveness (e.g., quality and quantity) of your job performance.	1	2	3	4	5
3. Other people in the organization, such as supervisors and co-workers, provide information as to the effectiveness (e.g., quality and quantity) of your job performance.	1	2	3	4	5
4. The job provides for positive social interaction such as team work or co-worker assistance.	1	2	3	4	5
5. The job duties, requirements, and goals are clear and specific.	1	2	3	4	5
6. The job has a variety of duties, tasks, and activities.	1	2	3	4	5
7. The job requires completion of a whole and identifiable piece of work. It gives you a chance to do an entire piece of work from beginning to end.	1	2	3	4	5
8. The job requires a high level of knowledge, skills, and abilities.	1	2	3	4	5

1 Strongly Disagree	2 Disagree	3 Neither	4 Agree	5 Strongly Agree		
9. The job is significant and important compared with other jobs in the organization.		1	2	3	4	5
10. The job allows opportunities for learning and growth in competence and proficiency.		1	2	3	4	5
11. There are opportunities for advancement to higher level jobs.		1	2	3	4	5
12. The job provides for feelings of achievement and task accomplishment.		1	2	3	4	5
13. The job allows participation in work-related decision making.		1	2	3	4	5
14. The job has access to relevant communication channels and information flows.		1	2	3	4	5
15. The pay on this job is adequate compared with the job requirements and the pay in similar jobs.		1	2	3	4	5
16. The job provides acknowledgement and recognition from others.		1	2	3	4	5
17. People on this job have high job security.		1	2	3	4	5
18. Just doing the work required by the job provides many chances for me to figure out how well I am doing.		1	2	3	4	5
19. The job itself provides me with clues about whether or not I am performing well.		1	2	3	4	5

Job Design Survey (French Translation)

INSTRUCTIONS

Voici un certain nombre d'énoncés concernant l'organisation pour laquelle vous travaillez, avec lesquels vous pouvez être plus ou moins d'accord. Pour chaque énoncé, veuillez indiquer dans quelle mesure vous êtes d'accord ou non en encerclant un chiffre de 1 à 5 selon l'échelle suivante.

	1	2	3	4	5
	Pas du tout d'accord	Pas d'accord	Indifférent(e)	D'accord	Tout à fait d'accord
1. Ce poste offre liberté, indépendance et pouvoir discrétionnaire en ce qui touche l'établissement du calendrier de travail, la façon de déterminer dans quel ordre les tâches doivent être remplies, le contrôle qualitatif ou la prise d'autres décisions.				1	2 3 4 5
2. Mes activités professionnelles elles-mêmes me donnent de l'information claire et directe sur mon rendement (p. ex., qualité et quantité).				1	2 3 4 5
3. D'autres personnes au sein de l'organisation, comme les surveillants et les collègues, fournissent de l'information sur mon rendement (p. ex., qualité et quantité).				1	2 3 4 5
4. Ce poste permet des interactions sociales positives, comme le travail d'équipe ou l'aide entre collègues.				1	2 3 4 5
5. Les tâches, exigences et objectifs de ce travail sont clairs et précis.				1	2 3 4 5
6. Ce poste comporte une gamme de fonctions, de tâches et d'activités.				1	2 3 4 5
7. Ce poste exige la réalisation d'une tâche en entier. J'ai ainsi la possibilité de mener à bien une tâche du début à la fin.				1	2 3 4 5

	1	2	3	4	5
	Pas du tout d'accord	Pas d'accord	Indifférent(e)	D'accord	Tout à fait d'accord
8. Ce poste nécessite un niveau élevé de connaissances, de compétences et d'aptitudes.				1	2 3 4 5
9. Ce poste est important comparativement à d'autres postes au sein de l'organisation.				1	2 3 4 5
10. Ce poste donne l'occasion d'apprendre et d'accroître ses compétences et aptitudes.				1	2 3 4 5
11. Il y a des possibilités d'avancement à des postes supérieurs.				1	2 3 4 5
12. Ce poste permet d'avoir un sentiment de réalisation et d'accomplissement.				1	2 3 4 5
13. Ce poste permet de participer à la prise de décisions concernant le travail.				1	2 3 4 5
14. Ce poste permet l'accès à des réseaux d'information et de communications importants.				1	2 3 4 5
15. La rémunération rattachée à ce poste est adéquate si l'on tient compte des exigences de l'emploi et de la rémunération pour des postes similaires.				1	2 3 4 5
16. Ce poste permet d'être reconnu par les autres.				1	2 3 4 5
17. Les personnes occupant ce poste bénéficient d'une bonne sécurité d'emploi.				1	2 3 4 5
18. Le simple fait de remplir les tâches exigées par ce poste me permet de déterminer si je m'en tire bien.				1	2 3 4 5
19. Le travail lui-même me fournit des indices me permettant de déterminer si mon rendement est bon.				1	2 3 4 5

Appendix H: Job Satisfaction Survey

INSTRUCTIONS

Think of your job in general. What is it like most of the time?

In the blank beside each word given below write

Y for "Yes" if it describes your job,
N for "No" if it does NOT describe it, or
? if you cannot decide.

_____ Pleasant

_____ Bad

_____ Ideal

_____ Waste of time

_____ Good

_____ Undesirable

_____ Worthwhile

_____ Acceptable

_____ Like to leave

_____ Better than most

_____ Disagreeable

_____ Makes me content

_____ Inadequate

_____ Excellent

_____ Rotten

_____ Enjoyable

_____ Poor

Job Satisfaction Survey (French Translation)

INSTRUCTIONS

Considérez votre travail en général. Comment est-il la plupart du temps?

Dans l'espace précédant chaque mot suggéré ci-après, inscrivez un O pour «Oui» si ce mot décrit votre travail, un N pour «Non» s'il ne le décrit pas, ou un ? si vous êtes indécis.

___ Plaisant

___ Mauvais

___ Idéal

___ Perte de temps

___ Bien

___ Indésirable

___ A un sens

___ Acceptable

___ Je voudrais quitter mon emploi

___ Mieux que la plupart

___ Désagréable

___ Me satisfait

___ Inadéquat

___ Excellent

___ Pourri

___ Agréable

___ Médiocre

Appendix I: Job Involvement Survey

INSTRUCTIONS

Answer each of the following 8 questions by circling the number of the answer you want to give.

In doing your job how often do you:

	1	2	3	4	5
	Never	Almost never	Sometimes	Almost always	All the time
1. Make extra efforts to do a good job?	1	2	3	4	5
2. Really put yourself out to improve the quality of your work?	1	2	3	4	5
3. Feel highly motivated to do a good job?	1	2	3	4	5
4. Let something go even when you know it isn't good enough?	1	2	3	4	5
5. Try to do your job more effectively?	1	2	3	4	5
6. Really enjoy doing a good piece of work?	1	2	3	4	5
7. Do just enough to get by?	1	2	3	4	5
8. Let someone else sort out a problem when you could do it yourself?	1	2	3	4	5

Job Involvement Survey (French Translation)

INSTRUCTIONS

Répondez à chacune des 8 questions suivantes en encerclant le chiffre correspondant à la réponse que vous voulez donner.

Lorsque vous faites votre travail, à quelle fréquence :

	1	2	3	4	5
	Jamais	Presque jamais	Parfois	Presque toujours	Toujours
1. Déployez-vous des efforts supplémentaires pour faire du bon travail?	1	2	3	4	5
2. Vous donnez-vous beaucoup de mal pour améliorer la qualité de votre travail?	1	2	3	4	5
3. Vous sentez-vous très motivé pour faire du bon travail?	1	2	3	4	5
4. Laissez-vous passer quelque chose même si vous savez que ce n'est pas assez bon?	1	2	3	4	5
5. Vous efforcez-vous de faire votre travail plus efficacement?	1	2	3	4	5
6. Avez-vous vraiment beaucoup de plaisir à faire du bon travail?	1	2	3	4	5
7. En faites-vous juste assez pour que ce soit acceptable?	1	2	3	4	5
8. Laissez-vous quelqu'un d'autre régler un problème quand vous auriez pu le faire vous-même?	1	2	3	4	5

Appendix J: Attitude Towards Technology Survey

INSTRUCTIONS

Answer each of the following 7 questions by circling the number of the answer you want to give.

To what extent does advanced technology (for example, computers and other machines that automate work) mean:

	1	2	3	4	5
	To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent
1. Greater efficiency?				1 2 3 4 5	
2. Better quality?				1 2 3 4 5	
3. Prevention of hospital closure?				1 2 3 4 5	
4. Less control?				1 2 3 4 5	
5. More boring work?				1 2 3 4 5	
6. Job losses?				1 2 3 4 5	
7. More stress?				1 2 3 4 5	

Attitude Towards Technology Survey (French Translation)

INSTRUCTIONS

Répondez à chacune des 7 questions suivantes en encerclant le chiffre correspondant à la réponse que vous voulez donner.

