"New Science" as a Lens Through Which to View Change in a University Facilities Management Division: Complexity, Wholeness, and Implicate Order

A Dissertation Submitted in the College of

Graduate Studies and Research

in Partial Fulfillment of the Requirements

for the Degree of Doctor of Philosophy

in the Department of Educational Administration

University of Saskatchewan

Saskatoon Canada

By

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ABSTRACT

This study sought to use “New Science” as a lens through which to view change in a university facilities management division and to determine in what ways “New Science” could help make sense of these changes. “New Science” takes scientific management concepts beyond Newton, Taylor, and Einstein and employs a systems and ecological view of life in organizations. “New Science” goes beyond quantum mechanics and includes uncertainty and unpredictability, complementarity, semantic and chaotic infinite complexity, non-linear adaptive feedback networks, and wholeness and implicate order.

The conceptual framework for the study was based on applying complex systems theory described by “New Science” to human systems undergoing change in a university facilities management organization. Making sense of life and change in organizations is critical for university facility managers expected to change their organizations.

I was the senior university officer of the study organization during and after the study period. The design and implementation of a computerized maintenance management system from 2000 to 2005 was used as the representative change initiative in the organization. Two integrated methods of collecting data on the change initiative were used: burography and case study. The burography was grounded in the reality of my daily life as a key actor in the study organization. The case study was my narrative of the change initiative based on archival evidence I collected in the study organization.

“New Science” concepts described in the literature review were used as a lens through which to view and to make sense of the change data collected for the burography and case study. The “goodness-of-fit” between “New Science” concepts and the data helped address the purpose of the research. The analysis demonstrated that “New Science” could be used to “map" the key

dynamic properties of complex systems onto the human systems in the facilities management organization.

Viewed through the lens of “New Science”, the study organization’s change initiative was successful because some people in the organization used understanding of the uncertainty and unpredictability in their internal and external environments in conjunction with new moral purpose, complementarity, and semantic complexity to create wholeness and implicate order sustained by adaptive non-linear feedback networks. The networks helped to manage chaotic complexity and to rejuvenate the organization.

“New Science” concepts proved to be an overarching lens through which other organizational and managerial lenses could be used to deal with practical aspects of leading organizations, including positional power and reciprocal leadership.

ACKNOWLEDGEMENTS

I first want to thank the University of Saskatchewan for allowing me to pursue my postgraduate degrees while continuing to work at the university. Dr. T Whitworth, Vice-President, Finance and Resources supported and encouraged me and allowed me to pursue my research and writing while continuing to work with him and the rest of the senior management team at the U of S.

I also want to acknowledge the Department of Educational Administration for affording me the opportunity to pursue my research interests. Dr. Murray Scharf taught me about human resources and research methods, Dr. Sackney showed me a whole new world of organizational theory, including quantum theory and “New Science, Dr. Patrick Renihan was my patient and understanding supervisor, and Dr. Wickett was my insightful cognate examiner. Dr. William Winchester was my external examiner who provided wonderful philosophy of science knowledge and discussion. They were all invaluable in the thesis development and review process. I very much appreciated the time and wisdom they provided.

I also want to thank the men and women of the Facilities Management Division at the University of Saskatchewan. They were an amazing group of dedicated, insightful, and courageous stewards of the university who showed me new ways in which to view the world and to make sense of organizations.

DEDICATION

Without Doreen, Tristan, Brynton, and especially Dulcy, this dissertation, and everything else, would not have been possible – I love them all more than I can say.

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List of Acronyms

The following is a list of acronyms used in the study:

EAQ	Educational Administration Quarterly
AVP	Associate Vice-President
ASPA	Administration and Supervisory Professional Association
CMMS	Computerized Maintenance Management System(s)
CUPE	Canadian Union of Public Employees
F&A	Finance and Administration
FMD	The Facilities Management Division of the University of Saskatchewan
FRS	Financial Reporting System
HS&E	Health, Safety, and Environment
IP	Integrated Planning
IPO	Integrated Planning Office
MWD	Measurement While Drilling
NCPEA	National Council of Professors of Educational Administration
O&M	Operations and Maintenance
OOS	Out of Scope
PCIP	Provost's Committee on Integrated Planning
RFP	Request for Proposal
UBC	University of British Columbia
U of S	University of Saskatchewan
UCEA	University Council for Educational Administration
UniFi	Unified Financial System

Chapter One

INTRODUCTION

Canadian universities are facing many political, economic, societal, technological, and cultural challenges (Morris, 2005). Universities can not meet these challenges unless their non-academic administrative units efficiently and effectively support, protect, and enable the academic mission. However, many university administrative units are perceived as not adequately fulfilling their support role (Becker, Faruquee, & Kalagnanam, 2004). The pressures on university administrative units to change have never been greater (Amaratunga & Baldry, 2002).

University "administration" includes all activities that are not directly associated with academic college, faculty, and department teaching and research activities. These activities can include various human resources activities; financial and accounting services; heath, safety and environment services; ancillary services such as bookstores, housing and residences, food services, and retail developments; corporate, business and legal affairs; and facilities management.

Facilities management units in universities are responsible for the stewardship of all physical assets owned by the institution. Assets include buildings, grounds, and utilities infrastructure. Facilities management activities include the development, design, construction, operations, and maintenance of all physical systems and equipment. The physical plant must be safe, comfortable, reliable, and reasonably attractive in order to support, protect, and enable the strategic directions of the university. Failure to do so will put critical teaching and research activities in jeopardy.

Competitive pressures on universities for faculty, students, and funding are increasing. Universities are responding to these pressures by constantly scrutinizing all of their activities to ensure that all units are contributing to the institution's competitive position. The process includes critical assessment of all functions in the university for alignment with the mission and for cost reduction opportunities (Varcoe, 1996). The non-academic functions in the university's administrative areas are receiving special attention through this process. The facilities management function, because it consumes more human, physical, and financial resources than any other non-academic unit on campus, is coming under review as never before (Becker et al., 2004).

As a result of the review process, facilities management units in universities are expected to transform themselves in order to be seen to be improving their stewardship and service roles to support the academic mission of the institution. Facilities management units need to be prepared to, and capable of, improving or altering their systems, structures, processes, and policies to meet these challenges. Facilities management units must also develop the capacity, capability, and mindset needed to make these changes. A changed facilities management unit is expected to be more service focused, to be more transparent in its technical and financial activities, to manage complex projects more effectively, to better communicate its purpose, and to engage in planning and improvement initiatives. Amaratunga and Baldry (2002) stated that facilities management organizations "must be able to anticipate the needed changes in the strategic direction of the organization and to have a methodology in place for effecting strategic change" (p. 217).

In this chapter, I describe my background as the author of the study and the general nature of facilities management. The impact of facilities management on university purpose is discussed and the local context of the university and the facilities management division that are

the focus of the study are explored. Chapter One also includes a description of the problem and a statement of the purpose of the research. As well, the assumptions, the delimitations, the limitations, and the significance of the study are explained as background to the research.

The Author

I was the author of the study and the Associate Vice-President (AVP) of the Facilities Management Division (FMD) at the University of Saskatchewan (the university). I was the researcher, an observer, a participant, and the leader of the changes in the Division during and after the study period. My background and my changing world-views shaped how I and others led the Division and how it changed between 2000 and 2005.

My father was a trades-person and an engineering technologist, my mother was a school teacher and an Anglican minister. I spent my summers between university terms first working in a steel plant as a welder, and then as a child and adult aquatics recreation instructor. I graduated with a Bachelor's degree in Applied Science in Mechanical Engineering in 1982 and became a Professional Engineer in 1984. I earned an MBA in Educational Administration in 2003.

My role as a key actor in the study, and how I changed along with the Facilities Management Division during the study period, required that I describe my work background prior to joining the Division in early 2000. The following is a brief description of my professional career starting in 1982 with my first job after graduating from university and ending with my current position as the Associate Vice-President of the Facilities Management Division at the University of Saskatchewan.

Offshore Oil Exploration Drilling Engineer – 1982 to 1983

Upon graduating from UBC with a degree in Applied Science (Mechanical Engineering) in 1982 I got a job as an offshore drilling engineering with a multi-national oil company. My job

was to be one of two oil company representatives on offshore drilling facilities (platforms, semi-submersibles, jack-ups, ships). As the oil company's Drilling Engineer I was to guide the 100-person contractor crew on all aspects of the drilling operation (versus the physical plant infrastructure and the nautical operations). The scope of my position included determining all mechanical engineering parameters of the drilling program: fluid dynamics, thermodynamics, controls, vibration analysis, heat transfer, equipment performance, materials sciences, stress and strain analysis, and metallurgical analysis. The design parameters that I operated under were to engineer the drilling program in order to minimize the number of days it took to drill to the required depth. With daily operating costs of over $200,000, all applied science knowledge was needed to increase speed and efficiency.

Offshore Oil Exploration Measurement Engineer – 1983 to 1986

For financial reasons, I left the oil company and joined an offshore oil exploration measurement-while-drilling (MWD) services firm based in Aberdeen, Scotland with offices in Fort Worth, Texas and Edmonton, Alberta. While still working on offshore drilling facilities my perspective quickly changed from being the "company-man" on the rig to being a service contractor employee.

With no union to protect worker rights, and with the goal being to minimize operating and capital dollars and to maximize return-on-investment and assets, once again I was working in an environment where production and output were paramount.

Mail Processing Automation Industrial Engineering – 1986 to 1989

After working in six offshore drilling locations around the world I left the oil exploration business and began working as an industrial engineer in the mail processing industry. In Canada, a few universities offer degrees in industrial engineering although some do include a few

industrial engineering courses as electives in their mechanical engineering programs; this was the case in my mechanical engineering program at UBC.

Industrial engineering became a branch of applied science due to the work of Frederick Winslow Taylor described in his published work in 1911, *The Principles of Scientific Management*. The practice of industrial engineering involves the application of scientific management to the management of workers in order to improve productivity by optimizing the way tasks are performed and by simplifying jobs enough that workers can be trained to perform their specialized sequence of motions in one "best" way.

In developing and applying scientific management techniques to mail processing operations I was involved in time-and-motion studies, plant layout and assembly line design, materials handling and storage automation systems, productivity measurement and reporting systems, robotics, and efficiency analysis. I also led the implementation of various management programs, including management by objectives (MBO), zero-based-budgeting (ZBB), 360^{o} evaluation, total quality management (TQM), constant quality improvement (CQI), and program planning budgetary systems (PPBS).

The labour relations situation was such that none of this work involved discussion or input from any employee or employee group. All analysis was done in the engineering offices using computer models and simulations. Changes to plant equipment, alterations to plant configuration, and re-engineering of human processes were made without talking to employees.

Computer Simulation Consultant – 1989 to 1990

I was very successful at applying scientific management techniques to manufacturing and processing activities involving machines and people. I joined a consulting firm as a specialist in

developing computer models of human processes in the manufacturing sector in eastern Canada and the United States.

Industrial Engineering at UBC – 1990 to 1996

In 1988, the University of British Columbia (UBC) hired an "efficiency" consulting firm to do a complete review of all of its physical plant operations. This review was in response to the faculty and senior administration's opinion that the physical plant operations at the university were inefficient and unresponsive. I was hired by Plant Operations at UBC in 1990 as the Operations Engineering Manager to continue this work and to ensure that the efficiencies were fully implemented and sustained over the long-term.

Just as I arrived at UBC, Plant Operations went live with their new *computerized maintenance management system* (CMMS). My main function as the Operations Engineering Manager was to use the new CMMS in conjunction with "leading-edge" and "best practice" industrial engineering to develop and implement new processes to make the operation more efficient. Data from the CMMS were used to "re-engineer" processes and to track, analyze, and report on continuous improvements in the operation.

Again, I did not have to deal with workers and I did not have to consult with other staff. Senior management was under pressure to become more efficient and my data and analysis were essential to this pursuit. Data were being collected automatically by the CMMS and work practices were being changed accordingly. The spreadsheets, graphs, charts, and flow diagrams I produced were taken as fact and I had full authority to make any process, structural, systems, and operational changes I thought were needed.

I was the only one who knew how the human processes and the technical and software systems were integrated. I was also the only person who knew how to extract this information

and present it in a dramatic, clear, and managerial manner. I thrived in this environment. My industrial engineering background combined with the "magical" way I could present cost and time data made me a star. I was soon making presentations to the Board of Governors, to the Province, and to senior administrative and academic staff. My salary doubled in six years and I was promoted two times until I was the Director of Plant Operations reporting to the Associate Vice-President.

Middle Management at UBC – 1996 to 2000

Upon becoming the Director of Plant Operations in 1996 my role changed. It was no longer my job to extract and present information on activities and processes. I was now the person accountable and responsible for effecting the actual changes in service, in culture, and in attitude as perceived by the campus community.

Soon after becoming the director, our department was reorganized and an Associate Vice-President position was created and filled with a new person from outside the university. As well, the university decided that our traditional department would become an "ancillary unit" of the university, similar to the bookstore, residences, food services, and other units that received no funding from the university and that had to charge full fees for all of its services. We were expected to be "entrepreneurial", to "run like a business" and to be "customer-focused" in all that we did. The university charged us fees similar to municipal business taxes. These fees were passed on to our fee-for-service customers through dramatically increased charge-out rates.

We had been a fully funded department of the university for over 80 years. Every aspect of the organization was built around this paradigm. In a three month period we were expected to change ourselves into a service driven, profit generating, and stand-alone business unit of the university.

I decided that a formal strategic planning session was the first order of business. I found an expensive consultant from the U.S. and organized a full day strategic planning session with my senior staff. We went through the process of developing our mission, our vision, and our values. We set goals, objectives, strategies, and tactics needed to fulfill our mission. We developed operational, financial, and organizational sub-plans and key performance indicators as part of our "balanced performance scorecard". We designed new income statements, balance sheets, statements of cash flow, amortization schedules, retained earnings, and equity positions. We set timelines for deliverables and assigned detailed action plans and individual performance criteria.

The result of becoming an ancillary unit of the university was dramatic and immediate. It was also disastrous. Receivables jumped to $2,000,000 a month; service levels declined since the focus was now on revenue generation; staff morale and labour relations got even worse; Plant Operations' reputation suffered; costs increased to pay for new overheads and "taxes"; and critical staff started to leave the organization.

The entire "ancillarization" exercise was flawed. None of the elements of a true private sector business had been, or would ever be, put in place. Collective agreements, systems, processes, culture, attitude, skills, experience, talent, mind-set, worldview, and Plant Operations' core mission were all contrary to the concept of "running like a business". In fact, we never did actually get any explanation as to what this actually meant.

Senior Management at the U of S – 2000 to 2005

I was hired as the Associate Vice-President of the Facilities Management Division at the University of Saskatchewan in Saskatoon and began the job on January 2, 2000. My predecessor had been with FMD for over 30 years. He had been the Acting Associate Vice-President for three years before he retired. His predecessor, the original AVP of FMD, had been the AVP for over 25 years and had had a significant impact on all aspects of the Division. They had both been fine stewards of the university's public assets.

I believed that part of the reason I got the job was because of my experience in balancing public and private sector approaches to changing university administrative organizations. I was not given any specific directions as to what needed to be changed in FMD. My sense was that I was to make any changes necessary in any manner that I thought was appropriate.

Background on Facilities Management

The British Institute of Facilities Management defined facilities management as the practice of coordinating the physical workplace with the people and work of an organization (Amaratunga & Baldry 2002). Atkin and Brooks (2000) defined facilities management as an integrated approach to operating, maintaining, improving, and adapting the buildings and infrastructure of an organization in order to create an environment that strongly supports the primary objectives of that organization. Spedding and Holmes (1994) noted that the aim of facilities management should be not just to optimise the operating costs of buildings, but to raise the effectiveness of the management of space and related assets for people and processes so that the mission and goals of the organization may be achieved at the best combination of cost and effectiveness. Alexander (1994) stated that facilities management should be positioned as a cross-functional activity evolving as the intelligent client, close to and interpreting the needs of the core business.

In practical terms, the facilities management function involves the planning, design, construction, operations, and maintenance of an organization's physical assets. Assets include mechanical, electrical, and architectural building systems and municipal and utilities infrastructure. Infrastructure includes hard and soft landscaping, roads and pathways, exterior lighting, street furniture, steam and electrical generation and distribution, and gas, water, and sewer systems.