Dans quelle mesure une technologie avancée (par exemple, des ordinateurs et d'autres machines permettant l'automatisation du travail) signifie-t-elle :

	1	2	3	4	5
	Dans une très faible mesure	Dans une faible mesure	Dans une certaine mesure	Dans une grande mesure	Dans une très grande mesure
1. Une plus grande efficacité?	1	2	3	4	5
2. Une meilleure qualité?	1	2	3	4	5
3. La poursuite des activités de l'hôpital?	1	2	3	4	5
4. Moins de contrôle?	1	2	3	4	5
5. Un travail plus ennuyeux?	1	2	3	4	5
6. Des pertes d'emploi?	1	2	3	4	5
7. Une plus grande tension au travail?	1	2	3	4	5

Appendix K

Percentage of Hospital Staff Who Commented on the Listed Categories During the
Pre-Implementation Interview

	Pharmacy (N = 9)	Nursing Unit 1 (N = 9)	Unit 2 (N = 13)
Goals and Values			
Yes, the hospital has a philosophy and goals	90	100	85
The philosophy/goal is			
to maintain the best care possible	70	67	54
an emphasis on efficiency/modernization	20	11	31
The philosophy/goals are communicated to workers	100	100	92
Through meetings	20	22	31
Through memos	40	56	39
Through policy and procedure books	20	44	31
Verbally	10	33	31
Yes, their department/unit has a philosophy and goals	90	78	92
The philosophy/goal is			
to maintain the best care possible	60	67	62
to meet the standards of efficiency equal to those			
of an assigned comparable hospital	30	---	---
The philosophy/goals are communicated to workers	80	89	85
Through meetings	40	44	8
Through memos	40	44	23
Through policy and procedure books	20	22	38
Verbally	10	33	31
Communication			
The flow of communication in your hospital is:			
Poor or not very good	50	56	69
Fair	30	11	23
Good	10	27	8
Communication from a senior level could be improved	40	56	69
The flow of communication in their dept/unit is:			
Poor or not very good	10	0	15
Fair	10	11	15
Good to excellent	70	67	54

		Nursing	
	Pharmacy	Unit 1	Unit 2
Worker-Management Relations			
Relations between workers and hospital management are:			
Poor or not very good	50	44	54
Fair	20	33	31
Good	10	11	0
Relations between workers and management in their department is:			
Poor or not very good	50	0	0
Fair	0	0	23
Good	30	78	69
Excellent	0	22	0
Supervisory Practices			
The ideal supervisor is:			
Supportive/considerate	80	89	85
Sets structure	20	22	23
Promotes the department to others outside the department	--	11	23
Competent/knowledgeable	10	11	23
The ideal worker is:			
Pleasant/cheerful/open	--	56	77
Competent/knowledgeable	20	22	38
Is adaptive	20	22	38
Problem-solving			
Problems with their supervisor:			
Problem with distribution of assignments/opportunities	10	33	31
Supervisor has difficulties listening to new ideas	40	22	0
Personality issues (too abrupt)	30	0	0
Problems get resolved by:			
Discussion between individuals	20	78	54
At meetings	30	11	23
Supervisor gets to solve it	10	11	31

	Pharmacy	Nursing Unit 1	Unit 2
Work environment			
The most desirable aspect of their work is:			
Patient contact	0	89	77
Work interest/challenges	70	11	0
Contact with colleagues	20	22	54
The least desirable aspect of their work is:			
Workload issues	30	56	15
Lack of appreciation and respect	10	11	31
Job does not match skills/interest/aspirations	20	22	23
Aspects of their job that has helped them do their best work:			
People-related (i.e.helpful colleagues)	40	23	46
Function/technology related (i.e. unidose/CIVA)	40	0	31
Aspects of their job that prevents them doing their best work:			
Increased workload	10	11	38
Working in a stressful department	40	11	15
Problems with their supervisor	20	0	0
Problems with colleagues	20	11	15
They feel that their work is valued by their supervisor			
Yes	50	67	62
No	10	0	31
Unsure	20	33	8
They feel that their work is valued by their hospital			
Yes	50	44	0
No	10	0	77
Unsure	20	56	23
They feel that their work is valued by their department			
Yes	60	67	69
No	10	11	8
Unsure	20	11	8

	Nursing		
	Pharmacy	Unit 1	Unit 2
Opinions on Planned Changes			
Change described:			
Amalgamation of departments	0	0	54
Budget cuts	0	0	31
Loss of jobs	0	44	23
Implementation of unidose system	90	56	0
CIVA	20	0	0
There will be more computers	0	11	15
There will more casual staff	0	22	8
These changes are being introduced to:			
Improve patient care - 'yes'	70	33	8
- 'no'	20	56	62
To decrease the number of staff - 'yes'	30	33	85
- 'no'	60	56	15
To save money - 'yes'	50	67	85
- 'no'	30	22	0
To provide a more interesting work environment 'yes'	30	22	15
'no'	10	89	77
Who will benefit from the changes in your department?			
The administration	10	22	77
Nurses	20	0	8
Pharmacy department staff	30	11	0
Patients	50	33	15
Changes will affect how they do their work	80	89	100
These changes will affect their department by:			
Diminishing healthcare	--	11	54
Re-organizing the way in which work is done	40	22	--
Increasing stress	40	--	8
Changes planned for other departments			
Nursing re-structuring/head nurses and personnel losing their positions	40	--	--
I.V. solution preparation will increase in scale	--	0	8
Unidose system will be implemented in pharmacy	--	11	23

Nursing
Pharmacy Unit 1 Unit 2

Training

The training received regarding the planned changes

Is expected to be enough - 'yes'	30	44	0
- 'no'	40	56	92

Technical Experience

A computer is used at work	90	100	85
For getting patient information to/from other departments	10	100	85
For inputing prescriptions	70	0	0
For work-processing	20	0	0
A computer is used at home	80	44	23

Reward System

Feel their position is given adequate recognition

In terms of money - 'yes'	30	100	54
- 'no'	40	0	31
In terms of status - 'yes'	40	67	46
- 'no'	40	22	39

How this compares to those in other departments

With respect to salary - 'worse'	10	33	8
- 'same'	40	33	54
- 'better'	20	11	8
With respect to status - 'worse'	10	22	23
- 'same'	20	22	31
- 'better'	40	11	15

Appendix L
Percentage of Pharmacy Staff (N = 7) Who Commented on the Listed Categories
During the Post-Implementation Interview

	Unidose	CIVA
Changes that have occurred over the last six months	71	57
More work/frustration/difficulties adapting to the new system	100	0
How staff was informed about the new system/program		
Meetings	71	71
Why the system/program was initiated		
To save money	100	86
To save time	86	14
To improve patient care	86	86
It has improved patient care	43	86
Unsure whether it has saved money	57	57
Has not saved time	71	---
Has provided a more interesting work environment for employees	57	71
No reduction in staff	86	---
Who has benefited from the new system/program?		
Nurses	100	100
Patients	57	57
Pharmacy personnel	29	29
The system/program has not affected jobs in the department	57	71
The system/program has not had any effect upon relations between		
Workers and their supervisor	83	86
Co-workers	100	57
Has had a negative impact on relations with co-workers	43	0
New system/program has resulted in:		
Fewer dispensing errors	43	100
Fewer medication errors on nursing units	43	100
Regarding relations between the nursing units and the pharmacy dept:		
Has had a positive impact	0	43
Has had no impact	14	0
Has had a negative impact	57	14

Categories	%
Communication	
Relations between the nursing unit and pharmacy department are:	
Good	50
Bad	50
These relations have worsened over the last six months	43
These relations have improved over the last six months	29
There has been no change in relations over the last six months	14
Worker-Management Relations	
Relations between workers and hospital management:	
There are very few relations between the hospital management and employees	43
Many frustrations exist	14
Conflicting opinions exist on decisions at the hospital	14
They are poor and have not changed over the last six months	14
Relations have deteriorated over the last six months	14
There has been no change in this relations over the last six months	86
Relations between workers and management in their department:	
We work well together but there are existing frustrations	29
Employees do not follow the manager's plan anymore	29
There is pressure to be productive	14
Relations have deteriorated over the last six months	14
There has been no change in relations over the last six months	57

Categories	<u>%</u>
Supervisory Practices	
During the implementation and training on the new dispensing system:	
Supervisor does not take into account the knowledge base/abilities of employees and pushes them too hard	100
Supervisor was excited and tried to be positive	50
Refused to listen to negative comments	17
Involved employees in planning stages - 'Yes'	33
- 'No'	67
Ideas for how their supervisor could have done a better job of helping them through the change period:	
Allowed for more employee input and adjustment	83
Had the dispensing machine company train all the employees	50
Develop a better work routine	17
Supervisor competence rated as - 'Very competent'	67
Employees feel they can discuss work-related problems with their supervisor	
'Yes'	50
'No'	50
Employees feel they can discuss personal problems with their supervisor	
'Yes'	17
'No'	83
Work Environment	
Enjoyment of work environment compared to six month's previously	
Enjoy it less	43
Enjoy it the same amount	29
Enjoy it more	29
Productivity compared to the previous six months	
More productive	17
No change in productivity	83
Less productive	17

Appendix M

Percentage of Nurses Who Commented on the Listed Categories During the Post-Implementation Interview