Facilities management personnel include trades-persons, custodians, planners, engineers, architects, technologists, accountants, information and communication professionals, and administration and clerical staff. Facilities management responsibilities include

- break-down and service call responses;
- preventive and predictive maintenance;
- minor renovations;
- planning, design, construction and commissioning capital construction;
- space and master campus planning;
- engineering and architectural design;
- code, legislative and regulatory adherence;
- health, safety and environmental programming;
- infrastructure and information systems management;
- financial reporting; and
- using computerized maintenance management, financial, and human resource systems.

Facilities Management in the Public Sector

Service, value, accountability, efficiency, stewardship, and responsiveness challenges facing facilities management units are typical of challenges facing other non-academic administrative units (Grimshaw, 1999). Some of the more serious issues these units must deal with revolve around their operational versus strategic purpose and their peripheral versus central role in supporting and setting university direction. Grimshaw described three paradoxes which he explained are at the heart of facilities management challenges: first, facilities management professes to be a strategic discipline, when it is clear that most of its practitioners are at an operational level in their respective organizations; second, facilities management professes to want to be at the heart of organizational development, when clearly many facilities management services are delivered either by external consultants or in-house teams set up as internal consultants; and third, facilities management professes to be proactive in managing change within organizations, when quite clearly it is reactive in most cases.

Grimshaw (1999) argued that this tension between ambition and reality has created a profession that has found it hard to come to terms with its purpose. This makes providing leadership to its own organization, or to the institution in which facilities management resides, even more difficult. Nutt (1998) stated

> The field of facilities management remains under-researched, supported by an inadequate knowledge base, with few secure methods and techniques of its own to underpin best practice performance. Facilities management continues to be reliant to a large extent on borrowed management concepts on one hand, and on the technical results of building performance techniques on the other. (p. 24)

Grimshaw commented that even the various definitions of facilities management that emphasized the link between the physical facilities and the organizational environment is inadequate when clearly the profession is much more diverse and complex than this. Barrett (1995) defined facilities management as “an integrated approach to maintaining, improving, and

adapting buildings of an organization in order to create an environment that strongly supports the primary objectives of the organization" (p. 24). Grimshaw stated that it is time to address the contextual issues that underpin facilities management and relate them to wider social, political, and economic movements that were taking place at the end of the twentieth century. Facilities management can only be understood within the wider context of these changes. Grimshaw argued that the key to the link between facilities management and postmodernism is change.

Facilities management has grown out of a need for organizations to manage change, especially in respect of technology, because the physical environment is seen to be hampering organizational efficiency (Becker, 1990). The number of changes that are characteristic of the context of facilities management is much wider than technology and mechanistic operations and management; the whole relationship between organizations, the employees, and the physical space they occupy is changing (Grimshaw, 1999).

Facilities Management and Modernism

Grimshaw (1999) stated that facilities management is dealing not just with an amalgamation of technical problems in an organizational context. The management of the consequences of radical cultural change within organizations impacts equally on physical facilities and people. Facilities management holds the connection between an organization, its employees, and its physical space. Grimshaw explained that the implications of change for facilities management organizations can be categorized under several headings. These headings are the nature of research, the political nature of strategic facilities management, the diversity of practice, coping with the nature of new physical forms of the workplace, and being proactive.

The nature of facilities management research has depended, first, on its ability to embrace its object of study in its own processes; second, on its capacity to work across conventional

boundaries; and third, on its willingness to recognize the chaotic, contingent, and non-systemic nature of social and physical realities (Grimshaw, 1999). These concepts support the view that facilities management is a multidisciplinary, multifaceted phenomenon symptomatic of a postmodern view of the world. Grimshaw argued that modernist research paradigms are unlikely to be able to deal with facilities management defined in these terms. Facilities management does not fit easily into the modernist paradigm of distinct academic disciplines or experimental science. Rather, it can only be dealt with as a multifaceted concept (Grimshaw).

English (2001) argued that the alternative to paradigmatic monism is to move towards a multi-paradigmatic approach with competing perspectives. Such an approach requires a suspension of the quest for a short-term empirical meta-criterion which supports a line of demarcation defining legitimate "science activity and hence truth from non-truth" (p. 25). A true multi-paradigmatic model of research posits many knowledge bases and multiple fields. The purpose of paradigm domination is to create a monistic mental box in which the acceptable problem is contained within its period, the paradigm in use defines the problem and provides the web of possible solutions (Kuhn, 1970).

Facilities management can be viewed as a symptom of the wider changes that were impacting the world at the end of the twentieth century that can be broadly categorized under the banner of postmodernism (Grimshaw, 1999). Characteristic of the period is the management of unprecedented change that threatens to undermine the modernist state. Viewing facilities management as a postmodernist concept allowed its true nature and relevance to be appreciated and the nature of the necessary research underpinning to be revealed (Grimshaw).

Facilities Management "Best Practices"

Price and Akhlaghi (1999) examined best practices in several areas of facilities management and compared them to two dominant paradigms, or patterns, of modern organizational theory. They argued that a view of organizations as living, learning systems better explained – and more importantly, better enabled – best practices. The challenges facing facility managers in the future were those of finding new ways of leading, of cultivating environments for performing, and of finding new conversations with clients, customers, and employees. This more recent approach to facilities management incorporated the total integration of people, processes, and places.

Price and Akhlaghi (1999) stated that there had also been an increase in both management practices fads and in the serious theoretical investigation of the art and science of management. Operational facilities management managers tended to be practical and frequently had engineering backgrounds. Many senior managers mistakenly viewed facilities as a necessary evil rather than a strategic asset and therefore something to be managed for minimal cost rather than for optimum value. Facilities management had been particularly exposed to fads, such as re-engineering, grounded, at least superficially, in the classical mechanistic or Taylorist managerial paradigm (Price & Akhlaghi).

Facilities Management's Affect on University Purpose

The efficient and effective functioning of facilities management has a direct or indirect impact on all university activities (Becker et al., 2004). A central goal of facilities management is to provide safe and reliable physical plant systems to support teaching and research activities. Facilities management processes thousands of service requests from the university community annually and is responsible for significant university resources. However, facilities management

suffers from a dearth of objectively researched and publicly available information concerning the impact of facilities on individual organizations (Price, Matzdorf, Smith, & Agahi, 2003).

My opinion as a senior facilities manager in a Canadian medical-doctoral university during and after the study period was that the fundamental value driver for university facilities management units is to support all of the institution's strategic directions by fulfilling its stewardship goals designed to protect the billion dollar publicly-owned physical assets of the university. University facilities must be safe, comfortable, and reasonably attractive. Increasing campus-wide commitment to research, scholarly and artistic work is not possible in an environment of deterioration and decline.

I have presented many plans to senior university administration and to Boards of Governors describing the purpose of facilities management. I have explained that stewardship is the core mission of facilities management units. Facilities management strategies are designed to reduce life-cycle costs, to stop the deterioration of important public assets, to catch-up on deferred maintenance, and to keep-up the assets in a steady-state condition. Millions of dollars of cost can be avoided over the life-cycle of an asset if dollars of the right type are invested at the right time. Failure to do so will cost the university more in the long-term and will result in more rapidly deteriorated assets.

At the Association of Physical Plant Administrators (APPA) and the Canadian University Business Officers (CAUBO) conferences I have made presentations where I stated that the objective of facilities management is to minimize life-cycle costs; to improve the reliability, safety and comfort of the physical assets; and to streamline the operational systems needed for teaching and research. I have argued that failure to enrich the environment by adequately supporting the stewardship of the university's physical resources will result in increased costs

and impaired research and teaching activities. I have explained that an important facilities management stewardship outcome is being able to use a functional, supportive, efficient and reliable physical plant to help attract and retain outstanding faculty, students and staff.

The Local Context for the Study

I was the author of the study and the Associate Vice-President (AVP) of the Facilities Management Division (FMD) at the University of Saskatchewan. I was the senior university officer in the Division and a Board of Governors' appointee during and after the study period. I was the person with the authority over all aspects of the university's physical assets. The context of the study was partially determined by my position in the Division and at the university. Some issues were confidential and I could not breach any governance, financial, or human resources protocols.

The study addressed events in the study organization from January 2000 to April 2005. There were organizational and interpretive elements of the study that extended outside the study period, especially the Division's history and traditions; these were addressed in the study as required.

University of Saskatchewan Context

The University of Saskatchewan was a medical-doctoral university located in Saskatoon, Saskatchewan, Canada. The following information was based on the university's status in 2005. The university offered 58 degrees, diplomas, and certificates in over 100 areas and disciplines. Colleges and schools included Agriculture, Arts and Science, Commerce, Dentistry, Education, Engineering, Graduate Studies and Research, Kinesiology, Law, Medicine (including Physical Therapy), Nursing, Pharmacy and Nutrition, Veterinary Medicine, and programs in the Extension Division. The university was central to the development of Canada's most vibrant

agricultural research and development community which became world famous for the application of biotechnology in the agriculture industry. The university employed approximately 4,500 faculty and staff. Student enrolment included 15,144 regular session full-time graduate and undergraduate students and 4,119 regular session part-time graduate and undergraduate students (October 2001). Since its founding in 1907, approximately 141,000 people have received degrees, certificates, and diplomas from the institution. In 2002, for the first time in its recent history, the university embarked on an integrated planning initiative involving the entire university community.

Integrated planning context. The most significant contextual element for FMD during the study period was the new Strategic Directions and Integrated Plan (IP) of the university initiated in 2002. The integrated planning process and its consequences created a new political, social, technical, and cultural context for the Division during the study period and added to the challenges it was already facing in 2000.

The IP initiatives shifted power and authority over all university resource planning and allocation from various senior university managers to the Vice-President, Academic. The role of the Vice-President, Academic was expanded and the addition of "Provost" to his title served as acknowledgement of his new position as chief operating officer of the university and second-in-command to the university President. A change in the role and authority of other senior board officers resulted from the change in the Provost's authority. The integrated planning process also resulted in a redistribution of university resources, including a reduction of FMD's operating budget by 10% ($1,200,000) in the fiscal year 2004 to 2005. The IP also created an acceleration of demands for accountability, performance, transparency, changing practices, re-allocations, and

performance measurement in most administrative units of the university. This was especially the case in FMD.

Beginning in 1999 the university experienced the largest capital building program in its history. Hundreds of millions of dollars from traditional and non-traditional sources were directed at new buildings and new infrastructure projects all of which FMD oversaw. As well, accelerated research activities increased FMD's discretionary "fee-for-service" revenues by 100% between 2000 and 2005. In response to this increase in work requests and revenues in that time period, FMD's pool of outside service contractors increased by a factor of three and over 30 term staff positions were made permanent. The context for the study, therefore, was one of political, environmental, societal, technological, and cultural change.

The Facilities Management Division context. The Facilities Management Division (FMD) at the University of Saskatchewan was steward of all physical assets on the Saskatoon campus. Stewardship responsibilities included the planning, development, operations, maintenance, renewal, replacement, and construction of buildings and municipal and utilities infrastructure. Some work was funded by the Division's core operating funds while other work was funded on a fee-for-service basis by paying "customers". The Division's organizational chart in 2005 can be found in Appendix A. The Division's staff complement in 2005 is shown in Table 1.1.

The main stewardship role of FMD was to plan, develop, operate and maintain all systems, equipment and components that were part of all campus lands, building, and municipal and utilities infrastructure. The physical asset had a current replacement value of $1,000,000,000. FMD's 2004 - 2005 functional revenue budget is shown in Table 1.2.

Table 1.1

FMD Staff Complement 2005 Including Collective Association

Employee association	Number of staff
CUPE	439
ASPA	80
OOS	6
Total	525

[a]See employee association description in List of Acronyms.

Table 1.2

FMD 2004 – 2005 Functional Revenue Budget

Function	$, millions
Operations & Maintenance	12
Capital Projects	22
Fee-for-service	8
Utilities	18
Total	60

[a]See function definitions in Definitions section.

The key activities of FMD during the study period were operating and maintaining all assets, purchasing and distributing utilities, managing large capital construction projects, managing fee-for-service renovations, and directing campus planning and development programs.

During a strategic planning workshop held in 2000, FMD determined that its mission was to "provide world-class, sustainable facilities in support of learning, discovery and engagement". FMD also determined that its vision was "to be a center of excellence responding to competitive pressures and operating in an accountable and innovative fashion".

Facilities Management Division's environment. An environmental scan of its external environment in 2000 to 2001 identified, and helped to develop strategies to cope with, the political, economic, social, technical, and cultural factors that were impacting FMD. The scan also identified organizational strengths and weaknesses including system, structural, and leadership gaps. Issues requiring significant change processes were identified in the scan. The full environmental analysis can be found in Appendix C.

For many years, FMD was perceived by senior administration and the campus community as being inefficient and inattentive to the needs of the academic community. When I was hired in January 2000 as the Associate Vice-President of FMD, my mandate was to change the Division so that it could better define its stewardship and supportive role on campus and demonstrate added-value to the campus community. FMD was expected to increase the community service attitude of all employees and to balance competitiveness with care of its human, financial, and physical "resources". Ensuring on-time and on-budget performance of capital projects and improving performance of renovations works were also important issues for the Division. The Division was also expected to develop the campus planning and development infrastructure and to increase outreach and relationships across campus. As well as improving its reputation on campus, the Division was mandated to enhance employee skills and to increase the use of technology. Developing and maintaining the human, physical, financial, and organizational and operational systems and infrastructure needed to accomplish the above were also important considerations.

FMD had not been able to deal with these issues for many years. In 2000, some in FMD were unaware of the extent to which the problems existed. If the Division had not been able to change, and the issues not successfully addressed, it would have been in serious peril. The

problem identified in the study was FMD's lack of awareness of the need to change and the capacity and capability to change prior to 2000.

Purpose of the Study

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes.

Significance of the Study

The general awareness of the significance of facilities management functions in institutions, and of how the social science aspects of changes in facilities organizations can inform educational administration in general, is increasing (Leaman, 1992). Leaman described facility management as a discipline and industry that "emerged in the 1980s as a candidate for professionalism, mainly because the effects of building-related decisions are less easy to predict than other institutional decisions" (p. 18). He also stated that the study of facilities management has helped establish a focus on the productive use of building assets as workplaces for human beings. Except for the emergence of facilities management as a profession in its own right, the overall property industry has for many years appeared to be impervious to the radical changes being experienced by other industries (Pitt & Hinks, 2001).

There has been dramatic growth in facilities management activities world-wide (Nutt, 1999). Nutt claimed that the relevancy and importance of facilities management is becoming recognized widely by business and industry, but less so by government. The field of facilities management remains at a very early stage of development. Nutt claimed that facilities management operates in an ever-widening and ill-defined sphere of activities. The claims that facilities management makes for itself are mainly untested and facilities management has few

secure methods of its own to underpin good practice experience. Facilities management is not yet supported by an adequate knowledge base and facilities management has yet to make its own distinctive contribution to the management discipline. Nutt also argued that facilities management development to date has been unsupported by practical theory and that facilities management is grossly under-researched. Facilities management continues to be reliant, to a large extent, on borrowed management concepts on the one hand and the results of building performance research on the other hand. Nutt argued that too many in business and government feel that facilities management lacks identity and that it remains an ill-defined and ever-expanding and confusing field of activity. Facilities management has been increasingly challenged to justify the ambitious claims that it makes for itself. Nutt stated that facilities management must demonstrate its own distinctive contribution to management practice and to facilities research.

Cairns (2003) explained that facilities management has required a philosophical basis, referring to the basic theory and general principles of knowledge that underpin everyday activities. The philosophy of the workplace includes the separate but related social, physical, technological, and organizational context of work. The chaotic work environment is center stage of facilities management activity. Cairns argued that facilities management must provide a knowledge base that critically engages with the complexities and ambiguities of the diverse but interconnected context of work. Facilities management must deal with some of the failings of facilities management knowledge where idealistic best practice is presented as if it were only theory. Cairns stated that a knowledge base must be able to stand up to critical analysis from other fields of knowledge, some of which overlap with the field of facilities management.

Foucault (1998) advised that facilities management should find ways of listening to, and understanding, people who live, think, and act within their facilities. Research of such processes would lead to the development of a new knowledge base for facilities management: one that is process-oriented, dealing with questions of why and how, instead of being object-oriented, dealing only with questions of what and how much (Cairns, 2003).