	Unit 1 (N = 8)	Unit 2 (N = 19)
Comments Regarding Changes Over the Past Six Months		
Amalgamation of surgical units	38	74
Bumping of nurses	75	47
Difficulties with adapting to the changes	25	32
New chief-of-services	38	16
Increase in workload	63	42
Increase in stress	25	26
Have less time for patients	50	47
Decrease in quality of patient care	0	63
Introduction of the unidose system	0	21
Opinions on the Unidose System		
Like it	88	68
Fewer medication errors	75	56
Same number of medication errors	25	16
Improved effectiveness as a nurse	38	68
Same effectiveness as a nurse	62	26
Diminished effectiveness as a nurse	0	1
Any problems encountered?		
Yes	100	67
Medications take too long to reach the floor	63	22
Sometimes there are missing medications in the packets	50	32

	Unit 1	Unit 2
Opinions on the CIVA Program		
Good opinion	88	89
Takes less time to administer intravenous medications	100	84
Has benefited nurses	75	84
Has benefited patients	50	47
Improved effectiveness as a nurse	75	74
Fewer medication errors	38	63
Same number of medication errors	50	16
No problems encountered with CIVA	75	68
Communication		
Relations between the nursing unit and pharmacy department		
Good	50	84
Bad	50	5
These relations have worsened over the last six months	0	21
These relations have improved over the last six months	13	16
There has been no change in relations over the last six months	63	42
Unidose has had a negative impact on these relations	25	0
Unidose has had a positive impact on these relations	13	21
Unidose has had no effect on these relations	50	47
CIVA program has had a negative impact on these relations	0	0
CIVA program has had a positive impact on these relations	13	26
CIVA program has had no impact on these relations	75	53

Appendix N

Usability Assessment Package Given to Usability Experts

Instructions for the Usability Experts

Your heuristic evaluation package includes:

1. These instructions
2. An introduction (*not included in this appendix*)
3. Pictures of the two new pharmacy computers and the new oral solids dispensing machine (*not included*)
4. A page describing: the system document
the user's task goal
the input, process, and output
the hardware and software
the users
5. A flowchart of pharmacy dispensing operations
6. A combination Cheat Sheet and Glossary for quick reference
7. A letter from the Pharmacy Director with consent from the hospital to perform the evaluation (*not included*)
8. A consent form for you to sign and return (*not included*)
9. A usability expert information sheet for you to fill-in and return (*not included*)
10. The system document to be returned unmarked except for attached post-it notes
11. System 2 help manual examples to be evaluated and returned (*not included*)
12. Erik Nielsen's chapter on how to perform a heuristic evaluation (*not included*)
13. The usability assessment worksheets to be used and returned (*not included*)
14. The usability evaluation to be completed and returned
15. A debriefing sheet for you to read following the completion of your evaluation (*not included*)

Proceed with your evaluation of the new pharmacy dispensing system as follows:

Read through the introduction, look at the pictures, read the page describing the system and users, and look at the flowchart. Read the highlighted sections in Nielsen's chapter. You

may read the whole chapter if you wish but this is optional. Read through the system document, the usability assessment worksheets, and the usability evaluation form to give yourself an idea of what you are being asked to do. Section A of the usability worksheets and of the usability evaluation form relates to the System 1 software and Section B relates to the System 2 software. Section C of the usability evaluation form asks you to perform additional ratings on the two systems - you are asked to rate how easy or difficult you think it would be to learn the processes involved in dispensing drugs with the new system and also how easy you think the software would be to run once the process has been learned. The worksheets are mainly to help you keep track of things for yourself but these will also be used to gain an understanding of the ratings you give to each system. For the two user-interfaces involved in running the new automated drug dispensing machine, you are asked to provide a rating on a 5-point scale on:

Visibility of the system status

The match between the system and the real world

User control and freedom

Consistency and standards

Error prevention

How well the system helps users recognize, diagnose, and recover from errors

Whether the system relies more on users' recognition or recall

Flexibility and efficiency of use

Design (aesthetic/minimalist)

Quality of help available to the user (for System 2 only)

For each system, you are asked to describe its best feature and its worst problem. You are also asked to list the problems that you think should be addressed with this system and any

ideas you may have to go about resolving them. Please do not worry about making your assessment without having the opportunity to conduct user tests. Your opinions will only be used to provide a rating of the usability of the system for this thesis as one of the factors that has been identified as having an impact on the introduction of new technology in organizations. Your assessment will not be used to do a re-design of the systems software, although it might give the pharmacy manager some ideas of changes to ask for. Fill-in the form requesting information about yourself except for the questions asking you how you did the evaluation, how long it took you to do it, and any problems you had with doing it - fill these parts in once you're finished. This means that you need to keep track of your time and method. Timing yourself accurately to the minute is not required but accuracy to within a half hour would be appreciated. Although Nielsen claims that a heuristic evaluation can be done in 2 hours, I suspect that it will take closer to 3 to 6 hours, depending on how detailed you get.

Proceed with writing notes for yourself in the spaces provided on the worksheets. If it would help to be able to shuffle the pages easily, you might want to take out the staple keeping the worksheets together. The same may be true of the evaluation sheets and the pharmacy document. The pages are numbered so that you don't have to worry about losing track of their order. You may proceed with your work in whatever manner you think will lead to the most accurate assessment based on your experience in the least amount of time. Provide as much useful information as you can. Please write legibly when you are making notes on the worksheets as I would like to be able to read them even though the main purpose of providing the spaces is to provide a space for you to keep notes for yourself in order to help you decide on the ratings in each category. Write on the backs of the sheets if you do not have enough room in the spaces provided, making sure that you label which page(s) in the system document you are referring to. Circle the ratings on the

evaluation form in whatever order you like but please make certain that you have provided a rating for every question. If you are unable to provide a rating, please state why.

A package of post-it notes is provided if you wish to make notes for yourself. Leave the post-it notes on the document when you return it. Once you have completed your usability assessment, read the debriefing sheet and return the materials to me.

Your efforts are greatly appreciated!

Usability Assessment of the New Oral Solids Dispensing System

Purpose of this document: To provide usability experts with screen pictures and a description of how pharmacy staff navigate through the screens in order to dispense drugs with the new dispensing system

Task goal: Fill the medication carts to go to the nursing units with unit dose drugs using the new automated drug dispensing system

Input: Doctors' medication (drug) orders for their patients

Process: Dispensing of medications

Output: Unit dose tablets for each patient for whom there are drug orders for the next 24 hours

Hardware/Software: There are three computer applications involved in the dispensing of unit dose tablets with the new technology:

- 1) The pharmacy management software on the hospital mainframe computer. This is the existing DOS-based software used to enter drug orders. You will not be asked to evaluate the usability of this system because it is not 'new' to the pharmacy staff.
- 2) The ATC-212 DOS-based (System 2) software is the software that controls the ATC-212 oral solids dispensing machine. You will be asked to evaluate the usability of this software.
- 3) The System 1 Windows-based software that translates the drug file from the mainframe into a format that can be used by the ATC computer. You will be asked to evaluate the usability of this software.

The Users: Pharmacists and pharmacy technicians whose main computer experience is with the hospital DOS-based mainframe pharmacy management software but who are familiar with the Windows environment and are comfortable using a mouse as well as a keyboard. Other than one of the pharmacy technicians who was sent on a 2-day training course and who runs the system frequently and could therefore be classified as a power user, none of the users can either be classified as 'novice' or 'power' users. All users could be classified as experienced but they are experienced in a very limited way; they follow the procedure they are used to and they do not deviate from this procedure unless they are directed to do so by the pharmacy manager or by the power user. Novices would not be allowed to run the system without supervision.

Training: Two of the pharmacy technicians were sent on a 2-day training session held by the manufacturer of the ATC machine. This course covered the ATC system functioning and maintenance. One of these technicians is an infrequent user as she is in charge of drug inventory. The day the new dispensing system was installed, the developer of the System 1 software and representatives from the ATC company were in the pharmacy department to demonstrate how to operate the new systems. Since then, any training on the two systems has been done on an informal basis. If a pharmacist or a pharmacy technician are having trouble running either of the systems, they would likely first ask the power user or the pharmacy manager for help, consult the ATC manual if it was an ATC system problem, or call the appropriate system technical support line.

Flowchart of Pharmacy Dispensing Operations

Glossary

System 2 ATC: ATC stands for Automatic Tablet Counter. The large drug dispensing machine's is called the ATC-212 Oral Solids Dispensing Machine but it is commonly referred to as the ATC machine. The 212 refers to the fact that the machine holds 212 canisters in order to dispense 212 different drugs in either tablet or capsule form. The computer and the software that run this machine are commonly referred to as the System 2 computer and the System 2 software.

System 1: The software that translates drug order information from the hospital mainframe into a format that can be used by the System 2 computer.

Error File: A file where the machine errors are logged so that pharmacy staff can make sure that all the unit dose drugs for the patient whose orders were being filled when the dispensing machine alarmed can be accounted for. The error file is also referred to as the exception log by the System 2 computer. (Pgs. 14 - 18).

File Transfer Orders: These are the drug orders for all the patients in the hospital which are filled by the System 2 machine. The drug file is transferred from the mainframe to the System 2 computer via the System 1 computer. (Pgs. 1 - 12).

Pharmacy bins: These are plastic containers that contain unit doses of common drugs to be used for initial or interim doses. They can either be packaged using the Pre-Pack option in the System 2 software or by using the older, manual unit dose dispensing machine in the pharmacy department.