There is little to no research literature on the administration of university facilities management units, despite the major technical, financial, and human role these units play in most universities. Indeed, there is a relatively small body of knowledge concerning educational administration in universities in general. The research and literature that is available tends to focus more on the academic side of post-secondary educational administration. Most of the literature on facilities management attempts to follow Newtonian, positivistic, and scientific management practices which have, perhaps, contributed to the problems in the first place.

A new approach to organizations and to organizational change was required. “New Science” provided a lens through which to view change in university administration and to specify a new framework for making sense of change in a contemporary university facilities management division.

Assumptions

The following are the assumptions upon which the study is based:

1. The internal and external environmental factors and pressures identified in the study were representative of long-term trends for Canadian universities and their facilities management units.

2. The need for change in university facilities management units in response to pressures from the internal and external environment were representative of conditions in other Canadian medical-doctoral universities.
3. I had the ability to position myself, and to use reference materials, in such a manner as to accurately reflect and report on the events and changes in FMD over the research period.
4. My personal and professional experience and worldview shaped the changes in FMD.
5. The burographical research method adequately captured and contextualized my biases and my role in the changes in FMD.
6. The CMMS project used in the study was a good representation of the many change initiatives in FMD between 2000 and 2005.
7. The "New Science" concepts used in the study are legitimate scientific principles.

Delimitations

I was the Associate Vice-President of the Facilities Management Division (FMD) at the University of Saskatchewan in Saskatoon, Saskatchewan, Canada before, during, and after the study period. I have been in this position since early 2000. FMD was chosen as the study organization because facilities management units are the largest and most complex non-academic units in most Canadian medical-doctoral universities. Facilities management units also include a wide array of systems, structures, and processes by which many organizational paradigms and theories can be tested.

FMD experienced many change activities during the study period. In order to keep the scope of the study manageable, only one representative change initiative was used in the study: the designing and implementing of a *computerized maintenance management system* (CMMS). A CMMS is a large, enterprise-wide computerized system used to manage the operations and

maintenance of physical assets using work order tracking and reporting. The CMMS project was the most comprehensive and representational of all change activities experienced by FMD between 2000 and 2005.

Although the purpose of the study was to use “New Science” to help make sense of the CMMS change initiative in FMD during the study period, the study did not use “New Science” concepts of “String theory”, also know as the “Theory of Everything” (Greene, 2003), and the study did not delve into fractal or attractors theory.

The organization’s environmental conditions are discussed in the background to the study. Although the relationships between the Division and the rest of the university were important, the scope of this study did not focus on those dynamics. However, two significant events in FMD’s environment were included in the scope of the study: a new integrated planning process at the university and the implementation of a new central financial system. Although the integrated planning process had many significant impacts on FMD (as it did on most campus units) only some of these impacts are specifically addressed the study.

The study used two integrated research methods: burography and case study. My burographical information was interwoven with the case study data. It was based on my recollections and reflections of the Division during the study period. The CMMS project case study data consisted of project management reports, correspondence, meeting minutes, policies and procedures, structural diagrams, and schedules.

Limitations

I was the senior person in FMD during and after the study period and my biases and worldview shaped the changes in the Division. My perspective also framed the reflections and the application of "New Science" concepts to the changes in the Division as discussed in this document.

The results of the study cannot necessarily be applied to other university administrative units or to non-university facilities management units. Nor can one assume that the results apply directly to other public or private sector organizations. The utility of the data was limited by the evidence I was able to research in current and archival sources in the Division and by my own abilities to accurately recall events.

The case study looked at one particular type of organization in one institutional sector: a facilities management division in a Canadian medical-doctoral post-secondary institution. The data was not triangulated to other institutions or to other sectors.

Definitions

The following are definitions of terms used in the study:

- Ancillary units – university departments and units that receive no operating funds from the university and that must be financially self-sufficient by generating revenues from the sale of goods and services. These usually include residences, bookstores, and food services.
- Burography – an intersection of biography, personal experience, and text based on the cultural study of the person's own group.
- Capital projects – one-time monies to acquire assets that were capitalized in financial statements and/or to do renovations/refurbishments that extend the life of the asset.

- Change – in organizations means creating a culture and the capacity to see and to incorporate new ideas and practices inside and outside the organization. Change seeks diversity of employees, ideas, and experiences while simultaneously establishing mechanisms for sorting out, reconciling, and acting on new patterns and valuing alternate opinions; and building, sharing, creating, and managing new knowledge and displaying the hidden benefits of creativity and novel solutions that are often generated when the status quo is disrupted (Fullan, 1999).
- Fee-for-service – services offered that require fees to be charged.
- Limitations – limitations describe restrictions or shortcomings in the research.
- Operating budget – ongoing, annual funding received from the provincial government.
- Operations & Maintenance – tradespersons-based ongoing, annual repair and upkeep of building and infrastructure mechanical, electrical and architectural systems, equipment and components funded from the university's annual operating budget.
- "New Science" – a branch of physics that goes beyond relativity and quantum mechanics to consider the uncertain and unpredictable nature of the relationships and the wholeness and implicate order of matter as waves, particles, and fields and how these concepts comprise complexity theory, chaos theory, complementarity, and non-linear adaptive feedback networks.
- Permanent employees – employees hired with no end date contemplated.
- Provost – a title usually given to the Vice-President of Academics at a university.
- Term employees – employees hired with a definite end date to their employment.

- Utilities – mechanical, electrical, civil and structural systems, equipment and components for the generation and/or distribution of steam, gas, water, and electricity and sanitary and storm sewers.

Organization of the Thesis

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes. A diagram of the structure of the chapters in the study can be found in Figure 1.1.

Chapter One describes the underlying premises of the study and the context and the organizational problem to be studied. It also includes my career background as the researcher and as a key participant in the study.

Chapter Two is the literature review of the concepts of "New Science". It begins with a discussion of how the evolution of science has informed organizational theory. This is followed by literature on "New Science" concepts of complexity including chaotic complexity and semantic complexity; complementarity; uncertainty and unpredictability; wholeness and implicate order; and organizational fields and forces. Chapter Two also includes the conceptual framework for the study that describes how "New Science" concepts can be used for making sense of change in organizations.

Chapter Three describes the research methodology used in the study. First, a representative change initiative used to focus the study is explained. Then, a justification for the use of qualitative research methods is proffered. This is followed by descriptions of the two integrated research methods used in the study: burography and case study. The role of the researcher is outlined and the quality of the research product is addressed. The chapter also

includes a description of the data and how the data were collected and managed. Chapter Three ends with a discussion of the ethical considerations of the study.

Chapter Four includes the case study and burography data. The case study data is comprised of evidence of change found in the facilities management division. The burography data is interwoven with the case study in Chapter Four. It is based on my recollections and reflections of my time as a key actor in the Division during the study period.

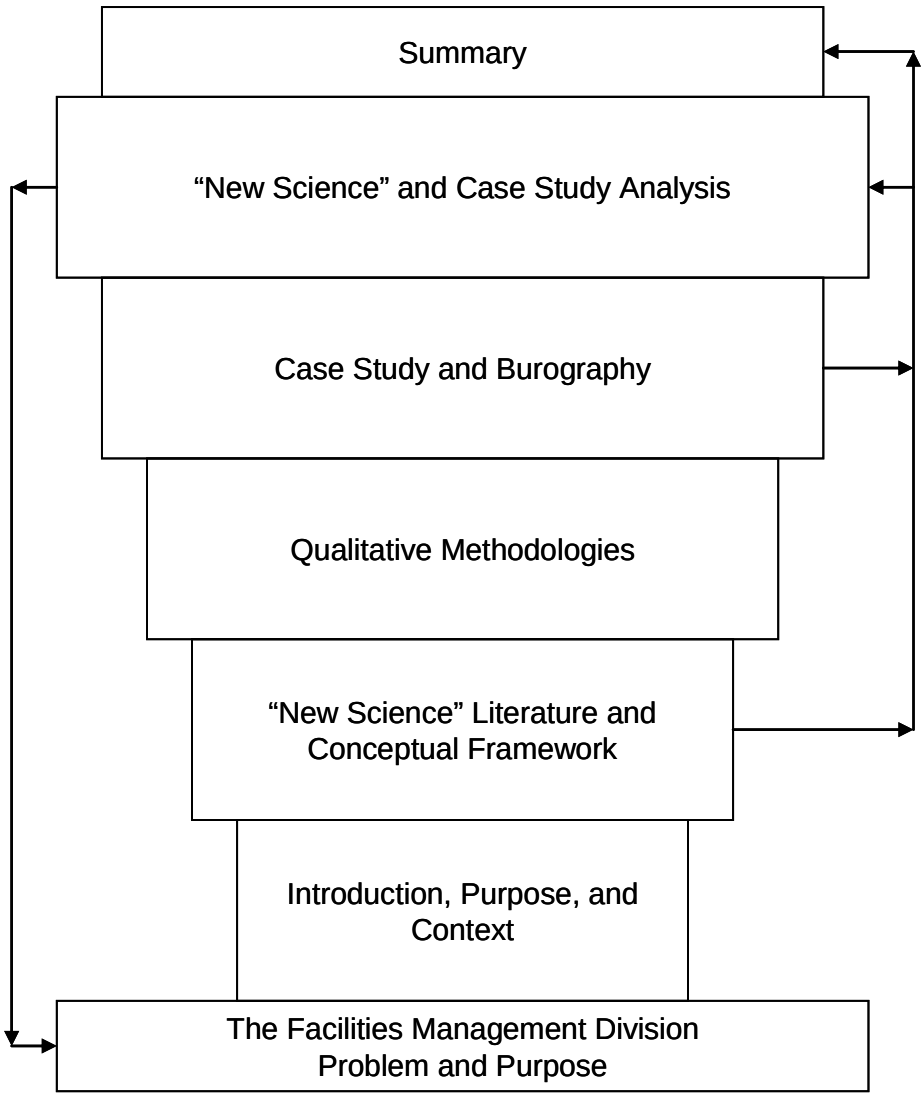

Figure 1.1. *Organization of the Thesis*

Chapter Five is the main chapter in the study where “New Science” literature from Chapter Two was used to view, and to help make sense of, the Chapter Four case study and burography data. It was in Chapter Five where the applicability of “New Science” concepts to a specific change initiative in a university facilities management division was tested for coherence and usefulness.

Chapter Six concludes the study with a summary of the study’s procedures and findings. It also includes implications and recommendations for further study and conclusions. The end of the main text is followed by references and appendices. The ethical review and approvals are included in the appendices.

Chapter Two

LITERATURE REVIEW

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes. The change was in response to new realities, to new knowledge, and to increasing demands for improvements from the organization's internal and external environments. This chapter is a review of the literature on the concepts of "New Science". It includes literature on organizational theory and its scientific beginnings and literature explaining "New Science" theory, complexity theory, and chaos theory. The review then addresses literature on the organizational elements of "New Science" including complementarity, uncertainty, fields, forces, and wholeness and implicate order.

Organizational Theory and Science

Capra (1982) described how science and Sir Isaac Newton's theory of the universe and the belief in the rational approach to human problems in the eighteenth century were central to the "Age of Enlightenment" (p. 68). The logically empirical and linear solutions provided by Newton's science found their way into the scientific management of many different types of organizations. Promoters of the science of administration claimed to have found a rational basis for human decision-making and a value-free technology for increasing the effectiveness and efficiency of organizations (Greenfield, 1986).

Science has now progressed well beyond Sir Isaac Newton. The discovery of evolution in biology forced scientists to abandon the "Cartesian" (Capra, 1982, p. 57) conception of the world as a machine. Instead, the universe had to be viewed as an evolving and ever-changing system in

which complex structures developed from simpler life forms. Evolutionary concepts also emerged in physics. However, whereas in biology evolution meant a movement toward increasing order and complexity, in physics it came to mean just the opposite – a movement toward increasing disorder; something the laws of thermodynamics addressed with the concept of entropy.

Although physicists debated when they replaced Newton's concepts of gravity with Einstein's principles of relativity, physics may now be converging on what the science refers to as a "unified field theory of everything" (Greene, p. 16). This area of science is called "New Science". "New Science" includes the concepts of quantum mechanics, complexity theory and chaos theory, uncertainty and probability, order and disorder, indeterminacy and unpredictability, complementarity and relationships, string theory, multi-dimensions, and interconnectedness.

The science of Copernicus, Descartes, Locke, Bacon, and Newton were applied to management and administrative theories by authors and practitioners such as Taylor, Simon, and Halpin (Greenfield, 1986). Similarly, the philosophies of the "New Science" can be used to help discover how organizations work, how organizations can change, and how organizations can be simplified (Wheatley & Kellner-Rogers, 1996). Zohar (1990) stated

> In quantum physics we now have the foundation of a physics upon which we can base both our science and our psychology, and that through a wedding of physics and psychology, we, too, can live in a reconciled universe, a universe in which we and our culture were fully, and meaningful, parts of the scheme of things. (p. 25)

The metaphors provided by the philosophy of "New Science" can help one understand both resistance to change and the novel new order that can emerge through chaos and unpredictability. Kuhn (1970) described how Ptolemy popularized the notion that the sun revolves around the earth, and how this view was defended for centuries even in the face of conflicting evidence. In

the pursuit of science, Kuhn observed, "novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation" (p. 64).

Defense of a New Science

Much has been written against the use of modernist, positivist, and scientific management concepts in administration (Dolmage, 1992; Greenfield, 1993; Kendell & Byrne, 1977). “New Science”, however, may suggest ways in which new scientific metaphors might address some of the scientism and humanism concerns raised by authors of critical theory and postmodernism.

Marshall and Peters (1999) described how Foucault, Lyotard, and Derrida explained their views of science, meaning, and postmodernism. Lyotard stated that the effects of new technologies since the 1950s have had an impact on research and on the transmission of learning. Language-related developments (theories of linguistics, cybernetics, informatics, IT language, mathematics, etc.) have been significant. The status of knowledge has changed. It has become a commodity used for financial, political, and militaristic competitive advantage. Knowledge has become the principal force of production thus changing the composition of the workforce and educative structures. This, according to Lyotard, has created larger gaps between nation-states, between information haves and have-nots, and has created legal, ethical, political, and educational problems. Lyotard was also concerned with the legitimating of knowledge.

Foucault portrayed the Enlightenment and the path it has taken as darkness. According to Marshall and Peters (1999), Foucault did not accept the Enlightenment view of the improvement of human beings through advances of reason. He rejected the form reason has taken. Foucault (1998) criticized Descartes claiming that Descartes attempted to confine reason thereby limiting potential for imagination, creativity, and freedom.

When describing the evolution of the philosophy of science, and how post-Enlightenment scientism and modernism has created many concerns about the human condition, postmodernists used a definition of science limited to Newtonian-based linear mechanisms. Perhaps "New Science" can help Foucault "find a way out" (Marshall & Peters, 1999, p. 245).

Heisenberg (1999) stated that "the world thus appears as a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole" (p. 107). Wheatley (1999) further explained

> New science makes us more aware that our yearning for freedom and simplicity is one we share with all life. Order and form were created not by complex control, but by the presence of a few guiding formulas or principles repeating back on themselves to exercise individual freedom. The survival and growth of systems were sustained by a few key principles that express the system's overall identity combined with high levels of autonomy for individuals within that system. New understandings of change and disorder have emerged from chaos theory. The world continues to create systems of great scope, capacity, and diversity. Fluctuation and change were essential to the process by which order is created. Life is about creation. This ability of life to create itself is captured in a strange sounding new word, autopoiesis (from Greek, meaning self-production or self-making). Autopoiesis is life's fundamental process for creating and renewing itself, for growth and change. A living system is a network of processes in which every process contributes to all other processes. (p. 12)

Heisenberg and Wheatley both claimed that a return to science – to "New Science" – can help organizations change by understanding complexity and inter-subjectivity.

Bohm (1980) argued that quantum theory is the most basic way available in physics for understanding the fundamental and universal laws relating to matter and its movement. It must clearly be given serious consideration in an attempt to develop an overall worldview. In quantum theory, there is no consistent notion at all of what the reality may be that underlies the universal constitution and structure of matter. If we try to use the prevailing worldview based on the notion of particles, we discover that the particles, such as electrons, can also manifest as waves, that they can move discontinuously, that there were no laws at all that apply in detail to the actual

movements of individual particles and that only statistical predictions can be made about large aggregates of such particles. If, on the other hand, we apply the worldview in which the universe is regarded as a continuous field, we find that this field must also be discontinuous, as well as particle-like, and that it is undermined in its actual behavior as is required in the particle perspective of relation as a whole (Bohm).

Marvin (2005) described how Heraclitus' focus also shifted continually between two perspectives – the objective and everlasting processes of nature on the one hand and ordinary human beliefs and values on the other. Heraclitus challenged people to come to terms, theoretically and practically, with the fact that they were living in a world "that no god or human has made" (p. 1). Heraclitus' great truth was that "all things were one" (p. 1), but this unity, far from excluding difference, opposition and change, actually depends on them, since the universe was in a continuous state of dynamic equilibrium (Marvin). Day and night, up and down, living and dying, heating and cooling – such pairings of apparent opposites all conform to the everlastingly rational formula (logos) that unity consists of opposites; remove day, and night goes too, just as a river will lose its identity if it ceases to flow (Marvin).

"New Science" and Complexity Theory

Biggiero (2001) distinguished between difficulty and complexity in organizations. Difficult problems are those which require time, hard work, dedication, skills, information, and effort. Complex problems, according to Biggiero, are different. Biggiero's different types of "observed irreducible complexity" (p. 3) are summarized in Table 2.1.

Table 2.1.

Classifications of observed irreducible complexity

	Trans-Computational	**Infinite**	**Logical**
Quantitative (syntaxical)	Computational	Chaotic	Logical
Qualitative (semantic)		Intuitive, spiritual knowledge and the meaning of words	Relational

Chaotic complexity can be observed, quantified, and ordered; intuitive, spiritual, and semantic complexity can not be, it is subjective and contextual (Biggiero). The science of complexity studies the fundamental properties of non-linear feedback networks and complex adaptive networks (Stacey, 1996b). Complex adaptive systems consist of a number of components, or agents, that interact with each other according to sets of rules that require them to examine, and to respond to, each other's behavior in order to improve their behavior and the behavior of the system they comprise. Stacey argued that such systems operate in a manner that constitutes learning. Because those learning systems operate environments and consist mainly of other learning systems, it follows that together they form co-evolving supra-systems that create and learn their way into the future (Stacey).

Stacey (1996b, p. 349) described the essence of complexity theory in organizations by stating that organizations are webs of non-linear feedback that are capable of operating in stable or unstable equilibrium, or between stability and instability at the edge of chaos. Organizations can be powerfully pulled toward stability by the forces of integration, staff desires for security and certainty, and adaptation to the environment. Organizations can also be powerfully pulled to the opposite extreme of unstable equilibrium by the forces of division and decentralization, by

staff desires for excitement and innovation, and by isolation from the environment. If organizations give into the pull of stability they fail because they become ossified and cannot change easily. If organizations give into the pull of instability, they disintegrate.

Success, therefore, lies in sustaining organizations in a state between stability and instability (Stacey, 1996b). This is a state of chaos, a potentially difficult to maintain dissipative structure. The dynamics of such a successful organization are those of irregular cycles and discontinuous trends, falling within qualitative patterns, fuzzy but recognizable categories taking the form of archetypes and templates. Agents within an organization cannot be in control of the organization's long-term future. Long-term development of an organization is a spontaneous self-organizing process from which new strategic directions may emerge (Stacey). Organizations can use these dynamics for learning how to deal with complex change and for creating and using moral purpose to bound instability and shape organizational transformation.

Lessons for Complex Change

Organizations change when logical instrumental-technology rationality rules slowly make room for subjectivism and hope (Kincheloe & McLaren, 2000). Fullan (1999) stated that organizational change is complex and that theories of change and theories of education need each other. Moral purpose in organizations, too, is complex and problematic; conflict and diversity are friends. Understanding the meaning of operating on the edge of chaos is critical to understanding change, and emotional intelligence is both anxiety provoking and anxiety containing (Fullan). Collaborative cultures are anxiety provoking and anxiety containing and organizations should attack incoherence to ensure connectedness and knowledge creation. Fullan argued that there is no single solution; craft your own theories and actions.

Organizations can connect the many diverse units in its organization to the many unpredictable conflicts in its internal and external environments (Fullan, 1999). Removing the protection of Newtonian mechanical answers to objective and subjective problems can uncover a potentially chaotic and uncontrollable world. New common knowledge based on anxiety motivated discussions around values and purpose and morals can create a collaborative culture that attacks incoherence and creates new internal and external relationships and interconnectedness (Fullan, 1999; Wheatley, 1999).

Complexity Theory and Moral Purpose

Fullan (1999) provided insights into complexity combined with moral purpose that included complexity and the change process; the deep meaning of inside and outside collaboration; the complexities of transferability; and intellectual, political, and spiritual fusion. The new science of complexity claims that the link between cause and effect is difficult to trace. Change, planned and otherwise, unfolds in non-linear ways. Paradoxes and contributions abound and creative solutions arise out of interaction under conditions of uncertainty, diversity, and instability (Fullan).

According to complexity theory, adaptation is most effective in systems that are only partially connected. The argument is that too much structure creates gridlock, while too little structure creates unbounded chaos. Brown and Eisenhardt (1998) argued that “complexity theory began with an interest in how order springs from chaos” (p. 14).

Moral purpose – making a positive difference in the lives of all citizens – is worth striving for as a value in itself because it may eventually be a higher form of evolutionary benefit to humankind (Fullan, 1999). The pathway to moral purpose is a perpetual pursuit because

pluralistic (self-centered along with unselfish) motives abound. Narrow self-interest and commitment to the common good co-exist.

Intensive human interaction involving people different from ourselves (diversity) provides us with an evolutionary advantage because (a) interaction is essential to solving problems, and (b) diversity of interaction is most suited to discovering moral and effective solutions to problems presented by turbulent environments (Fullan, 1999).

"New Science" and Chaos Theory

Wheatley (1999) provided a historical description of chaos as follows:

> In Greek story, Chaos and Gaia were partners, two primordial powers engaged in a duet of opposition and resonance, creating everything we know. From Chaos' great chasm comes both support and opposition, creating the light without which no form would be visible. We, the generative force, give birth to form and meaning, organizing chaos through our creativity. We fill the void with worlds of our own making and turn our backs on him. But we must remember that deep with in our Gaian centres, so the Greeks and our science tell us, is the necessary heart of chaos. Chaos is always partnered with order – a concept that contradicts our common definition of chaos – but until we could see it with computers, we saw only turbulence, energy without predictable form. Chaos is the last state before a system plunges into random behavior where no order exists. (p. 115)

Wheatley described chaos containing order as an essential, nourishing element of systems that fall apart. The layers of complexity and the sense of things being beyond our control and out of control are but signals of our failure to understand a deeper reality of organizational life and of life in general (Wheatley).

Chaos theory has shaken science to its foundations with the realization that very simple dynamic rules can give rise to extraordinarily intricate behavior (Waldrop, 1992). Complex systems can acquire the ability to bring order and chaos into a special kind of balance.

The balance point, often called the edge of chaos (Fullan, 1999; Waldrop, 1992) is where the components of a system never quite lock into place, and yet never quite dissolve into

turbulence either. The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo and where even the most entrenched old guard will eventually be overthrown (Fullan). The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive.

Cartwright (1991) stated that chaos is order without predictability. The shape of chaos materializes from information feeding back on itself and changing in the process. This is the familiar process of iteration and feedback described in much of new science. It is the same process that results in self-organization. This process succeeds in creating newness because it takes place in a system that is non-linear. The recognition of non-linearity and the new mathematical tools of chaos theory have made it possible to see more clearly how life works (Cartwright).

Sullivan (1999) described chaos theory and the change process that can transform an organization into a new order. Organizations need to be able to understand themselves better. Organizations need intuitively to feel the simple small changes within them and to apply gentle creative action in the appropriate places to effect change. Chaos theory tells us that the obvious or expected place to attack a problem may not always be the most effective (Sullivan). The art of instigating organizational change becomes not the heavy-handed directive approach. Rather, change in an organization can be implemented by studying the self-renewing and the self-transcending dynamics that are operating on particular aspects of the organization.

The strategy is to ride the crest of chaotic and disorderly change dynamics, making small adjustments on the way and eventually achieving a renewed and ordered system (Sullivan, 1999). Organizations need to consider their goals as continuously evolving. Organizational

policies and plans need to be presented and implemented with the understanding that when and if goals are reached, goals will always remain just one moment in the organization's evolution (Sullivan). Organizations must realize that fully controlling a chaotic and unpredictable world is impossible. Being able to manage on the edge of that chaotic and unpredictable world, and being able to respond and adapt to whatever presents itself, is freeing and inspiring.

Chaos theory and its application to organizational complexity can be an important theory for organizational leadership and for bounding chaotic disorder and unpredictable change forces in organizations.

Chaos Theory and Leadership

Rost (1991) described how the construct of leadership is illuminated by chaos theory. Leadership is not limited to the leadership behaviors of a key position holder or team of top people. Leadership is conducted throughout the organization, through all its agents. Leadership is broadly conducted precisely because in chaotic systems, all agents have potential access to vital information from the environment. Though leadership is broadly distributed, it is specific in function. Building on Rost, Burns (2002) stated

> Leadership first functions to inspire continuously agents to revisit the ultimate purpose and core values of the system to ensure that all agents comprehend and hold those values and purposes as indelible core schema. Secondly, leadership requires continuous assessment of environmental demands as they relate to the primary mission and values of the organization and then forwarding adaptive schema from the shadow systems that satisfy those demands. As an organization goes through this process, its ultimate purpose and core values become clearer because they are viewed from multiple perspectives over time. This clarity of ultimate purpose and core values liberates the organization from becoming trapped in unhealthy dependence on past policies and procedures, an expression of defensive single loop learning. Instead it is freed to become creative as it responds to the current environmental challenges. The ability to conduct these functions of leadership is not uniquely located at the top of a hierarchy. (p. 47)

Therefore, organizational leaders should not focus on operational, objective, and day-to-day problems (Burns). Burns argued that transporting the values underpinning "New Science" philosophical foundations throughout an organization via language and listening ought to be the prime purpose of these leaders. Indeed, the leadership function, as a defined functional box on an organizational chart, should disappear. Ordering disorder and simplifying semiotic, semantic, relational, and chaotic complexity (Biggiero, 2001) can happen throughout the organization. Centralized and top-down management is not required (Burns).

Chaos Theory, Order, and Change

Bohm (1980) explained that order in its totality is ultimately indefinable, in the sense that it pervades everything that we are and do (language, thought, feeling, sensation, physical action, the arts, and practical activity). In physics, the basic order has for centuries been that of the Cartesian rectilinear grid (extended slightly in the theory of relativity to the curvilinear). Physics has made enormous developments during this time with the appearance of many radical new features, but the basic order has remained essentially unchanged.

The Cartesian order is suitable for an analysis of the world into separately existing parts. However, Bohm (1980) looked into the nature of order with greater generality and depth and discovered that both in relativity and quantum theory the Cartesian order is leading to serious contradictions and confusion. This is because both theories imply that the actual state of affairs is unbroken wholeness of the universe, rather than analysis into independent parts. Bohm believed that the two theories differ radically in their detailed notions of order. In relativity, movement is continuous, causally determinate, and well-defined. In quantum mechanics, movement is discontinuous, not causally determinate, and not well-defined. Each theory is committed to its own notions of essentially static and fragmented modes of existence (relativity to that of separate

events, connected by signals, and quantum mechanics to a well defined quantum state). Bohm argued that a new kind of theory is needed which drops these basic commitments and at most recovers some essential features of the older theories as abstract forms derived from a deeper reality in which what prevails is unbroken wholeness.

Order and form were created not by complex control but by the presence of a few guiding formulas or principles repeating back on themselves (Wheatley, 1999). The survival and growth of systems were sustained by a few key principles that express the system's overall identity. These combine with high levels of autonomy for individuals within that system (Bohm, 1980).

Wheatley (1999) stated that a new understanding of change and disorder has emerged from chaos theory. Work in "New Science" has lead to a new appreciation of the relationship between order and chaos. Order and chaos are now understood as mirror images, two states that contain order. A system can descend into chaos and unpredictability, yet within that state of chaos the system is held within boundaries that are well ordered and predictable. Without the partnering of these two great forces, no change or progress is possible. Chaos is necessary to new creative ordering (Wheatley).

Any living system is a never-resting structure that constantly seeks its own self-renewal (Jantsch, 1980). Change is only possible when the organization decides that changing is the only way to maintain itself. An organization can live in a world rich in processes that can support its renewal and growth if the organization chooses to think about and embrace these processes.

"New Science" Organizational Elements

"New Science" has developed from new descriptions and interpretations of quantum mechanics. Quantum principles require us to fundamentally change our relationship to measurement and observation (Wheatley, 1999). If quantum matter develops a relationship with

the observer and changes to meet his or her expectations, then how can there be scientific objectivity? If one structures an experiment to study wave properties, matter behaves as a wave. If the experimenter wants to study particles, matter obliges and shows up in particle form. The act of observation causes the potentiality of the wave packet to collapse into one or the other aspect. One potential becomes realized while the other instantly disappears. Before the observer acts, an endless profusion of possibilities continues to be available. Once the observer chooses what to perceive, the effect of perception is immediate and dramatic. All the wave functions representing the observed system collapses, except the one part, which actualizes into reality (Zukav, 1979).

The quantum theories of waves and particles and of the perceptions and impact of the observer or the participant are explained in a few fundamental "New Science" concepts. These concepts are complementarity and uncertainty, organizational fields and forces, and wholeness and implicate order.

Complementarity and Uncertainty

"New Science" includes the important quantum principles of complementarity and uncertainty. Matter can appear as particles (specific points in space) or it can show up in waves (energy dispersed over a finite area) (Bohm, 1980; Heisenberg, 1999; Wheatley, 1999). Matter's total identity includes the potential for both forms – particles and waves. This is Bohr's "Principle of Complementarity" (p. 36). Wheatley described "Heisenberg's Uncertainty Principle" (p. 37) where one can measure the particle aspect or the wave aspect of matter – either location or movement. One can never measure both at the same time. Thus, while one can measure wave properties, or particle properties, the exact properties of the duality itself must always elude any measurement one may hope to make.

Wheatley (1999) argued that a quantum perspective provides one powerful explanation of Newtonian empirical and linear beliefs. If there is no objective reality out there, then the environment and our future remain uncreated until we engage with the present. We must interact with the world in order to see what we might create. Through engagement in the moment, we evoke our futures. To live in a quantum world, to weave here and there with ease and grace, we need to change what we do (Wheatley). We need fewer descriptions of tasks and instead need to learn how to facilitate process. We need to become savvy about how to foster relationships, how to nurture growth and development. All of us need to become better at listening, conversing, and respecting one another's uniqueness because these are essential for strong relationships.

There are no familiar ways to think about the levels of interconnectedness that seem to characterize the quantum world (Wheatley, 1999). Quantum leaps are an excellent example of quantum interconnectedness. Quantum leaps are abrupt and discontinuous changes where an electron jumps from one state to another without passing through any intermediate stages. The imagery of quantum leaps more accurately reflects experience of organizational and societal change than any other. One should not spend time on elaborate plans or timelines. Rather, time formerly spent on detail planning and analysis should be spent on creating the organizational conditions for people to set clear intent, on agreeing how they are going to work together, and on practicing how to become better observers, listeners, and colleagues as they co-create with their environment (Wheatley).

Organizational Fields and Forces

The gravitational field is thought to be a curved structure in space-time (Heisenberg, 1999). Electromagnetic fields create disturbances that manifest as electromagnetic radiation. Quantum fields, perhaps a different field for each particle, is energy manifesting into form when

two fields intersect (Wheatley, 1999). In all of these theories, fields are unseen forces, invisible influences in space that become apparent through their effects. Consideration of fields encourages us to think of a universe that more closely resembles an ocean, filled with interpenetrating influences and invisible forces that connect. In the field world, there are potentialities for influence whenever two energies meet. Wilczek and Devine (1998) stated

> The Newtonian picture of a world populated by many, many particles, each with an independent existence, has been replaced by the field picture of a world permeated with a few active media. We live amid many interpenetrating fields – each filling space. The laws of motion, in field language, were rules for flows in this ocean. And the rules of transformation were, in this picture, telling us what…reactions occur among the components of the universal ocean. (p. 163)

The invisible forces that field theory exposes can help manage other aspects of organizational life (Wheatley). For example, vision – organizational clarity about purpose and direction – is a wonderful candidate for field theory. In "old science" linear fashion we have most often conceived of vision as designing a future, creating a destination for the organization. We have believed that the clearer the image of the destination, the more force the future would exert on the present, pulling it to that desired state. It is a very strong Newtonian image, much like the old view of gravity. Thinking of vision as a field, however, we would start by recognizing that in creating the vision, we were creating a power, not a place, an influence, not a destination. This field metaphor would help us understand that we need congruency in the air, visionary messages matched by visionary behaviors. We would also know that the vision must permeate through the entire organization as a vital influence on the behavior of all employees (Wheatley).