Pre-Pack: Pre-packs are unit doses used to replenish the pharmacy bins with unit dose drugs for initial or interim doses to be used until the next daily run of file-transfer orders. (Pgs. 18 - 22).

PRN: 'As needed'.

Unit Dose: One unit dose is one tablet or capsule for one patient in a shrink-wrapped packet. The picture of the dispensing machine shows that day's batch of unit dose drugs for all the patients in the hospital. Each unit dose packet contains the drug name and dosage and at the end of the section of unit dose drugs for each patient, an empty packet will contain that patient's name, room number and hospital number so that the pharmacy staff can tear off each patient's unit dose drugs for the next 24 hours, roll them up and put them in that patient's drug drawer to be sent to the nursing unit. This pharmacy does not use the option to have the patient's name on each packet so that unused unit dose drugs can be recycled.

Usability Assessment : Description of the Heuristics

Here are the heuristics to use to evaluate:

- A) The System 1 Software Interface
- B) The System 2 Software Interface

According to Nielsen (1994), p. 30:

Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world: The system should speak the users' language, with words, phrases, and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom: Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

Consistency and standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place.

Recognition rather than recall: Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Flexibility and efficiency of use: Accelerators - unseen by the novice user - may often speed up the interaction for the expert user to such an extent that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

<i>Help users recognize, diagnose, and recover from errors:</i>	Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
---	---

Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Heuristic Evaluation of the New Pharmacy Dispensing System

Part A: System 1 Software Interface: Pages 1-4, 13, 23-26:

Visibility of system status:

1. The system does a(n)

Bad	Poor	Reasonable	Good	Excellent
1	2	3	4	5

job of keeping users informed about what is going on.

Match between system and the real world:

2. Information is presented in a logical order.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

3. The system uses language which is easily understood.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

User control and freedom:

4. There is an obvious way to undo actions.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Strongly Agree	Agree
1	2	3	4	5

5. How to exit the system is clearly displayed.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Consistency and standards:

6. The system maintains interface consistency.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

7. The system accurately follows platform conventions.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Error prevention:

8. The interface is designed in a way that encourages error prevention.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Helping users recognize, diagnose, and recover from errors:

9. The system allows users to easily correct mistakes.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

10. Error messages are expressed in plain language.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

11. Error messages precisely indicate the problem.

Never	Seldom	Occasionally	Often	Always
1	2	3	4	5

12. The error messages constructively suggest a solution.

Never	Seldom	Occasionally	Often	Always
1	2	3	4	5

Recognition rather than recall:

13. Does the system make more use of users' recognition or recall?

Recall				Recognition
1	2	3	4	5

Flexibility and efficiency of use:

14. The system provides shortcuts for experienced users.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

15. How efficient are the steps involved in carrying out the work?

Very Inefficient	Inefficient	Neutral	Somewhat Efficient	Very Efficient
1	2	3	4	5

16. The interface strikes the right balance between presenting enough information without presenting too much.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Part B: System 2 Software Interface (Pgs. 5-12, 14-18, 19-22, 27-30)

Visibility of system status:

1. The system does a(n)

Bad	Poor	Reasonable	Good	Excellent
1	2	3	4	5

job of keeping users informed about what is going on.

Match between system and the real world:

2. Information is presented in a logical order.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

3. The system uses language which is easily understood.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

User control and freedom:

4. There is an obvious way to undo actions.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

5. How to exit the system is clearly displayed.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Consistency and standards:

6. The system maintains interface consistency.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

7. The system accurately follows platform conventions.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Error prevention:

8. The interface is designed in a way that encourages error prevention.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Helping users recognize, diagnose, and recover from errors:

9. The system allows users to easily correct mistakes.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

10. Error messages are expressed in plain language.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

11. Error messages precisely indicate the problem.

Never	Seldom	Occasionally	Often	Always
1	2	3	4	5

12. The error messages constructively suggest a solution.

Never	Seldom	Occasionally	Often	Always
1	2	3	4	5

Recognition rather than recall:

13. Does the system make more use of users' recognition or recall?

Recall				Recognition
1	2	3	4	5

Flexibility and efficiency of use:

14. The system provides shortcuts for experienced users.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

15. How efficient are the steps involved in carrying out the work?

Very Inefficient	Inefficient	Neutral	Somewhat Efficient	Very Efficient
1	2	3	4	5

Aesthetic and minimalist design:

16. The interface strikes the right balance between presenting enough information without presenting too much.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Help:

17. The help available to the user is well done.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Part C: Ease of Learning Versus Ease of Procedure Once it's Learned:

1. Taking the daily processing of file transfer orders only into account (pgs. 1 - 12), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

2. Once a pharmacy worker has learned the process, how easy would you rate the process of running the file transfer procedure (pgs. 1 - 12)?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

3. Taking the daily System 1 process 'Resetting database' function only into account (pg. 13), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

4. Once a pharmacy worker has learned the process, how easy would you rate the System 1 process of resetting the database (pg. 13)?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

5. Taking the daily System 2 process of 'Error File printing and purging' only into account (pgs. 14 - 18), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

6. Once a pharmacy worker has learned the System 2 Error File printing and purging process, how easy would you rate this process (pgs. 14 - 18)?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

7. Taking the daily System 2 process 'Filling of Pre-Packs' only into account (pgs. 19-22), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

8. Once a pharmacy worker has learned the System 2 process of filling Pre-Packs, how easy would you rate this process (pgs. 19 - 22)?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

9. Taking the System 1 drug file maintenance process only into account (pgs. 23 - 26), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

10. Once a pharmacy worker has learned the process, how easy would you rate the System 1 file maintenance process (pgs. 23 - 26)?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

11. Taking the System 2 file maintenance process only into account (pgs. 27 - 30), how easy do you think it would be for new staff to learn this process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

12. Once a pharmacy worker has learned the process, how easy would you rate the System 2 file maintenance process?

Very Difficult	Difficult	Neutral	Easy	Very Easy
1	2	3	4	5

System 1 Computer, Screen 1

This computer runs software designed to connect the System 2 computer with hospital mainframes that run software incompatible with the System 2 computer. The System 2 computer controls the System 2 machine.

Click on 'System 1' to get to the next screen. It is also possible to get to the next screen by activating the 'Interface' option in the 'Run' pulldown menu (pg. 13); however, pharmacy staff never go to the next screen this way, they always go to the next screen by clicking on the large 'System 1' button.

This application can be exited as any other Windows application. However, this application is never exited by the pharmacy staff as this computer is not used by them for any application other than the System 1 software.

System 1, Screen 2

Click on 'Capture Fill List'

The Fill List is the list of patients and their medication orders to be filled for the next 24-hour period captured from the pharmacy software on the hospital mainframe.

System 1, Screen 3

This is the screen that pops up when you click on 'Capture Fill List'. The System 1 program accesses the drug orders entered into the mainframe using an emulation program called 'Reflection' which you can see in the background.

After the red bar reaches the end, the screen reverts to the previous System 1 screen.

System 1, Screen 4

After clicking on 'Process Fill List', each patient's name, location, the drug(s) to be dispensed for that patient, and the number of tablets of that drug for each patient to be dispensed for the next 24 hours flip across the screen.

The Non-System 2 Fill List is the list of unit-dose medications that:

1) cannot be filled by the System 2 machine such as nitroglycerine skin patches or sublingual tablets that are so small that the System 2 canisters cannot be calibrated accurately for them and

2) are in the System 1 drug file but are currently inactive (see pg. 24).

The Non-System 2 Fill List is printed automatically. These drugs will then be dispensed manually.

'Send Initial Doses' is not used because the code for it has not yet been written.

'PRN Orders' is not used because the code for it has not yet been written.

'Charges' are used by the pharmacy manager only to track drug inventory costs.

Click on 'Exit' to return to Screen 1.

After this process is completed (within about 5 minutes), the next step is to go to the System 2 machine.

System 2 Computer, Security Password Input Screen

Type in your password (can be composed of any combination of 4 letters or numbers). As you are typing, XXXX appears in the green box and when you type in the last letter or number, the screen automatically flips into the Main Menu on the next page. If your password was entered into the security file with Caps Locked, then your password must be entered here with Caps Locked. Passwords entered in the security file with Caps unlocked must have passwords entered in the password screen with Caps unlocked.

Of the 4 levels of user clearance allowed, 2 levels are used in this pharmacy department. There are three Level 4 users (the pharmacy manager and the two pharmacy technicians who attended the 2-day training session). The rest of the pharmacy staff are Level 3 users. Level 4 users have access to all screens. Level 3 users have access to all screens except for the Main Menu F9 function 'Password Maintenance'.

		Main Menu		96/04/30 15.00.37				
S. SMITH								
F1 Password Screen F2 Patient Order Entry F3 Reports Menu F4 System Functions Menu F5 Filling Menu F6 Drug File Maintenance F7 Sig Code File Maintenance F8 System & Packet Format Setting F9 Password Maintenance								
F1:	F2:	F3:	F4:	F5:	F6:	F7:	F8:	F9:
S2 Active								

System 2, Main Menu

F1 'Password Screen' returns you to the password screen.

F2 'Patient Order Entry'

This function is used in hospitals where medication orders are entered directly into the System 2 computer (i.e. the System 2 computer does not receive these orders from the hospital mainframe or from an intermediary computer like the System 1 computer). *This function is not used at this hospital.*

F3 'Report Menu' (pg. 15)

Not used at this hospital.