Wheatley (1999) asserted that an organizational plan and planning processes simply do not work by asking people to sign on when they have not been involved in the planning process. This is where the observation phenomenon of quantum physics has something to teach us. In quantum logic, it is impossible to expect any plan or idea to be real to people if they do not have

the opportunity to interact personally with it. Reality is co-created by our process of observation, from decisions we the observers make about what we choose to notice.

We live in a universe where relationships are primary (Wheatley, 1999). Nothing happens in the quantum world without something encountering something else. Nothing exists independent of its relationships. We were constantly creating the world – evoking it from many potentials – as we participate in all its many interactions. This is the world of process, the process of connecting when "things come into temporary existence because of relationship" (p.69). We must create organizations of process and relationships, quantum organizations that work more effectively in this relational universe.

Heisenberg (1999) described the world of modern physics as one divided not into different groups of objects, but into different groups of connections. Wheatley (1999) asked, "Why do organizations limit themselves so quickly to one idea or one structure or one perception, or to the idea that truth exists in objective form?" (p. 73). We should not stay locked in our belief that there is one right way to do something, or one correct interpretation of a situation, when the universe demands diversity and thrives on a plurality of meaning. We should not avoid participation or worry about its risks when we need more and more eyes to be wise. Wheatley advised that we should not resist the powerful visions and futures that emerge when we come together to co-create the world. We should not be rigid or predictable when we have been invited to be part of the generative dance of life.

Stories and conversations are means for employees to connect with one another and to share their knowledge and experience (Wheatley, 1999). It is the meaningfulness of information that makes it potent or not. When information is identified as meaningful, it is a force for change. Information is generated freely by the system and fed back on itself so that it continues to grow

and change. We can not continue to use information technology in management systems as a gatekeeper, excluding and predefining who needs to know what. Instead, we need to evoke contribution through freedom, trusting that people can make sense of the information because they know their jobs, and they know the organizational or team purpose. Restricting information and carefully guarding it does not make us good managers. It just stops good people from doing good work. Information provides true nourishment; it enables people to do their jobs responsibly and well (Wheatley).

One of an organization's most critical competencies is to create the conditions that both generate new knowledge and help it to be freely shared (Wheatley, 1999). More and more, there is an acknowledged benefit to sharing information within and beyond the organization, to doing away with the gates and blockages, to moving past the hoarding and the fear, and to developing trusting relationships.

Wholeness and Implicate Order

Unbroken wholeness in organizations is "implicate or enfolded order" (Bohm, 1980, p. 188). Bohm used the term "implicate" (p. 188) to describe the intimate and entangled connections between people in organizations. In the enfolded order, space and time are no longer the dominant factors determining the relationships of independence or dependence of different elements. Rather an entirely different sort of basic connection of elements is possible from which our ordinary notions of space and time, along with those of separately distinct material particles, are extracted as forms derived from the deeper order. These ordinary notions in fact appear in what is called the explicit or unfolded order, which is a special and distinguishable form contained within the general totality of all the implicate orders (Bohm). Implicate order describes

how randomness and instability in organizations can become ordered through the intimate, entangled, and enfolded relationships and connections between the people within it.

What is needed in organizations is an act of understanding in which we see the totality as an actual process that, when carried out properly, tends to bring about a harmonious and orderly overall action in which analysis of parts has no meaning (Bohm, 1980). In quantum physics, a homologous process is described as relational holism where the whole systems were created by their relationships among subatomic particles. Bohm argued that in this process, the parts do not remain as parts, they are drawn together by a process of internal connectedness. It is not difficult to recognize ourselves as electrons in organizations, moving, merging with others, forming new wholes, being forever changed in the process (Bohm).

Science itself is demanding a new, non-fragmentary worldview. Analyzing the world into independently existent parts does not work very well in modern physics (Bohm, 1980). Science has shown that both relativity theory and quantum theory implying the undivided wholeness of the universe would provide a much more orderly way of considering the general nature of reality.

Reality can be considered a set of forms in an underlying universal movement or process (Bohm, 1980). Bohm also stated that knowledge can be considered in the same manner. The way, therefore, can be open for a new world in which consciousness and reality would not be fragmented. Bohm arrived at the notion that our general worldview is itself an overall movement of thought which has to be viable in the sense that the totality of activities that flow out of it are generally in harmony, both with themselves and in regard to the whole of existence. Such harmony is seen to be possible only if the worldview itself takes part in an unending process of development, evolution, and enfoldment, which fits as part of the universal process that is the ground of all existence (Bohm).

Quantum Change Forces

Wheatley (1999) stated that we think we were being helpful to others when we manage change so carefully because we believe that people do not like change. We have not thought that we might work with the forces of change and keep it under control every cautious step of the way (Wheatley). It is a particular characteristic of the human species to resist change, even though we were surrounded by tens of millions of other species that demonstrate wonderful capacities to grow, to adapt, and to change.

Our ideas and sensibilities about change come from the world of Newton. We treat a problematic organization as if it were a machine that has broken down. We use reductionism to diagnose the problem; we expect to find a simple, single cause for our woes. We sift through all the possible causes of failure searching for that one broken part - a bad manager, a dysfunctional team, a poor business unit. To repair the organization, we believe all we need to do is replace the faulty part and gear back up to operate at predetermined performance levels (Wheatley).

"New Science" is filled with tantalizing and hopeful processes that foster change (Wheatley, 1999). New science and quantum theory suggest that we must learn to look past an object or thing into the invisible level of dynamic processes. Wheatley suggested that we should lay aside the machine metaphor with its static mechanisms and separated parts. Look, Wheatley stated, for the underlying processes that give rise to innumerable and different life forms. Wheatley explained that this helps develop answers to how life is capable of so much change, so much newness.

Wheatley (1999) also stated that surrounded by creativity expressed as unending diversity, living in a world proficient at change, which maintains its resiliency through change, we can begin to work with powerful change forces rather than seeking to control or deny them.

But the shifts required to do this are enormous; they lead us into lands that are foreign and uncharted in Western thought. We need to work with the whole of a system, even as we work with individual parts or isolated problems; no problem or behavior can be understood in isolation (Wheatley).

We must account for dynamics operating in the whole system that are displaying themselves in these individual moments (Wheatley, 1999). This orientation is revealed in both quantum physics and chaos theory. When we shift our vision from the parts to the whole, what looks like chaos reveals inherent order (Bohm, 1980). What seemed like an aberration of Newtonian laws becomes lawful: paired electrons refuse to act individually and exhibit their inseparable wholeness across vast distances. A system world cannot be understood by looking only at discreet events or individuals (Wheatley).

We must understand that any phenomenon is not an isolated event, but a consequence of its relationship to other phenomena and that we must see the wholeness of nature (Wheatley, 1999). In traditional science, the scientist invents the questions and then interrogates the object of study. Wheatley described how Johann von Goethe, a philosopher and poet of the early nineteenth century, was intrigued to understand that we can “move from interrogation to receptivity, being open to what is occurring, allowing ourselves to be influenced by wholes we cannot see (p. 141).

Wheatley (1999) argued that while this sounds like reductionism, it is something quite different. We inquire into the part as we recognize our participation in the whole system. We can hold our attention at two levels simultaneously. Wheatley described how this manner of thinking is familiar in Buddhist belief, as illustrated in the following teaching story as told by Thich Nhat Hanh:

> All things depend on all other things for their existence. Take, for example, this leaf… earth, water, heat, sea, tree, clouds, sun, time, space – all of these elements have enabled this leaf to come into existence. If just one of these elements is missing, the leaf can not exist. All things rely on the law of dependent co-arising. The source of one thing is all things. (p. 142)

Therefore, collaborative processes are those that motivate people to change. People in organizations develop a deeper awareness of the work, not of personalities or particular parts of the organization. Wheatley stated that these people want the work to be more effective and they now see how they individually can better contribute to that outcome.

A system must develop greater self-knowledge in three critical areas (Wheatley, 1999). People need to be connected to the fundamental identity of their organization or community. Who were we? Who do we aspire to become? How should we be together? People need to be connected to new information. What else do we need to know? Where is this new information to be found? And people need to be able to reach past traditional boundaries and develop relationships with people anywhere in this system. Who else needs to be here to do this work with us?

Wheatley (1999) described zeitgeist as a way of thinking that characterizes a generation or a time period, adding that our zeitgeist is a new awareness that we participate in a world of exquisite interconnectedness. We were learning to see systems rather than isolated parts and players. Under the titles of system thinking or ecological thinking we are discovering many things worthy of wonder. Wheatley stated that we can now see the webs of interconnections that weave the world together. We are more aware that we live in a relationship, connected to everything else. We are learning how profoundly different processes in living systems emerge and change. Wheatley also explained that many disciplines, and many different voices, now

speak about the behaviors of networks, the primacy of relationships, the importance of context, and new ways to honor and work with the whole ways of life.

"New Science" Summary

Newtonian science has been used to develop logically empirical, mechanistic, and scientifically-focused organizational and management theories where organizations can be reduced to individual, objective parts, assessed, and reassembled in a positivistic manner. Critical theory and postmodern organizational paradigms do not agree with these views of organizations. The concepts of "New Science" use the uncertainty, complementarity, interconnectedness, relationships, wholeness, and the implicate order of new science help address the qualitative, subjective, and humanistic aspects of organizational change.

The concept for the study herein was framed using "New Science" as described above to help make sense of change in a university facilities management division.

Conceptual Framework

The study organization, the Facilities Management Division (FMD) at the University of Saskatchewan, was created almost 50 years ago. Upon my arrival in FMD in 2000, it was apparent that the Division had not kept pace with the demands from the university community. I believed that the Division had to change in some significant ways. Between 2000 and 2005 the Division did change. This did not mean that all people in the Division changed in the same ways. However, based on a successful third attempt at implementing a new maintenance system in 2003, many things in the Division did change. The Division began to function very differently than it had prior to that point.

As has been explained, modern science, specifically modern physics, is exploring new interpretations of large and small phenomena that go beyond Einstein's relativity and that go

beyond discoveries in quantum mechanics (Greene, 2003). This view is called “New Science”. A return to science, to “New Science”, may suggest ways in which new scientific organizational concepts may help critical theory and postmodern writers such as Foucault, Lyotard, and Derrida find a way out of their concerns over the issues of scientism versus humanism (Marshall & Peters, 1999). “New Science”, then, can be a useful lens through which to view change in a traditional scientifically managed organization.

The conceptual framework for the study was based on using the concepts of “New Science” to understand, and to make sense of, change in the Facilities Management Division. One particular initiative was used as an exemplar of how the Division changed during the study period. That initiative was the successful implementation of a *computerized maintenance management system* (CMMS). For many reasons, the Division had been unable to implement a complete CMMS despite two previous attempts in the preceding decade. The Division did implement a complete CMMS in October 2003.

“New Science” ideas used in the analysis included uncertainty, unpredictability, complementarity, complexity science theories of chaotic complexity and semantic complexity, non-linear adaptive feedback networks, and wholeness and implicate order. The framework is based upon determining how “New Science” ideas can provide a tool to understand how people are, or can be, connected in organizations and the adaptive and unifying mechanisms in organizations that can sustain change.

The changes in the Facilities Management Division were portrayed by text-based case study evidence collected from within the Division. The case study evidence was interwoven with my burographical reflections and observations of the changes in the Division from my perspective as the main actor in the Division during and after the study period.

The validity and credibility of the study was complicated by the qualitative and subjective nature of the approach and my role in the study organization. As suggested by Guba and Lincoln (1989), different aspects of authenticity and cross-checking were used to judge the quality of the research product.

Chapter Three

RESEARCH METHODOLOGY

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes. The changes were in response to new realities, to new knowledge, and to increasing demands for improvements from the division's internal and external environments.

This chapter begins with a description of the theoretical paradigms and perspectives upon which the research is based. This is followed by a description of qualitative research methods and a discussion of the choice of specific research strategies. Next, data collection methods and evidence are presented. The quality of the research product using ontological and educative authenticity is described, as is the role of the researcher. Ethical considerations are also presented in the chapter.

Theoretical Paradigms and Perspectives

The study is a qualitative research method into change in a university facilities management division and the applicability of the concepts of "New Science". Qualitative research combines beliefs about ontology (What kind of being is a human being? What is the nature of reality?), epistemology (What is the relationship between the inquirer and the known?), and methodology (How do we know the world, or gain knowledge of it?) (Denzin & Lincoln, 2000). These beliefs shape how the qualitative researcher sees the world and acts in it. The researcher is "bound within a set of epistemological and ontological premises which – regardless of ultimate truth or falsity – become partially self-validating" (p. 19).

Denzin and Lincoln (2000) stated that the net that contains the researcher's epistemological, ontological, and methodological premises may be termed a paradigm, or an interpretive framework, a basic set of beliefs that guide action. All research is interpretive, it is informed by a set of beliefs and feeling about the world and how it should be understood and studied. Each interpretive paradigm makes particular demands on the researcher, including the questions he or she asks, and the interpretations the researcher brings to them (Denzin & Lincoln).

The constructivist paradigm assumes a relativist ontology (there are multiple realities), a subjectivist epistemology (knower and respondent co-create understandings), and a naturalistic (in the natural world) set of methodological procedures (Denzin & Lincoln, 2000). Terms such as credibility, transferability, dependability, and confirmability replace the usual positivist criteria of internal and external validity, reliability, and objectivity. The authenticity criteria explained by Guba and Lincoln (1989) replaced these parallel criteria in the study.

Research methods have variously been classified as objective versus subjective, as being concerned with the discovery of general laws (nomothetic) versus being concerned with the uniqueness of each particular situation (idiographic), as aimed at prediction and control versus explanation and understanding, and as taking an outsider (etic) versus an insider (emic) perspective, and so on (Burrell & Morgan, 1979).

Qualitative Research

Keeves (1999) stated that there should be a rejection of the misleading dichotomy of research procedures into qualitative and quantitative methods, since it is argued that the "choice of procedures to be employed depends on the nature of the problem under investigation" (p.3). Keeves also argued that wisdom no longer refers to "knowledge of an abstruse kind", but rather

to the “quality of being wise in relation to conduct and the choice of ends and means” (p. 4) in particular situations. According to Keeves, the knowledge generated by research activity must be debated among scholars and tested against evidence from the real world and stored and structured in a coherent way prior to further review and testing. Failure to review the products of educational research as a coherent body of knowledge would seem to misunderstand the nature of the research enterprise. Keeves stated that education research has a unique function in this enterprise insofar as it not only involves the construction of a body of knowledge, but it also involves the investigation of the processes by which all knowledge is passed on to successive generations and by which the skills of inquiry were acquired, as well as the processes by which social action is initiated.

Schwandt (2000) argued that qualitative inquiry is a name for a reformist movement that began in the early 1970’s in the academy. The movement encompassed multiple epistemological, methodological, political, and ethical criticisms of social scientific research in fields and disciplines that favored experimental, quasi-experimental, correlational, and survey research strategies. Schwandt stated that qualitative inquiry is a comprehensive site for social scientific criticism. That site is a “home” (p.190) for a wide variety of scholars who are often seriously at odds with one another but who share a general rejection of the blend of scientism, foundationalist epistemology, instrumental reasoning, and the philosophical anthropology of disengagement that has marked “main stream” (p.190) social science. Schwandt focused on the site as an arena in which different epistemologies vie for attention as potential justification for doing qualitative inquiry. Schwandt examined three of the philosophies that appear in the many books that explain the aims and methods of qualitative inquiry. Interpretivism, hermeneutics, and social constructionism embrace different perspectives on the aim and practice of understanding human

action, different ethical commitment, and different stances on methodological and epistemological issues of representation, validity, objectivity, and so forth (Schwandt).

Guba and Lincoln (1994) suggested four underlying paradigms for qualitative research: positivism, post-positivism, critical theory, and constructivism. Meyer (2002) suggested three categories based on the underlying research epistemology: positivist, interpretive, and critical. While these three research epistemologies are philosophically distinct (as ideal types), in the practice of social research these distinctions are not always so clear cut (Meyer).

Interpretive researchers start out with the assumption that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, and shared meanings (Meyer, 2002). The philosophical base of interpretive research is comprised of hermeneutics and phenomenology (Boland, 1985). Interpretive studies generally attempt to understand phenomena through the meanings that people assign to them. Interpretive research does not predefine dependent and independent variables, but focuses on the full complexity of human sense-making as the situation emerges (Kaplan & Maxwell, 1994). My study used hermeneutics and phenomenology as the philosophical basis for interpreting and making sense of change in the study organization though the lens provided by the concepts of “New Science”.

Choice of Specific Research Strategies

The research design described a flexible set of guidelines that connected theoretical paradigms: first, to strategies of inquiry; and second, to methods for collecting empirical material (Denzin & Lincoln, 2000). The research design situated me in the empirical world of the study organization and connected me to specific sites, persons, groups, institutions, and bodies of relevant interpretive material in FMD, including archival documents. Denzin and Lincoln argued that strategies of inquiry put paradigms of interpretations into motion. Strategies of inquiry

connected me to specific methods of collecting and analyzing empirical materials in the study. For example, the case study used in the research relied on observing, reflecting, and document analysis. Research strategies implement and anchor paradigms in specific empirical sites, or in specific methodological practices, such as making a case study an object of study (Denzin & Lincoln). These strategies included the autobiographical (burography) and the case study methods employed in the study.

The Schwabian tradition of practical reasoning and Schon's notion of the reflective practitioner (Kemmis, 1999) were also used in the study. Denzin (1999) stated the following when he described how Derrida contributed to the understanding that there is no clear window into the inner life of a person:

> For any window is always filtered through the glaze of language, signs, and the process of significance. Moreover, language, in both its written and spoken forms, is always inherently unstable, in flux, and made up of the traces of other signs and symbolic statements. Hence there can never be a clear, unambiguous statement of anything, including an intention or a meaning. The researcher's task is to reconcile this concern with the metaphysics of presence, and its representations, with a commitment to the position that interpretative sociologists and anthropologists study real people who have real lived experience in the real world. (p. 94)

The data in the study were based on the understanding of various text and imbedded signs, signals, and symbols from within FMD during the study period.

The research involved the study of real events and experiences in FMD from 2000 to 2005. As the Associate Vice-President of the Division I was directly or indirectly connected to all events that took place during the study period. My impact on the changes in the Division can not be ignored. Indeed, certain autobiographical aspects of my role in the changes in the Division are critical to the study's analysis and conclusions.

Due to my role in the study, and in order to keep the study focused and manageable, two integrated qualitative research methods were chosen that facilitated the interpretation of the changes that a university administrative division experienced over a five-year period. These two research methods were burography and case study.

Burography

The study employed a research method Denzin (1999) attributed to sociologist John M. Johnson called "burography" (p. 92). Burography describes "an intersection of biography, personal experience and text based on the cultural study of the person's own group" (p. 92). In this case, this was my personal experience as the Associate Vice-President of the Facilities Management Division at the U of S. I used burography as a method by which to include my role as the main actor in the Division and as a mechanism to provide my recollections and reflections about the changes in the Division. Burography was not used as a method to make me a direct subject of the study. Johnson explained that burography not only reports the struggle to realize one's values with real life experience, but is part of one's personal struggle to bring order to a disordered world. Here, too, "New Science" concepts of complexity, chaos, and order can be informative.

Grounded in the reality of daily life, burography seeks to aid understanding of organizational processes that remain true to the perspective(s) of the organizational actor (Johnson, 1989). Burography "articulates the organizational experience and meaning from the actor's perspective" (p. 440). Johnson also stated that a particular bureaucracy can only be understood fully in reference to its larger environment. The perspective of the larger environment, and how one and one's organization is related to the larger environment, influences the types of bureaucratic perspectives one finds (Johnson).

Perspectivism and relativism were significant factors in FMD's historical and evolving relationship with the campus community. Schwandt (2000) argued that "perspectivism opposes a naïve realist and empiricist epistemology that holds that there can be some kind of unmediated, direct grasp of the empirical world and that knowledge simply reflects or mirrors what is 'out there'" (p.197). The study's analysis and conclusions addressed how the Division's knowledge, meaning, and understanding changed along with its perspective during the study period.

Marvin (2005) described how Heraclitus required his audience to try to think away their purely personal concerns and view the world from a more detached perspective. By the use of telling examples Heraclitus highlights the relativity of value judgments. The implication is that unless people reflect on their experience and examine themselves, they are condemned to live a dream-like existence and to remain out of touch with the formula that governs and explains the nature of things. This formula is connected (symbolically and literally) with "ever-living fire" (p. 1), whose transformations were not only the basic operation of the universe but also essential to the cycle of life and death. My burography was based on my reflections that include telling examples of my changing perspective, values, and worldview during the study period.

The data from my burography did not stand alone as separate data to be interpreted using the concepts of "New Science". Rather, my burography was incorporated into the case study of change in the study organization. This was appropriate since the burography was based on my recollections and reflections as the senior person in the same organization that was the focus of the case study.

Case Study

My burography was imbedded within the case study of the implementation of a computerized maintenance management system in the study organization from 2000 to 2005. A

single case study involves personal recollections of an event or social process and their causes and their effects; a case study is not about a person (Denzin, 1999). The advantages of the case study are its applicability to real-life, contemporary, human situations and its public accessibility through archival materials (Soy, 1997). Case study results can facilitate an understanding of complex real-life situations. The case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (Yin, 1984, p. 23). I followed the case study approach recommended by Soy based on the work of Yin, and others.

The first step in the case study was to establish a firm research purpose to which I could refer over the course of study. The research object in a case study is often a program, an entity, a person, or a group of people intricately connected to political, social, historical, and personal issues, providing wide-ranging possibilities for questions and adding complexity to the case study (Soy, 1997). My aim was to investigate the object of the case study in depth using a variety of data to produce evidence that could address the purpose of the study. The object of the case study was the Facilities Management Division at the U of S. Case study research generally answers one or more questions which begin with "how" or "why" or "what" (Soy). The questions are targeted to a limited number of events or conditions and their inter-relationships.

To assist in targeting and formulating the purpose of the study, I conducted a literature review of "New Science". This review established what research on "New Science" had been previously conducted and helped refine the problem and the purpose of the study. The purpose of the study, and the question imbedded in the purpose, was to use "New Science" as a lens through

which to view change in a university facilities management division and to determine in what ways “New Science” could help make sense of these changes.

The second step in the case study was to determine the data gathering and analysis techniques to be used. I needed to determine what approaches to use in selecting single or multiple real-life cases to examine in depth and which instruments and data gathering approaches to use. I did not assume that the case study of FMD was unique or typical of facilities organizations based on location or size or a variety of other parameters. The case study involved a single industry (facilities management in the Canadian post-secondary education sector) and a firm participating in that industry (FMD at the U of S). Soy (1997) stated that this type of case study involves a multi-layered analysis and increases the complexity and amount of data to be gathered and analyzed. Soy explained that a key strength of the case study involves using multiple sources and techniques in the data gathering process. I determined in advance what evidence in the Division to gather and what analysis techniques to use with the data in order to address the purpose of the study. The data gathered was qualitative. Tools to collect evidence included documentation search and review, observation, and recollection and reflection.

The third step in the case study was preparing to collect the data (Soy, 1997). Because the data came from multiple sources in the Division, systematic organization of the data was important to prevent becoming overwhelmed by the amount of data and to prevent losing sight of the original research purpose. I prepared an electronic database for categorizing, sorting, storing, and retrieving data for analysis.

Soy (1997) described the fourth step in case study as collecting the data in the field. I collected and stored multiple sources of evidence comprehensively and systematically in the database for future sorting and analysis. I reviewed the evidence as it was being collected to see

if the purpose and the method of the study needed to be renegotiated. I categorized and referenced the data so that it was readily available for subsequent reinterpretation.

The fifth step was evaluating and analyzing the data. I examined the case study data to determine how “New Science” could help makes sense of the change evidence collected from the Division as per the purpose of the study. Throughout the evaluation and analysis process, I tried to remain open to new opportunities and insights for better understanding of “New Science” concepts in relation to change in the study organization. The case study, with its use of multiple data collection and analysis techniques, provided opportunities to triangulate data in order to strengthen the research findings and conclusions (Soy, 1997). For example, I looked for correspondence, presentations, reports, and my own reflections on the changes in the Division that either confirmed or contradicted the analysis and conclusions. During the analysis, I tried to move beyond my initial impressions of the changes in the Division to improve the likelihood of accurate and reliable findings. This was especially important given my role in the Division during the study period. Soy argued that exemplary case studies (such as this study) should attempt to compare the data in order to expose or create new insights and to identify conflicting data that may disconfirm the analysis. The CMMS project case study data included project management reports, correspondence, presentations, meeting minutes, policies and procedures, structural diagrams, and schedules.

Integration of Burography and Case Study

The case study included evidence of change in the Facilities Management Division during the CMMS project and my burographical reflections as the head of the Division during and after the system implementation. My burographical reflections were embedded in the change evidence in the case study. I based my reflections partially on my personal daily log which can

be found in Appendix B and Appendix F. I also included burographical information about my career prior to joining the Division in Chapter One.

Data Collection and Evidence

The qualitative research method used in this study was designed to determine how concepts from "New Science" could help make sense of change in a university facilities management division. The qualitative data sources used in the study included fieldwork collection of documents and texts and my observations, reflections, impressions, and reactions as burography embedded in the case study material. The qualitative method and data were designed to help me understand the people in the Division and the social and cultural contexts within which they lived and changed using the concepts of "New Science".

There were many change initiatives in the Division between 2000 and 2005. In order to manage the depth and breadth of the study, the most significant change initiative in the Division during the study period was used as an exemplar. This initiative was the designing and implementing a CMMS. The CMMS project included more knowledge, reality, human nature, methodological and "New Science" issues than any other initiative in the Division during the study period. The project was the core enterprise-wide system that managed every aspect of the Division. The project involved more staff and included more subjective and objective challenges than any other project between 2000 and 2005.

Prior to 2000, the Division had not dealt with the organizational changes necessary to ensure a successful CMMS implementation. Consequently, even after investing many millions of dollars, two previous attempts at implementing a new system failed. A new computerized maintenance management system was successfully implemented between 2000 and 2005.

Data and evidence were collected that comprehensively described all aspects of the CMMS project, the most representative and useful example of a change initiative in the Division during the study period. Excerpts from various management data sources were included in the study and included the following:

1. Information from management reports.
2. Information from internal and conference presentations by the project team.
3. Information from internal and conference presentations.
4. Divisional newsletters and communiqués.
5. Meetings agendas and notes.
6. Project schedules and action items.
7. My personal daily log.
8. Divisional policies and procedures.

The case study was a narrative based on the evidence I found in FMD of the CMMS project change initiative using the data sources described above. The evidence was coded as shown in Table 3.1 and stored in an electronic database. My burography was an integral component of the case study narrative.

Table 3.1.

CMMS Project Data Coding

Data type	Data code
Structure and process	S
Reports	R
Communications	C
Team meetings agendas/minutes/actions	A
Presentations	P
Policies and procedures	L

Data sources were freely available and existed as part of normal day-to-day functioning of the Division. The database was used to organize the data for the writing of the case study.

Quality of the Research Product

The study of FMD at the U of S was a qualitative study. Walker and Evers (1999) described how quantitative researchers have often seen qualitative research as "lacking in objectivity, rigor, and scientific controls" (p.43). Lacking the resources of quantification, qualitative research can not produce the requisite generalizations to build up a set of laws of human behavior, nor can it apply adequate tests for validity or reliability (Walker & Evers). Moreover, the positivist facts/value distinction is often employed to discredit the claims of qualitative inquiry to produce knowledge, since knowledge is value-free, whereas qualitative research is irreducibly value-laden and subjective. In short, qualitative research falls short of the high standards of objectivity and the tight criteria for truth of the quantitative or scientific paradigm. Walker and Evers explained that, given the prestige of science, and a positivist view

of science, it is easy to see why quantitative researchers sometimes see qualitative research as not being as sound as the scientific method.

Walker and Evers (1999) reported that many qualitative researchers, evoking the explanation/understanding distinction, claim that the genuinely and distinctively human dimensions of education can not be captured by statistical generalizations and causal laws. Knowledge of human affairs is irreducibly subjective. It must grasp the meanings of actions, the uniqueness of events, and the individuality of persons. Walker and Evers stated that from this perspective, it is easy to see the quantitative tradition as an intrusive, even alien and anti-human approach to the study of education. “Science may be appropriate to the study of nature, but it distorts the study of human affairs” (p. 44).

Quality Characteristics

The research method employed in the study involved integrating burography with a case study of change in a university facilities management division. Critics of the case study method believe that the study of a small number of cases can offer no grounds for establishing reliability or generality of findings (Soy, 1997). Others feel that one’s exposure to study of a case can result in biased findings. Some dismiss case study research as useful only as an exploratory tool. These concerns are especially important in this study where my burography was based on my reflections as the leader of the same organization that was the focus of the case study. Soy argued that researchers can continue to use the case study research method with success if the study is carefully planned and if it is a well-crafted analysis of real-life situations, issues, and problems.

Based on Soy’s (1997) advice on the quality of case studies, and based on Smith and Deemer’s (2000) characteristics for judging the quality of the research product, I was flexible and adaptable throughout the data synthesis and analysis and I was aware of and I stated my

history and prejudices. I recognized when concepts were difficult to articulate and I did not claim that the study was the final word on the topic. I understood that dialogue and challenge can advance theory and ideas and I was prepared to use other exemplars along with the CMMS project. As well, I avoided making objective and affirmative claims in the analysis and conclusions and I was prepared to re-prioritize, re-frame, and re-contextualize thoughts and ideas. I was aware that my socio-political world-view was constantly changing and I attempted to avoid imposing theoretical reality and knowledge claims.

I did not design the research with the intent of using traditional validity criteria to judge the quality of the research product. Instead, I used authenticity criteria described by Guba and Lincoln (1989).

Authenticity Criteria

Guba and Lincoln (1989) stated

> The so-called parallel or quasi-foundational criteria for judging the quality of goodness of a fourth generation evaluation, typically called the trustworthiness criteria, and the goodness of quality of the hermeneutic process itself, is not entirely satisfying since they are parallel criteria with their origins in positivist assumptions. (pp. 233-245)

These criteria are also primarily methodological. Guba and Lincoln argued that method is critical for ensuring that results are trustworthy but that method has primacy in a positivist paradigm. But method is only one consideration in constructivist inquiry or “fourth-generation evaluation” (p. 233). Outcome and product criteria are equally important in judging a given inquiry. Relying solely on criteria to speak to methods leave an inquiry vulnerable to questions regarding whether the stakeholder’s rights were in fact honoured. Prolonged engagement and persistent observation do not ensure that stakeholder constructions have been collected and faithfully represented.

Reliance on pure or pristine method alone is insufficient to guarantee that the intent of the inquiry effort was achieved (Guba & Lincoln).

Ontological authenticity. Guba and Lincoln (1989) defined the ontological authenticity criteria as referring to the extent to which individual respondents' emic constructions are improved, matured, expanded, and elaborated. It is, literally, "improvement in the individual (or group's) conscious experiencing of the world" (p.248). Ontological authenticity can be enhanced through the provision of vicarious experience, which enhances the opportunity for individual respondents (stakeholders and others) to apprehend their own worlds in more informative sophisticated ways.

The study used the technique suggested by Guba and Lincoln (1989) for demonstrating that the criterion of ontological authenticity had been achieved. Documents showed that individual stakeholders attested to the fact that they now understood a broader range of issues, and that they can appreciate (understand, comprehend) issues that they previously failed to understand. The case study data included entries of individual constructions throughout the study period in order to document "progressive subjectivity" (p. 248).