F4 'System Functions Menu' (pg. 16)

Used to display the Exception Log (i.e. Error File) if you wish to look at it without printing it. Gives various reports on system functioning and medication orders.

F5 'Filling Menu'

This function puts you into the Filling Menu screen where you can choose between types of orders to be filled. Used daily for File Transfer Orders (pg. 8-12) and for filling of Pre-Packs (pg 18-22).

		96/04/30 15.00.37	
		Main Menu	
S. SMITH			
F1 Password Screen F2 Patient Order Entry F3 Report Menu F4 System Function Menu F5 Filling Menu F6 Drug File Maintenance F7 Sig Code File Maintenance F8 System & Packet Format Setting F9 Password Maintenance			
F1:	F2:	F3:	F4:
F5:	F6:	F7:	F8:
F9:			
S2 Active			

System 2, Main Menu (Continued)

F6 'Drug File Maintenance' (pg. 27-30)

The file where various parameters of the drug file can be changed or updated. Infrequently accessed. The drug file is a list of medications in the System 2 machine canisters.

F7 'Sig Code File Maintenance'

Not used at this hospital. Sig Codes are codes given to the computer to represent the drug administration frequency ordered by the physician. For instance, b.i.d. means twice a day and t.i.d. means three times a day. This information has already been set up in the pharmacy mainframe system.

F8 'System and Packet Format Setting'

Used initially in setting up the system and packet formats.

F9 'Password Maintenance'

For assigning and maintaining passwords. Has already been set up. Would only be accessed by a Level 4 user if a new employee has been hired to add them to the list or, in the case of employees leaving, to remove them from the list.

		96/04/30 15.04.59	
Filling Menu			
S. SMITH			
F1	FILL STAND ALONE S2 Order		
F2	FILL ON LINE Order		
F3	FILL FILE TRANSFER Order		
F4	FILL PRE PACK Order		
[]		Return to Main Menu	
F1:	F2:	F3:	F4:
S2 Active			

System 2, Filling Menu

You get here from pressing F5 in the Main Menu.

F1 'Fill STAND ALONE System 2 Orders' not used at this hospital. Used if you are typing drug orders directly into this computer or transferring orders from a floppy disk.

F2 'Fill ON-LINE Orders' not used at this hospital. Used if the System 2 software interfaces directly with the pharmacy management software (i.e. where the drug orders are entered). In the case of this hospital, the System 1 software is needed to translate the drug order information from the hospital mainframe into a format that can be used by the System 2 computer.

Can choose F3 'Fill FILE TRANSFER Orders' to fill the orders entered into the hospital mainframe and translated by the System 1 computer, or F4 to 'Fill PRE-PACK Orders'. Pre-Packs are used for initial doses or other (interim) orders that do not make the usual daily filling. Pre-Packs are usually done once or twice a day.

After Pressing F3, the System 2 computer automatically starts running the System 2 machine.

96/04/30 15.04.59

Filling Menu

S. SMITH

Records to Process	: 119
Processing Record	: 33

Patient Name	: SMITH, JOSEPH
Patient ID	: 10-31-02
Patient Location	: N22654-3

Drug Monomer	: 1908401
Dosage	: 81
SGT Code	: NOT USED

F1: F2: F3: F4:

S2 Active

System 2, Filling Menu: F3 'File Transfer Orders'

This screen pops up after pressing F3 in the 'Filling Menu' (previous page).

The batch file transferred from the System 1 computer to the System 2 computer's hard-drive is located by the System 2 program and is converted into a form that can be understood by the System 2's dispensing machine. The '**Records to Process**' continually change until the number of records left to process is zero.

'**Processing Record**' tells you which record the computer is currently processing.

Once the file has been converted, the machine controlled by this computer starts dispensing drugs. The processing screen disappears after about a minute, revealing the Filling Menu. In the bottom right-hand corner of the Filling Menu, the message '**Orders Remaining: #**' appears. The # starts with the number of drug orders to be filled and is complete when the # is zero.

The mechanical dispensing of the orders usually takes about one hour. It is possible to perform other functions inside the System 2 application while the System 2 machine is dispensing the drugs.

96/04/30 15.04.59

Filling Menu

S. SMITH

Records to Process	: 119
Processing Record	: 33

Patient Name	: SMITH, JOSEPH
Patient ID	: 10-39-87
Patient Location	: H22054-3

Drug Mnemonic	: T90840T
Dosage	: R1
SGT Code	: NOT USED

F1: F2: F3: F4:

S2 Active

System 2, Filling Menu: F3 'File Transfer Orders' (Continued): Alarms

If there is an alarm state, an auditory alarm sounds and a message pops up on this screen at the bottom where it usually says 'System 2 Active' when there is no problem. An alarm state would occur if there is an interruption in the dispensing process for any reason, such as an empty canister or a cut or jammed printing ribbon. Alarm states occur once or many times during the filling process.

If there is a canister alarm for whatever reason (i.e. it is empty or broken), the following message will appear in the Filling Menu (pg. 8):
'[Alarm] ... F9: Start F10: Cancel F8: Refill'. If there was simply a tablet stuck preventing the canister from dispensing the drug and this is cleared, you can press F9 to continue the filling process. If the problem is more serious or you do not have a new supply of that drug to put in the canister and you need to cancel that drug until the problem is fixed, you can press F10 which will cancel this drug. The message line: **'Verify Record Deletion (Y/N)'** pops up. Once 'Y' is pressed, the filling process will then be continued and whenever the System 2 machine is asked to dispense the cancelled drug, the system will log a 'DNF' message in the Error File without alarming. 'DNF' stands for 'Drug Not Found'.

96/04/30 15.04.59

Filling Menu

S. SMITH

Records to Process	119
Processing Record	33
Patient Name	SMITH, JOSEPH
Patient ID	10-39-07
Patient Location	H22X54-3
Drug Monomer	ES08401
Dosage	01
SN Code	NOT USED

F1: F2: F3: F4:

S2 Active

System 2, Filling Menu: F3 'File Transfer Orders'(Continued): Refilling a Canister

If the canister is empty but you have more of that drug in stock to put in the canister, you can fill the canister and then press F8.

On the bottom left-hand corner of the menu, the lot number of that drug will be displayed. (A lot number is a number that the drug manufacturer assigns to that batch of drugs so that problems can be traced and recalls made if need be). You have the option of entering a new lot number if the lot number has changed, or of pressing carriage return to accept the current lot number. The following message line then pops up to replace the lot number: **'Verify # for Lot (Y/N)'**.

If the number is not correct, the program will allow you to key in a new number. If you press 'Y', a new message line appears: **'Exp. Date: 0699'** (for instance). You are similarly asked to verify the Exp. Date.

After making your choice of accepting this expiry date by pressing 'Y', or editing it, you are prompted to enter **'Qty'**. After entering the quantity and pressing carriage return, you are also asked to verify the quantity. Dispensing is then resumed.

System 2, Filling Menu, F3 has been pressed but file not found

This message will pop up if, in the course of running the daily filling on the System 2 computer (pgs. 5 to 8), the drug file has not been properly transferred from the System 1 computer or if, for some other reason, the System 2 program cannot find the transferred file on the hard drive. This happens occasionally.

Press carriage return to remove the pop-up message but stay in the Filling Menu. Press Escape to return to the Main Menu.

System 1. Run Menu

Interface

Gives you the next screen to capture and process the fill list. This menu function is never chosen by pharmacy staff who choose to get to the next screen by clicking on the 'System 1' button instead.

Reset Database

This is done once a day some time after that day's orders have been sent to the System 2 computer. Choosing this option compresses the database of that day's drug orders on this computer to be ready for the next day's drug orders. The 'processing' icon is displayed on the screen while the database is being cleared. Once the database has been reset, the message 'Reset Database completed successfully!' pops up on the screen and requires you to click on the 'OK' button that has popped up.

Exit gets you out of the System 1 program. As mentioned earlier, this is never done.

System 2 Computer, Master Menu: Printing the Exception Log

After the filling has been completed each day, the System Exception Report (also called the Error File) is printed and the drug orders for that day are purged in anticipation of the next day's drug orders.

In order to print the System Exception Report:

You have to exit the System 2 application by pressing Escape from the Password Screen (pg. 5) in which case the message '**Verify Exit to DOS? (Y/N)**' pops up on the left lower corner. If you press 'N', you are kept in the Password Screen. If you press 'Y', you are flipped into DOS. At the DOS prompt: C:\>System 2>, you type in Menu and the above Master Menu appears.

Press F6 'Print Reports'. This will get you into the report screen shown on the next page.

If instead of pressing F6, you press Escape, the following message pops up:
'Thank you for using the System 2 System. Press Any Key to Exit...'

System 2, Report Menu: Printing the Exception Log

Get here by pressing F6 in the Master Menu shown on the previous page.

From the Report Menu, press F4 to print the System Exception Report which starts printing right away. The message **'Press ESCAPE key to Abort Report'** lasts for a few seconds. If you press Escape, a message pops up saying **'Abort Report Printout (Y/N)'**.