Educative authenticity. Guba and Lincoln (1989) also explained that educative authenticity represents the extent to which individual respondents' understanding of, and appreciation for, the constructions of others outside their stakeholder group are enhanced. Stakeholders should have the opportunity to be confronted with the constructions of others very different from themselves.

The achievement of educative authenticity was demonstrated with archival data from the case study that attested to the fact that participants comprehended and understood the constructions of others different from themselves.

Member-Checking and Triangulation

Due to the case study and burographical methods of the study, member-checking (testing hypothesis and interpretations with members of the stakeholder groups from whom the original constructions were collected) (Guba & Lincoln, 1989) was not appropriate or possible. Although triangulation "carries too positivist an implication, to wit, that there can exist unchanging phenomena so that triangulation can logically *be* a check" (p. 240), a form of checking and triangulation was used to help ensure quality goodness and authenticity. I relied on my advisor, Dr. Patrick Renihan, a senior faculty member at the U of S, and someone who was familiar with FMD and its change history and culture, for "cross-checking" (p. 241) specific data items of a factual nature.

Role of the Researcher

Six interconnected activities defined the qualitative research process used in the study. They go by a variety of different labels including theory, method, analysis, ontology, epistemology, and methodology. Behind these terms stands the personal biography of the researcher who speaks from particular class, gender, racial, cultural, and ethnic community perspective (Denzin & Lincoln, 2000). Denzin and Lincoln stated that the gendered, multiculturally situated researcher approaches the world with a set of ideas, a framework (theory, ontology) that specifies a set of questions (epistemology) that he or she then examines in specific ways (methodology, analysis). Denzin and Lincoln also explained that every researcher speaks from within a distinct interpretive community that configures, in its special way, the multicultural, gendered components of the research act.

I have been the Associate Vice-President of FMD since early 2000. I was the senior internal resident actor (more than an external observer and more than an internal participant) of

the study and the prime driver for the changes in the Division. My hierarchical and positional management and leadership theories and values more than just shaped the changes in the Division. One has to look beyond the instructions and tasks I assigned to see the full impact I (and other leaders and managers) had on the changes in the Division. Of equal importance was my perspective of reality, of truth, and of knowledge about what was important to the division during (and after) the study period. The power and authority of my position, and the power I achieved by being the most knowledgeable about the uncertainty and the unpredictability facing the Division, and how this related to "New Science" concepts of complementarity, semantic and chaotic complexity, non-linear adaptive networks, and wholeness and implicate order were important considerations in the analysis.

My role in the research was to be a reflective practitioner engaged in a burographical case study. My observer-participant role and my theories, values, needs, desires, and worries cannot be ignored; they are captured in the burography.

Ethical Considerations

Schwandt (2000) stated that there is a good deal of criticism directed at the moral and political requirements of social research practices. At issue is how to answer the fundamental question, "How should I *be* toward those people I'm studying?" (p. 203). Schwandt argued that there were at least two sharply different answers to this question. Firmly in line with the interpretivist tradition of disengagement, Prus (1996) defended what some qualitative researchers would perhaps criticize as a conventional, modernist, and dangerous view of the inquirer. Schwandt described this view as "attempting to minimize the obtrusiveness of the observer in the field and in the text eventually produced…an image of a researcher who is more chameleon-

like…who fits into the situation with a minimum of disruption, and whose work allows the life-world of the other to surface in as complete and unencumbered a manner as possible" (p.203).

Schwandt (2000) described how Denzin, in sharp contrast, aimed to create a "form of gazing and understanding fitted to the contemporary, mass-mediated cinematic societies called post-modern" (p. 203). Such a gaze would undermine from within the cold, analytic, abstract, voyeuristic, disciplinary gaze of Foucault's panopticon. This is a newer, calmer, and gentler compassionate gaze which looked for, and desired, not technical instrumental knowledge, but in-depth existential understandings (Schwandt).

Schwandt (2000) also asked how one understands the differences in the ethical-political stances of the researcher illustrated by Prus (1996) and Denzin (1997) and how one decides what to do about one's own ethical-political commitments as a researcher depending in part on the ethical framework one draws on to make sense of these kinds of situations. This observation takes us into the realm of ethics and moral philosophy. Schwandt stated that morality is de-ontological (primarily concerned with moral obligations and commitments) and that the moral point of view is marked by its impartiality and universality. Schwandt also argued that conflicts of rights and obligations were open to argumentative resolution.

Taken collectively, these ideas constitute a largely formalistic understanding of morality. Schwandt (2000) explained that formalistic means that within the standard framework, the moral point of view is defined in terms of formal criteria. He argued that it would be both incorrect and naïve to argue that a formalistic theory of ethics and morality maps directly onto some set of quantitative methodologies. Linking this work in moral phenomenology and moral epistemology to thinking about the ethics and politics of qualitative (and, more generally, all social) research is a complex matter (Schwandt).

There were no changes in my interactions with any person at the university prior to, during, or after the research study. My activities were within my "normal" role as the Associate Vice-President of the Facilities Management Division. There were no changes to the moral and ethical obligations I had as mandated in my job profile, as I had as a Professional Engineer, as expected of me as a senior university officer, and as required of all Board of Governors appointees.

This study was originally judged to be exempt from full ethics review and approval (see Appendix D). Subsequent to the thesis defense, some concerns about the content of the thesis were drawn to the attention of the University Ethics Office. The matter was referred to the Behavioural Research Ethics Board which reviewed the thesis and recommended that a number of alterations be made to make it less likely that any specific individual could be identified. These changes were made by the author.

Research Methodology Summary

The research method used in the study was an integrated burographical case study involving personal recollections and reflections of the events, social processes, meanings, understandings, and interpretations in FMD during the study period. Critical (double) hermeneutics, interpretative understanding, discourse analysis, and social construction were key components of the methodology. The critical aspects of these methods were due to the significant power issues involved in the study, although not to the extent that a full critical theory or postmodern approach would prescribe. The study avoids paradigmatic monism and uses complementary and unity perspectives. A realistic (non-naïve neo-realism) ontology, and a relativistic, perspectivism-based, and morally pragmatic epistemology were used. A non-foundationalist approach will lead to an analysis of organizational change and unpredictability,

interconnectedness, and wholeness and implicate order suggested by the concepts of “New Science”.

The integrated research methodologies of burography and case study were designed to support the purpose of the study to use “New Science” as a lens through which to view change in a university facilities management division and to determine in what ways “New Science” could help make sense of these changes. The changes were in response to new realities, to new knowledge, and to increasing demands for improvements from the division’s internal and external environments.

Chapter Four

CASE STUDY AND BUROGRAPHY DATA

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes. This chapter is the case study of a representative change initiative in the study organization. The case study includes my burographical recollections and reflections as the main actor in the study organization during and after the study period. I used burography as a method by which to include my role in the changes in the Division and as a mechanism to provide my recollections and reflections about the changes. Burography was not used as a method to make me a direct subject of the study. The burography elements are interwoven into the case study data.

The unit of study was the Facilities Management Division (FMD) at the University of Saskatchewan (U of S). The representative change initiative was the design and implementation of a new *computerized maintenance management system* (CMMS).

Data Collection and Evidence Interpretation

Data sources used for the case study included communications, reports, meeting agendas and minutes, newsletters, presentations, and policies and procedures developed during the CMMS project. Data were located in divisional and individuals' current and stored electronic and paper files. All data were public information and were available to me as the Associate Vice-President and head of the facilities organization at the university. The burographical elements in the case study were based on my review of the case study data, on my review of my personal daily log, and on my reflections on my experiences and thoughts during the CMMS project.

Data were located, reviewed, sorted, categorized, coded, and entered into an electronic database. I used the electronic database in conjunction with my personal daily log to write the case study and burography. My recollections of dates and events in FMD from 2000 to 2005 were based on my personal daily log that can be found in Appendix F. My personal daily log and other materials referenced in the study and some that are available via the Internet are listed in Appendix B. A list of acronyms can be found in Chapter 1. The changes in FMD dealing with developing and implementing a new *computerized maintenance management system* (CMMS) were the focus of my recollections. Although I faced many issues as the new AVP of the Division, the case study and my burography used the CMMS as the project that best reflected organizational change in FMD between 2000 and 2005. It is important to note that it was not the individual data included in the case study as evidence of change in the organization that were important. Rather, it was the case study evidence portraying the dynamic complexities and relational holism in the organization that was significant.

This case study and burography begins with evidence describing the context for the case study of change in FMD and the need for new supporting systems and purpose in the Division. The timeline of the changes in the Division is then described and the beginning conditions in the Division are portrayed. I describe my arrival in FMD and how roles and responsibilities of individuals and groups were used to build connections and to overcome resistance to change.

The Context and Impetus: Change and Supporting Systems and Purpose

The context of facilities management, FMD's environmental conditions in 2000, and my career background were described in Chapter 1. The environmental scan and other outcomes of FMD's strategic planning sessions can be found in Appendix C. Internet locations for some other relevant data can be found in Appendix B.

Prior to 2000, the facilities organization at the U of S had been operating and maintaining the campus as it had been doing for the past 45 years. Funding for maintaining the physical plant had remained relatively stable over this period. The senior person in the Division, the Associate Vice-President, had reported directly to the university president and had been in his position for 25 years.

Upon my arrival in the Division in 2000, I was told by senior administrators and people in the campus community that the Facilities Management Division had been fulfilling its technical role to protect the university's physical assets reasonably well. However, I was also told that it had not responded well to comments and needs expressed by the campus community concerning its attitude and services. In addition, I soon became concerned that the Division seemed ill-prepared to manage a large capital building campaign expected to begin in late 2000 (some planning had begun in 1997). I felt that the human, financial, and technical issues for the Division related to the capital building program were similar to the issues the Division faced in addressing the complaints from the campus community. These issues included work processes and controls, priorities and planning, attitude and perceptions, transparency and communications, and management systems, structures, and policies. I believed that the fundamental problem was that the Division was not aware that it needed to change, and that it was not capable of making these changes even if it had been aware.

My first months at FMD were spent meeting people, setting up various working groups to help assess the organization, and joining many committees on campus. I set up a communications committee (1/11/2000, ongoing) and hired faculty to design, implement, and analyze customer and employee surveys (2/9/2000). I began to meet with my direct staff on a weekly basis (2/15/2000, ongoing) and I met with union executive (1/7/2000) and provincial

Ministers (1/18/2000). I set up Stakeholder Advisory Group (SAG) and Strategic Employee Partnership (STEP) committees (1/26/2000, 6/27/2000, respectively) and I began to meet with students (2/15/2000, ongoing). My directors and I met at our weekly Planning and Priority (P&P) meeting (9/13/2000, ongoing). I met with Deans (1/14/2000, ongoing), I met with the media (9/1/2000, ongoing), and I developed a new relationship with Health, Safety, and Environment (HS&E) (8/15/2000, ongoing). The communications group started a FMD newsletter (8/31/2000, ongoing) which included a new logo, a new slogan, and a new motto. A social committee was created (2/17/2000, ongoing) and it organized barbecues (7/12/2000, ongoing) and other social events (3/30/2001, 5/12/2000, ongoing). FMD also held a Customer Forum (10/16/2001), created a new web site (10/16/01, ongoing), started an Equity Committee (12/2/03), and held harassment and discrimination workshops for all staff (5/17/2000). I also began a process of strategic planning (5/3/2000, ongoing) that changed greatly over the five years of the study. The many university committees I joined are listed in Appendix G.

FMD and Computerized Maintenance Management Systems

Facilities management units use a CMMS to record, process, track, and report on internally or externally generated requests for service. Services requested ranged from help to repair broken equipment to renovation projects to preventative maintenance programs. Computerized maintenance management systems are enterprise-wide computerized systems designed to manage activities through the use of individual work orders. Work orders can be used to track stores inventories and to manage financial transactions and reporting. They can also be used by the CMMS to manage auxiliary services such as fleets, grounds, utilities, and engineering operations.

Facilities management units (or “physical plant departments” as they used to be called) started using computerized systems to help manage their work in the early 1980s; FMD at the U of S was no exception. CMMS applications were designed to

- receive and code requests for facilities management services (see Chapter 1),
- issue a work order to the appropriate shop or area for action,
- help plan and forecast scheduled work, and to
- report work completion and labour and material costs management information.

The CMMS system at FMD was also customized to

- support a purchasing and stores operation,
- provide functionality for fleet, garage and materials management,
- allow minor and major construction project management,
- process all accounts payable and receivables,
- interface with the university’s FRS system, and to
- handle all personnel record keeping and reporting.

FMD’s CMMS system was at the center of all its activities. All technical, financial, and human management information, work processes, structures, policies, and practices where driven by, or connected to, the CMMS.

Upon my arrival in the Division, it soon became clear that it was using only about 30% of its existing CMMS capability. This was discussed in detail at my first meeting with staff (5/25/2000). Despite the Division spending millions of dollars on the initial system and subsequent upgrades and enhancements, some staff had decided from the onset not to change their work practices in order to use the main functionality of the CMMS: the issuance of work orders to manage and report on work and budgets.

The Division had installed its first computerized maintenance management system in 1991; the system's core program and database were partially upgraded in 1998. During both installations, the full capability of the system was not installed and many of the system's modules and functions were not used. Unfortunately, by 2000, the pressures on the Division to change in order to improve its services, and to deal with the upcoming capital building program, required the Division to have a very robust and capable maintenance system. Not only had the original system been implemented without many of its key functions, FMD also lacked the understanding, the ability, the structures, the processes, and the desire to upgrade these functions. When I joined the Division in 2000, it did not realize that it needed a fully functioning maintenance system. Even had it been aware of this, the Division was not able as a unit to implement these changes. This was also the case for other important issues in the Division.

Full use of a CMMS would result in all activities, budgets, times, costs, backlogs, and planning and performance information being captured and available to Divisional senior management and to the university community. Although critical to improving many aspects of the Division, the system was not being used in this manner. A CMMS requires an individual work order to be created before any work can be authorized or done. The Division had been using a system of "standing work orders" that provided one work order per building for tracking costs for all work done in a building. Some in the Division claimed that using the CMMS to create unique work orders for each work request would insert work order "bureaucracy" between them and their "customers". They stated that using individual work orders for each work request would seriously impair their ability to maintain the physical plant and to serve the campus community.

My sense was that this purported concern for the campus community was a “red herring”. I believed that the motivation for some to not use the CMMS was to maintain their independence, power, and authority that came by not using a central oversight system to manage activities and budgets. Without such a system in place, people could run their operations as individual units. No one could tell what was happening in their areas because no data was being collected or reported. All activities, all costs, and all backlogs (as well as any questions about why, what, who, or when) were buried in the standing work order data collection system.

The attitude of some in the Division in 2000 towards any type of management or information system was, “Real men do it in their head” and no systems or processes were required to help them do this. I sensed that some staff did not want a comprehensive system reporting on their activities or those in their shops. It also seemed to me that the attitude that resisted comprehensive systems and processes (like the CMMS) was the same attitude that was partially responsible for the university’s opinion that FMD was arrogant and inward-looking.

Service time and cost standards were defined by the Division and people on campus were told what would be done, when, and for how much. The Division did not explain why its services had to be used, nor were outside contractors ever used to bring a different perspective to operations and maintenance. It knew best what work should be done for whom and in what priority. Campus activities had to stop when FMD wanted to do work in any building area. People could not choose the type of furniture they received and no explanation was provided as to why this was FMD “policy”. Senior university executive and academic Council were not consulted about how capital monies were allocated and FMD assumed the authority to set the capital building program with no input from anyone on campus. The Division did not concern itself with the campus community’s concerns about time, cost, quality, communication,

aesthetics, or comfort. These issues were deemed not important or they were defined by FMD and the campus was told how these concerns would be addressed. FMD did not communicate any campus planning and development decisions and FMD alone set all work and project priorities and plans. FMD defined its own position and authority on campus and it developed the service and stewardship standards that it believed were appropriate. Building closures, noise, classroom scheduling, space planning, moves, construction, and resource allocation were all determined by FMD alone, with no input from the campus community. FMD was not concerned about how it was perceived by the campus community.

Introduction to the CMMS Project

Soon after arriving in the Division in 2000 I realized that utilizing the CMMS to its fullest capability was central to the Division achieving many of its goals. Unfortunately, the CMMS's main function, work order processing, was resisted by the group who should have been using the system the most, the operations and maintenance group. I also realized that the funding and technical challenges associated with using all features of the CMMS were not going to be the biggest problem. The biggest problem was going to be getting some staff to understand why the Division needed to use the CMMS differently and why this was important.