The System Exception Report is printed once a day after the File Transfer filling has finished in order to check the Exception Report with the drug carts before they go up to the wards. For instance, if an alarm occurs during the filling of John Doe's Dilantin, this will show up on the Exception Report and one of the pharmacy staff will make sure that all dosages of John Doe's Dilantin are there. The Exception Reports are kept for one to two weeks. Once the Exception Report has been printed, the Exception Log is purged (see the following page for a description of this procedure). To get back into the System 2 application, press Escape to exit from this menu into the Master Menu, press Escape to exit from the Master Menu into DOS, choose the directory 'System 2', and type System 2. This puts you into the System 2 password screen (pg. 5).

You can view and purge but not print the Exception Log (i.e. System Exception Report) inside the System 2 application (next page). You can print but not purge this file from the Master Menu.

System 2, System Functions Menu: Purging the Exception Log

Get here by pressing F4 in the Main Menu (pg. 6).

F1 Press to display the Exception Log (gives you the Error File). See next page.

F2 Allows you to set the date (done once when setting up the system).

F3 Allows you to set the time (done twice a year in the spring and fall).

F4 Allows you to purge the verified orders. This option is never used since each day's drug orders (i.e. verified orders) are automatically purged once filling has been completed. An unusual circumstance would have to occur in order for you to have to manually purge the verified orders.

F5 Allows you to purge the security file. *So far not used at this hospital.*

F6 Allows you to set patient order refill. *Not used at this hospital.*

Filling Menu		96/04/30 15.04.59	
S. SMITH			
F1	FILL STAND ALONE order		
F2	FILL ON LINE order		
F3	FILL FILE TRANSFER order		
F4	FILL PRE PACK order		
[]	Return to Main Menu		
F1:	F2:	F3:	F4:
S2 Active			

System 2. To Fill a Pre-pack, Choose F4 in the Filling Menu

Pre-Packs are usually done once or twice a day. Pre-Packs are unit doses used to replenish the pharmacy bins with unit dose drugs for initial or interim doses to be used until the next daily run of file-transfer orders.

System 2, Pre-Pack Fill Menu

Reached after pressing F4 in the Filling Menu.

Computer asks for the Drug mnemonic of the pre-pack drug to be filled. Unless you know the drug mnemonic by heart and can type it in, press F1 for 'Mnemonic Help Screen'.

Ec

Exit by pressing the Escape button.

F2 'Take'

Save the entered data.

F4

Deletes entry.

```

Page 4 of 10
Mnemonic Help Screen
96/05/09 10.50.02
Record 46 of 138

Cao Mnemonic      Primary Name      Secondary Name
031 2040060-031  DIPHENHYDRAMINE CAPS 25 MG

Fc:      F2:      F5:      F7:      F8:      IB:      :      :      F9:

S2 Active

```

System 2, Mnemonic Help Screen

Reached by pressing F1 in the Pre-Pack Fill screen (pg. 19). This is the drug file. The drug to be pre-packed can be highlighted by using the arrow keys to go up and down and then pressing carriage return. On this screen, the drug **DIPHENHYDRAMINE CAPS 25 MG** is highlighted in white. If you press carriage return now, this is the drug that will be entered for a Pre-Pack by its Drug Mnemonic (pg. 22).

F2 'Take'

Chooses the highlighted drug and flips you back into the previous menu with the drug mnemonic (i.e. number) entered.

F5 'Go Pg'

Produces a prompt asking for the page number.

```

Page 4 of 10
Mnemonic Help Screen
96/05/89 10.50.02
Record 46 of 138

Can Mnemonic      Primary Name      Secondary Name
031 2040060-031  DIPHENHYDRAMINE CAPS 25 MG

Fc:  F2:  F3:  F4:  F5:  F6:  F7:  F8:  F9:

S2 Active

Ec:  F2:  F3:  F4:  F5:  F6:  F7:  F8:  F9:

```

System 2, Mnemonic Help Screen (Continued)

F7 'Find'

Can be used to find a drug by its name(s) or number(s). The field that you would like to search under has a grey background ('Mnemonic' in this screen). For each particular column, the following command will appear: **'Enter Search Key: _____'**. If you are in a number column, only a number will be accepted. If you are in a name column, only letters will be accepted. The length of the command box is appropriate to the length of the data to be entered. The most usual way to use the find command would be to tab the grey highlighted area to the 'Primary Name' column and search under the primary name for the drug by typing in enough letters to narrow your search.

F8 'Next'

Only works when you have pressed F7 to find a drug in the list and have entered the drug that you wish to find. After pressing F8, the next drug that matches your 'Find' entry is highlighted. For instance, if you press F7 and enter Flurazepam in the field that pops up, FLURAZEPAM CAPS 15 MG will be highlighted. If you then press F8, FLURAZEPAM CAPS 30 MG will be highlighted.

Pressing F9 'More' in the previous screen gives you a description of more functions. Pressing F9 in that screen will give you the listing of functions previously listed.

96/05/09 10.51.22

Pre-Pack Fill

Q

F1: Ec: F1: F2: F4: CR:

S2 Active

System 2, Pre-Pack Fill Screen

Once you have selected a drug from the Mnemonic Help Screen or you have typed in the mnemonic of the drug you wish to pre-pack and have pressed carriage return, the quantity field appears. Type in the quantity of the drug to be pre-packed.

Press 'carriage return' to start the process.

The program will then put you back in the Filling Menu.

System 1. Tables Menu

Gives you the drug file. The drug file lists the drugs in the System 2 machine canisters. This file is only accessed if you need to update the drug file. The most frequently performed editing function is changing which canisters are active, meaning those drugs in the drug file that currently activate canisters in the System 2 machine. A drug might be left inactive during the week if there is a stockpile of unit doses of that drug already. Some drugs are activated and then deactivated once a week. On Fridays, most drugs in the System 2 machine are activated in this program. This is done because there are only two pharmacy staff members working on the weekend and it is faster to have the System 2 machine fill all possible orders rather than using the stockpiled drugs since manual filling requires two people to check the filling of the drug order. Those drugs which have a large number of unit doses stockpiled are then deactivated in this program on Monday so that those drugs can be used up.

Reports Menu

There is nothing to pull down from this menu.

Help Menu

This gives you 'About...' to choose and choosing this option results in a screen popping up with a telephone number for the support person.

Hospital X - DRUG

Drug Code	Drug Description	Canister	ATC Code	Active
224001	ACEBUTOLOL 100 MG	001	224001001	☒
224002	ACEBUTOLOL 200 MG	001	224002001	☐
224003	ACEBUTOLOL 400 MG	001	224003001	☒
224004	ACEBUTOLOL 800 MG	001	224004001	☒
224005	ACEBUTOLOL 1600 MG	001	224005001	☐
224006	ACEBUTOLOL 3200 MG	001	224006001	☒
224007	ACEBUTOLOL 6400 MG	001	224007001	☒
224008	ACEBUTOLOL 12800 MG	001	224008001	☒
224009	ACEBUTOLOL 25600 MG	001	224009001	☒
224010	ACEBUTOLOL 51200 MG	001	224010001	☒
224011	ACEBUTOLOL 102400 MG	001	224011001	☒
224012	ACEBUTOLOL 204800 MG	001	224012001	☒
224013	ACEBUTOLOL 409600 MG	001	224013001	☒
224014	ACEBUTOLOL 819200 MG	001	224014001	☒
224015	ACEBUTOLOL 1638400 MG	001	224015001	☒
224016	ACEBUTOLOL 3276800 MG	001	224016001	☒
224017	ACEBUTOLOL 6553600 MG	001	224017001	☒
224018	ACEBUTOLOL 13107200 MG	001	224018001	☒
224019	ACEBUTOLOL 26214400 MG	001	224019001	☒
224020	ACEBUTOLOL 52428800 MG	001	224020001	☒
224021	ACEBUTOLOL 104857600 MG	001	224021001	☒
224022	ACEBUTOLOL 209715200 MG	001	224022001	☒
224023	ACEBUTOLOL 419430400 MG	001	224023001	☒
224024	ACEBUTOLOL 838860800 MG	001	224024001	☒
224025	ACEBUTOLOL 1677721600 MG	001	224025001	☒
224026	ACEBUTOLOL 3355443200 MG	001	224026001	☒
224027	ACEBUTOLOL 6710886400 MG	001	224027001	☒
224028	ACEBUTOLOL 13421772800 MG	001	224028001	☒
224029	ACEBUTOLOL 26843545600 MG	001	224029001	☒
224030	ACEBUTOLOL 53687091200 MG	001	224030001	☒
224031	ACEBUTOLOL 107374182400 MG	001	224031001	☒
224032	ACEBUTOLOL 214748364800 MG	001	224032001	☒
224033	ACEBUTOLOL 429496729600 MG	001	224033001	☒
224034	ACEBUTOLOL 858993459200 MG	001	224034001	☒
224035	ACEBUTOLOL 1717986918400 MG	001	224035001	☒
224036	ACEBUTOLOL 3435973836800 MG	001	224036001	☒
224037	ACEBUTOLOL 6871947673600 MG	001	224037001	☒
224038	ACEBUTOLOL 13743895347200 MG	001	224038001	☒
224039	ACEBUTOLOL 27487790694400 MG	001	224039001	☒
224040	ACEBUTOLOL 54975581388800 MG	001	224040001	☒
224041	ACEBUTOLOL 109951162777600 MG	001	224041001	☒
224042	ACEBUTOLOL 219902325555200 MG	001	224042001	☒
224043	ACEBUTOLOL 439804651110400 MG	001	224043001	☒
224044	ACEBUTOLOL 879609302220800 MG	001	224044001	☒
224045	ACEBUTOLOL 1759218604441600 MG	001	224045001	☒
224046	ACEBUTOLOL 3518437208883200 MG	001	224046001	☒
224047	ACEBUTOLOL 7036874417766400 MG	001	224047001	☒
224048	ACEBUTOLOL 14073748835532800 MG	001	224048001	☒
224049	ACEBUTOLOL 28147497671065600 MG	001	224049001	☒
224050	ACEBUTOLOL 56294995342131200 MG	001	224050001	☒
224051	ACEBUTOLOL 112589990684262400 MG	001	224051001	☒
224052	ACEBUTOLOL 225179981368524800 MG	001	224052001	☒
224053	ACEBUTOLOL 450359962737049600 MG	001	224053001	☒
224054	ACEBUTOLOL 900719925474099200 MG	001	224054001	☒
224055	ACEBUTOLOL 1801439850948198400 MG	001	224055001	☒
224056	ACEBUTOLOL 3602879701896396800 MG	001	224056001	☒
224057	ACEBUTOLOL 7205759403792793600 MG	001	224057001	☒
224058	ACEBUTOLOL 14411518807585587200 MG	001	224058001	☒
224059	ACEBUTOLOL 28823037615171174400 MG	001	224059001	☒
224060	ACEBUTOLOL 57646075230342348800 MG	001	224060001	☒
224061	ACEBUTOLOL 115292150460684697600 MG	001	224061001	☒
224062	ACEBUTOLOL 230584300921369395200 MG	001	224062001	☒
224063	ACEBUTOLOL 461168601842738790400 MG	001	224063001	☒
224064	ACEBUTOLOL 922337203685477580800 MG	001	224064001	☒
224065	ACEBUTOLOL 1844674067370955161600 MG	001	224065001	☒
224066	ACEBUTOLOL 3689348134741910323200 MG	001	224066001	☒
224067	ACEBUTOLOL 7378696269483820646400 MG	001	224067001	☒
224068	ACEBUTOLOL 14757392538967641292800 MG	001	224068001	☒
224069	ACEBUTOLOL 29514785077935282585600 MG	001	224069001	☒
224070	ACEBUTOLOL 59029570155870565171200 MG	001	224070001	☒
224071	ACEBUTOLOL 118059140311741130342400 MG	001	224071001	☒
224072	ACEBUTOLOL 236118280623482260684800 MG	001	224072001	☒
224073	ACEBUTOLOL 472236561246964521369600 MG	001	224073001	☒
224074	ACEBUTOLOL 944473122493929042739200 MG	001	224074001	☒
224075	ACEBUTOLOL 1888946244987858085478400 MG	001	224075001	☒
224076	ACEBUTOLOL 3777892489975716170956800 MG	001	224076001	☒
224077	ACEBUTOLOL 7555784979951432341913600 MG	001	224077001	☒
224078	ACEBUTOLOL 15111569959902864683827200 MG	001	224078001	☒
224079	ACEBUTOLOL 30223139919805729367654400 MG	001	224079001	☒
224080	ACEBUTOLOL 60446279839611458735308800 MG	001	224080001	☒
224081	ACEBUTOLOL 120892559679222917470617600 MG	001	224081001	☒
224082	ACEBUTOLOL 241785119358445834941235200 MG	001	224082001	☒
224083	ACEBUTOLOL 483570238716891669882470400 MG	001	224083001	☒
224084	ACEBUTOLOL 967140477433783339764940800 MG	001	224084001	☒
224085	ACEBUTOLOL 1934280954867566679529881600 MG	001	224085001	☒
224086	ACEBUTOLOL 3868561909735133359059763200 MG	001	224086001	☒
224087	ACEBUTOLOL 7737123819470266718119526400 MG	001	224087001	☒
224088	ACEBUTOLOL 15474247638940533436239052800 MG	001	224088001	☒
224089	ACEBUTOLOL 30948495277881066872478105600 MG	001	224089001	☒
224090	ACEBUTOLOL 61896990555762133744956211200 MG	001	224090001	☒
224091	ACEBUTOLOL 123793981111524267489912422400 MG	001	224091001	☒
224092	ACEBUTOLOL 247587962223048534979824844800 MG	001	224092001	☒
224093	ACEBUTOLOL 495175924446097069959649689600 MG	001	224093001	☒
224094	ACEBUTOLOL 990351848892194139919299379200 MG	001	224094001	☒
224095	ACEBUTOLOL 1980703697784388279838598758400 MG	001	224095001	☒
224096	ACEBUTOLOL 3961407395568776559677197516800 MG	001	224096001	☒
224097	ACEBUTOLOL 7922814791137553119354395033600 MG	001	224097001	☒
224098	ACEBUTOLOL 15845629582275106238708790067200 MG	001	224098001	☒
224099	ACEBUTOLOL 31691259164550212477417580134400 MG	001	224099001	☒
224100	ACEBUTOLOL 63382518329100424954835160268800 MG	001	224100001	☒

Select a Drug to pump to from dropdown list

Weekday
Weekend/Evenings

Select Drug to find

NUM

System 1, Drug File Menu

Get here by choosing 'Drug File' from the Tables Menu in the previous screen (pg. 23).

Lists drugs by:

Drug Code: A number assigned to that drug. Needed to match information from the mainframe.

Drug Description: Listing of drug by generic name, form (i.e. CO or CAPS), and dosage. CO is comprime - French for tablet and CAPS stands for capsule.

Canister: Canister location in the System 2 machine.

System 2 Code: Combination of the drug code and canister location.

Active boxes: Boxes which have crosses in them correspond to canisters that are active.

Can click on the box to designate a canister as being active or inactive. In this hospital, this option is not used because the program does not keep track of the charges if the changes are made in this screen. Instead, canisters are designated as being active or inactive in the drug edit file (pg. 26).

In order to edit a particular drug, you can position the arrow in the far left of the drug you want and press carriage return, or use the 'Select Drug to find', or double-click on the line the drug is on with the mouse. Pharmacy staff use the latter method and either use the PgUp and PgDn keys or scroll up and down with the mouse.

Hospital X (DRUGS)

Drug Code	Drug Description	Committee	ATC Code	Active
220019	ACEBURTOLE DR 100 MG	001	220019-001	☒
220022	ACEBURTOLE DR 50 MG	001	220022-001	☐
220024	ACEBURTOLE DR 25 MG	001	220024-001	☒
220041	ACEBURTOLE DR 25 MG	001	220041-001	☒
220042	ACEBURTOLE DR 12.5 MG	001	220042-001	☐
220050	AMOXICLINE CAPS 250 MG	005	220050-005	☒
220058	CARTOPRIL DR 12.5 MG	008	220058-008	☒
220059	CARTOPRIL DR 25 MG	008	220059-008	☒
220064	CANABAZEPINE DR 200 MG	010	220064-010	☒
220072	LEVODOPA CARBIDOPA DR 100 MG	011	220072-011	☒
220075	CEPHUROXIME DR 250 MG	012	220075-012	☒
220060	CEPHALEXINE DR 250 MG	013	220060-013	☐
220062	CEPHALEXINE DR 500 MG	014	220062-014	☒
220021	CHLORPRAZEPERONE CAPS 25 MG	015	220021-015	☒
220053	CHLORPRAZEPERONE DR 100 MG	016	220053-016	☐
220051	CHLORPRAZEPERONE DR 25 MG	017	220051-017	☒

Weekday
Weekend Evenings

Select Drug to find:

Select a Drug to jump to from dropdown list: NUM

System 1, Drug File Menu (Continued)

Placing the cursor on the buttons on the bottom elicits the name of the command that button performs. From left to right these are: **Print**, **Edit Drug Entry**, **New**, and **Charge Report**.

Print: Prints the drug list.

Edit Drug Entry: See next page.

New: The screen that pops up is the same as the screen for 'Edit Drug Entry' but the fields are blank. This button is used when entering a new drug to the drug file.

Charge Report: Only used by the pharmacy manager to obtain information on the cost of drug usage in order to analyze patterns of System 2 vs non-System 2 filling. In the future, the hospital plans to share this technology with other institutions and the charge report information will be needed for billing.

Can choose '**Weekday**' or '**Weekend Evenings**' to have different drugs active or inactive during the weekday as opposed to the weekend and evenings.

Exit: Exits back to 1st screen.

Select Drug to find: Can put in generic drug name to find it in this list.

Drug Maintenance			
Drug Maintenance			
Drug ID:	[REDACTED]		
Drug Name:	ACEBUTOLOL CO 100 MG		
Strength:	100 mg	Form:	Tab MNF:
Unit Cost:	\$0.11	Lonas Code:	02-240-019
S2			
S2 Code:	2240019-001	Active:	☒
Canister:	001	Weekday:	☒
		Weekend:	☒
Date Entered:	09 May 95		
Last Modified:	17 Mar 96		
		OK	

System 1, Drug Maintenance (i.e. Edit) Menu

Get to this menu by clicking on the drug you want to edit in the drug file (previous page). These files have previously been established. The only thing that would be modified is the Active window. *The option to activate drugs for weekday or evening/weekend usage is not currently being used at this hospital.* On Fridays, canisters that have been deactivated due to a large number of unit doses of that drug on hand are activated for the weekend. For each drug to be activated, the person clicks on the drug in the drug file in order to get into that drug's maintenance file, and they then click on the active window and a cross appears. The person then clicks on 'OK' and then on 'Exit' to return to the drug file, and repeats the procedure for the next drug to be activated. Drugs are activated in this way instead of the easier way of clicking on the 'Active' square in the drug file, or the even easier way of using the weekday vs. weekend/evenings option which would only have to be set up once. The more time-consuming method of activating and deactivating drugs is used in order to keep track of how often this is done. The date the drug was last modified appears in this screen. Using the weekday/weekend option would eliminate the need on Fridays to activate drugs and the need on Mondays to deactivate drugs. The goal is to do this once there is not so much variation in drug usage.

'MNF' stands for manufacturer. *This information is not entered here in this pharmacy.*

The Lonas Code is the drug inventory number.

The button options on the bottom from left to right are OK, Delete Drug Record, and Exit. Deleting a drug record removes it from the drug file. This is rarely done.

[illegible]

System 2, Drug File, Review Screen

This is the drug file for the System 2 dispensing machine. Since this drug file has already been set up, it's most common use is to cancel a drug that is active (see pg 30). A drug may need to be temporarily cancelled if the System 2 canister is broken or if the pharmacy department has temporarily run out of a drug. A drug would rarely need to be cancelled and if it did, it would preferably be done by inactivating it in the System 1 program (pg. 26) so that it would appear on the Non-System 2 fill list as a drug that needs to be filled manually.

The descriptions of the soft function keys at the bottom of the screen toggle back and forth between the 'help line 1' seen on the screen and 'help line 2' displayed below by pressing F9 'More'. All functions work no matter which help line appears on the screen. 'Help line' is the wording used in the System 2 manual.

Can	Manufacturer	Primary Name	Secondary Name
881			

Ec: IB: F3: F4: F5: F6: F7: F8: F9:

S2 Active

System 2, Drug File, Edit Mode

Get here by pressing F2 'Edit' in the Drug File.

Ec	Exit to Main Menu by pressing Escape button.
TB 'Tab'	Press tab button to tab through the drug file.
F3 'Sort'	Dialogue box pops up to provide options for sorting drugs (next page).
F4 'Del'	Deletes selected drug. Never done. When you press F4, the message line 'Delete Canister # (Y/N)' appears.
F5 'GoPg'	Prompts you to choose a page number to go to.
F6 'Act.'	Can use this option to activate a cancelled drug in the drug file.
F7 'Find'	Same as 'Find' function previously described (pg 20).
F8 'Next'	Finds the next drug or drug field that satisfies your search.
F9 'More'	Toggles you into the second help line.
	The 2nd help line in the drug file edit mode is the same as the 2nd help line in the review mode.

System 2, Drug File, Edit Mode, F3 key has been pressed

Press F3 when no drugs are currently selected to choose how you want the drug files to be sorted: by Canister, Mnemonic, Primary Name (i.e. generic name), Secondary Name (i.e. brand name), Lot, Expiry Date, Quantity, or Manufacturer. Once you have selected a sort type, the sort is done automatically and you are left in the drug file, edit mode. This function would only be performed if you wanted to change the order in which the drugs are listed in the drug file.

If you Press F1: Help, the following message appears:

SORT HELP SCREEN

ENTER Accept Highlighted Sort Key

ESC Abort Sort Function

↑ ARW Move Highlighter Up

↓ ARW Move Highlighter Down

PRESS ANY KEY TO CONTINUE

Page 6 of 10		Drug File		96/05/24 08.32.43	
				Record 81 of 138	
Can Number	Primary Name	Secondary Name			
CANCELLED					
Ec:	IB:	F3:	F4:	F5:	F6:
		F7:	F8:	F9:	
S2 Active					

System 2, Drug File, Edit Mode

If there is a previously cancelled drug that you would like to reactivate, meaning that you would like to restore the canister containing that drug to an active state, you press F6, and the program automatically reactivates that canister.

A drug can only be cancelled in the System 2 program if the canister containing that drug alarms. If the pharmacy staff want to cancel a drug before its canister alarms during filling, they can set that drug as being 'inactive' in the System 1 drug file (pg. 26) before the daily filling begins.

Appendix O: Summary of Usability Problems

Nine of the 10 usability experts returned comments with their survey. "#" is the number of usability experts who listed the problem outlined.

<u>Comments that Apply to Both System 1 and System 2</u>	<u>#</u>
1. There are menu and button options that are not applicable for the current set-up at this hospital.	9
2. There are buttons on screens that are not to be used but they are not greyed-out.	9
3. Lack of consistency in naming between System 1 and System 2. (e.g., 'Fill list' in System 1 is called 'File transfer orders' in System 2).	9
4. Lack of context-sensitive on-line help.	9
5. Lack of feedback for the user.	8

Problems with the System 1 Software Interface

General

6. Menu names and icons are confusing.	9
7. Screens contain non-functional information.	9
8. No indication of how to complete tasks.	9
9. Error prevention tactics are unclear.	9
10. It is not obvious how users recover from errors.	9
11. This interface seems like a complicated method of completing a simple task.	5

Page 1

12. Should not have arrows in a logo as users might expect them to move them to a different screen.	3
13. Product information should be in an about box.	5
14. Could eliminate this screen.	4

Page 2

15. It is confusing to have a button and also a box for 'process fill lists'.	6
16. The icon for 'capture fill list' and 'process fill list' should be different.	3
17. The purpose of the green dot is not obvious.	4

Page 3

18.	No value to having the 'Reflection' screen in the background.	7
19.	There is a great deal of information on this screen that the user doesn't need to know, such as 'WRQ file transfer protocol, Version 2.50', 'ASCII transfer', and 'Receiving hospitalx.txt from PHARM20'.	6
20.	If the word 'records' is going to be used, should be used instead of 'data'.	3
21.	Cancel should be labelled stop. 'Cancel' is ambiguous.	3

Page 4

22.	Don't see the value in having the name, drug and location flip across the screen. Having a status bar as in the previous screen would suffice.	2

Page 13

23.	Since the 'reset database' is used often, it should be more obvious rather than being hidden in a menu.	4
24.	It would be more efficient to have the database reset automatically when you start capturing the next day's records.	4

Pages 24-25

25.	Weekday/Weekend Evenings functions are confusing.	9
26.	Exit icon should be consistent throughout the interface.	7
27.	Charge report should not be in two locations.	2

Page 26

28.	The user should be told the minimum information needed.	4

Problems with the System 2 Software Interface*General*

29.	Is too hierarchical.	9
30.	Is poorly organized.	9
31.	Has poor labels for menus and function keys.	9
32.	Lacks consistency in the naming of the functions.
(e.g., F1 is 'Password Screen' at the top and 'Log' at the bottom).	9
33.	Should not have flip between program and DOS to perform actions.	8

- 34. Lacks error prevention opportunities. 7
- 35. Should be able to press 'Esc' to get to the previous screen. 5
- 36. Should not be automatically flipped into other screens. Where you are going in the interface should be in the users' control. 5

Page 5

- 37. Four characters with no name is not very secure for a system that controls everyone's drugs. 3

Pages 6-7

- 38. Password Screen should be the name of the previous screen instead of 'Security Password Input Screen'. 2

Page 9

- 39. Should use 'Continue' instead of 'Start' to indicate that the process was interrupted. 3
- 40. Yes/No messages should be framed as a question that can be responded to with yes or no. For example, 'Cancel drug?'. 5

Page 14

- 41. Deletion should be a users command and not an automatic process. 7
- 42. Users should be able to print the exception report immediately upon completion of dispensing drugs and should not have to go somewhere else to do it. Tasks should be grouped by functionality not just by topic. 2
- 43. Why is there no F4 or F5? 3
- 44. Should not have two terms for one function (i.e. 'system exception file' and 'error file'). 8

Page 15

- 45. Escape key message should not be transient. 6
- 46. Words should be simple. Instead of 'Press ESCAPE key to Abort Report', why not 'Press ESC key to stop printing'? 4
- 47. Why use 'purge' instead of 'delete'? 8
- 48. You get the exception log in the master menu from a selection called print reports. You get the exception log in the main menu from a selection called system functions menu. Why are reports not in the report menu from the main menu? 9
- 49. Why can you do different things with the system exception report depending on where you do it? 6

50. There is a poor organization of functions. 9

Page 17

51. It is confusing to have 'Exit' and 'End' on the same function line. 4
52. The use should decide where they want to go instead of automatically being sent somewhere. 6
53. It is possible that 'Error #' and 'Proc #' are not both useful pieces of information to the user. 2

Page 19

54. As it is unlikely that anyone will remember the numbered mnemonic for a drug, this screen should not be here. 3

Page 20-21

55. Should be able to use the same navigation functions throughout the interface, 89
not have 2 different ones.

IMAGE EVALUATION TEST TARGET (QA-3)

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