I created a CMMS working group team as shown in Figure 4.1. I did not believe that the new CMMS installation and upgrade project should be treated as an accounting and purchasing matter only and that only staff from these areas should be involved in the project. In fact, I wanted the system, and its design, implementation, and ongoing care and development, to be owned by the operations and maintenance group.

The schedule of CMMS team meetings can be found in Appendix G. The jointly agreed upon terms of reference for the CMMS project team was as follows:

1. Teams must include sub-teams with identified and empowered leaders.
2. Team leaders must meet with their teams daily.
3. Teams must create a detailed task schedule and link it to the master schedule.
4. Key staff must attend all team meetings.
5. Teams must develop, implement, and operationalize the system in their areas.
6. Engagement of operations and maintenance staff is critical.
7. Teams must maintain their own task schedule on a master server file.
8. Team leaders must report their progress at the weekly project team meetings.

I shifted the CMMS project management responsibilities from accounting and purchasing to the operations and maintenance group. That group selected the most respected and experience person to lead the operations and maintenance processes. The group also made someone the leader of the critical work control center and work order sub-team.

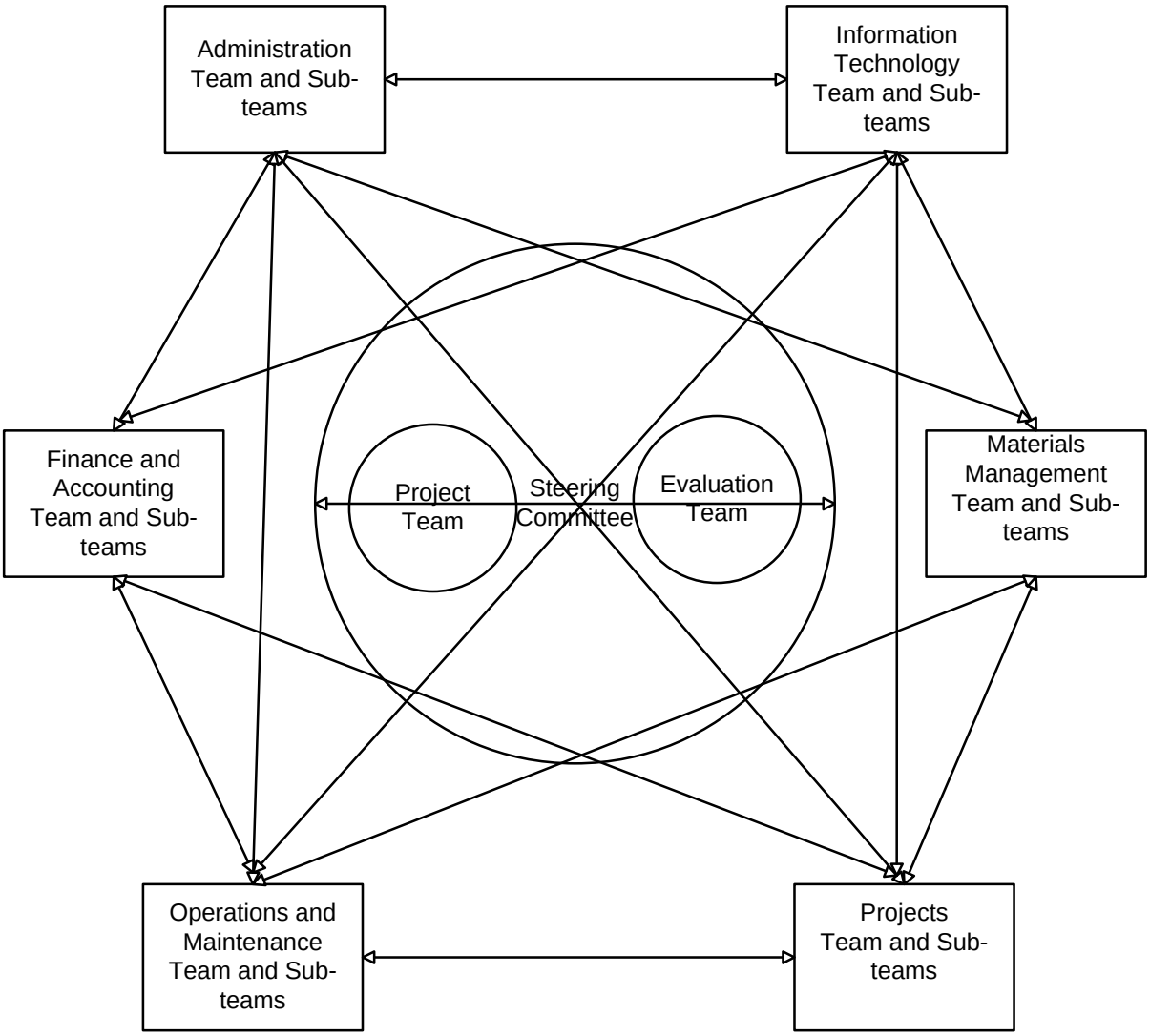

Figure 4.1. *CMMS Project Teams Structure*

The CMMS Project Timeline

Figure 4.2 is a broad timeline of the Facilities Management Division at the U of S. It is scaled to focus on the CMMS project. The timeline shows the project steering committee, the project team, the project sub-teams, and the project evaluation team working over the duration of the project. A detailed listing of events and dates can be found in Appendix O. The timeline

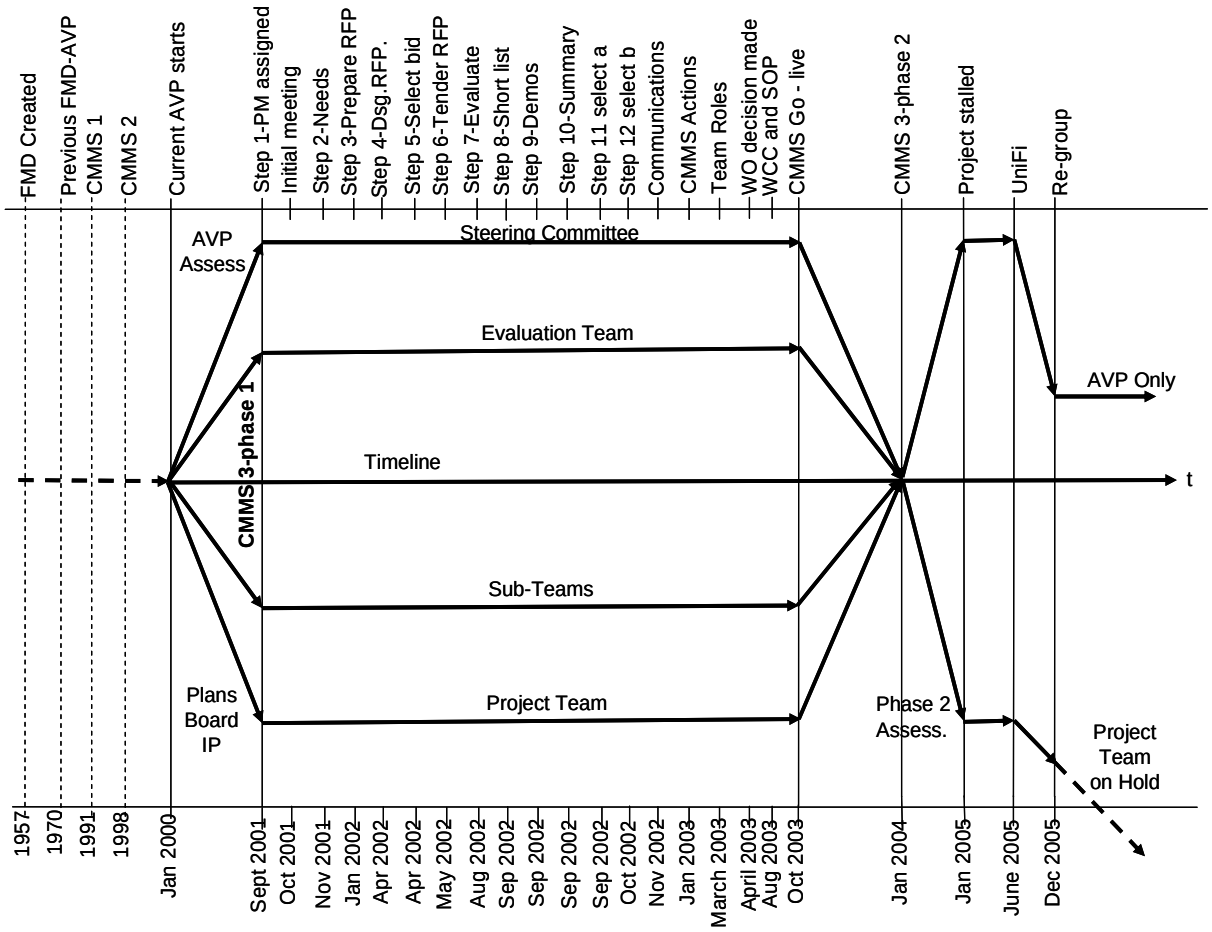

Figure 4.2. *The CMMS Project Timeline*

begins on the left in 1957 with FMD's creation as a formal unit at the U of S. Moving to the right, the timeline ends in December 2005 with the CMMS implemented successfully, but with further development stalled due to problems interfacing with changing university-wide systems. The first two attempts at implementing a CMMS are identified in 1991 and 1998. My arrival at the U of S is shown in Figure 4.2 as "Current AVP starts" in January 2000. My initial evaluation period in FMD is also shown. Strategic plans and integrated plans were being crafted during period this period. The "CMMS 3 – phase 1" project began with the first project team meeting in September 2001. The CMMS 12-step selection process and other event descriptions are shown at the top of the timeline and the corresponding dates are shown chronologically from left to right

at the bottom. Also shown in the timeline is the CMMS go-live time spent evaluating the new system and fine-tuning as required, the period spent preparing for phase two of the project, and the period where the project was put on hold pending the completion of the university's new financial system.

What follows is the case study and burography of the CMMS change initiative in FMD from 2000 to 2005. The narrative was based on evidence I found of complex dynamics in the Division before, during, and after the CMMS implementation. Some of the evidence refers to conditions in the Division during earlier stages of the CMMS project. For example, a key presentation that the project team staff made at a conference in May 2004 included rich information on how the people on the project team interpreted the human, technical, and financial conditions in the Division at earlier times in the project. The narrative presents this evidence chronologically based on the event time period referred to in the evidence, not the time period when the source evidence was created.

My Arrival at FMD: New Realities and New Relationships

I arrived in the Facilities Management Division in January 2000. I understood through the interview process that I was expected to change the Division. I was not given any specifics about what this actually meant but I assumed that I was expected to use the industrial engineering scientific management practices that had advanced my career for the past 18 years to make whatever changes I felt were necessary. I felt very comfortable about this since I believed I had a vast array of "leading-edge best practices" at my disposal to help me make these changes relatively quickly and relatively easily.

Upon reflection, when I started my new job in FMD I was considered very much an outsider. People had contacted colleagues at UBC to find out as much about me as they could.

They were told that I was responsible for the "ancillarization" of my old department at UBC and that my main purpose was to "privatize" university facilities management departments. I spent many months directly and indirectly dispelling these myths.

I spent the first year assessing what in the Division was working well and what was not (Figure 4.2, period "D"). Part of this assessment process was a customer and community satisfaction survey conducted in 2001. I presented the following summary of the results from the survey at a campus community forum held as part of the Integrated Planning process at the U of S in April 2003:

1. "FMD's services take too long."
2. "FMD's services cost too much."
3. "The campus wants more choice and service flexibility."
4. "The campus wants to use more contractors."
5. "FMD's standards are too high."
6. "FMD does a poor job at coordinating its work."
7. "Customers always get final cost surprises."
8. "FMD does not communicate well."
9. "FMD has a poor attitude."
10. "FMD must be more responsive, flexible, and accountable."

As I have stated, it was clear early on that the current CMMS was not being fully utilized even though it was essential for managing and monitoring the performance of the Division and for managing and improving work processes. I talked to many people and heard many different stories as to why the current CMMS was only being utilized 30%.

I set up and joined many committees upon arriving at the U of S (see Appendix G), including the CMMS project committee structure shown in Figure 4.1. The first official project team meeting was spent trying to make sense of the need for new management tools, like the CMMS and its potential functionality. The committee agreed that we needed to build a strong support group and that we needed to maximize staff involvement in all project decision-making. We needed to make sure that all system users defined their needs and priorities. We also needed

to maximize opportunities for staff education and training. We felt it was critical to create a vision for future system development and continued use. I started this process on behalf of the project team in my July 2002 email to the Division when I stated the following:

> The new CMMS system will provide us with the information we need to explain the tremendous job we do now in spending our budget to protect university assets as well as identify funding shortfalls that impact our ability to plan, develop and maintain the campus. In these days of increased accountability, oversight, tight funding and scrutiny it is very important that the main system we use: to drive our operations; to issue work orders; and to capture and report our costs and the money we spend on buildings, grounds and utilities is powerful and easy to use and provides us with the information we need to justify additional funding and resources.

Another message designed to help create a new vision for the future was contained in a newsletter sent by the project to all staff in the Division on November 27, 2002. It stated in part

> The CMMS has been initially configured. It needs to be reviewed by operations and maintenance personnel as to it implementation and practicality. The primary purpose of this meeting is to explore methods to facilitate this process. Further meetings and evaluations will provide the opportunity for operations and maintenance personnel to participate in the further refinement of the CMMS setup configuration and utilization.

Step 14 of the CMMS implementation action items (see Appendix K) shows how we started communicating the positive opportunities for staff education and training on the new system in order to deal with uncertainty and to get project buy-in as follows:

> User Training:
>
> b) Staff are working on Training schedule – Starting May 21/03 to be held in RM 161 Library – Tentatively 1 week duration. Need 2 qualified people to help in large sessions – any volunteers?
> c) Not addressing training for Space Management or Preventative Maintenance at this time.
> d) Draft Available on the CMMS/Training Schedules

Surprisingly, the group also thought it important that everyone understand that management retain ultimate control over the project budget and the project scope. I had expected more

suspicion over management's motivations for claiming that a more comprehensive work control and reporting tool was needed. There seemed to be an understanding that the institutional hierarchies were not going to change quickly and that they were necessary in order to deal with certain realities and requirements. For example, a message to all project team members in May 2003 regarding roles and responsibilities stated

> In response to concerns raised over decision-making accountability, the AVP and the Directors will be making final decisions on budget and project scope, including the work order module.

The project teams also felt that it was important for all project team members to understand the new realities that the Division was facing in order to properly design, choose, and implement a CMMS.

The Beginning: Change and Complexity in FMD

Computerized maintenance management systems and the organizational dynamics required to design and implement them are complex. The Division's two previous attempts at implementing a full CMMS had been unsuccessful (Figure 4.2, period "G"). Divisional staff were concerned about the introduction of a new CMMS system. Some basic concerns were expressed about the need for a new system when matters seemed to be working well. Other concerns included issues like the cost of the new system as opposed to spending money on additional personnel or equipment, the need to spend valuable time to learn how to use a computer and/or the new system, and the possibility that a new bureaucracy would be installed between the Division's clients and its service providers.

The existing CMMS was the main tool the Division used to manage its core functions: the design, construction, operations, and maintenance of all university physical assets. The first attempt at migrating from a manual paper-based system to a computerized system was in 1991.

The main module of CMMS systems, work order issuance and control, was not installed at that time. The initial CMMS was customized for those in the Division who had accepted the value of a new computerized system. These people were in the materials management unit included those in inventory control, timekeeping, stores, warehousing, garage, and the moving crew. The accounting staff was also keen on the initial system because they needed it to keep the financial interfaces with the university's systems functioning. The trades Operations and Maintenance group did not participate fully in the project and remained isolated from those groups who did participate.

The initial CMMS installed in 1991 was upgraded for the first time in 1998. The upgrade involved client/server applications, Oracle databases, Open VMS platforms, and Windows NT client operating system. The 1991 functionality for trades operations (preventative maintenance, work control) was not upgraded in 1998; some people still did not accept the use of a CMMS to manage their activities. The need for a comprehensive maintenance system developed by a more purposefully connected and complementary process did not become apparent until after 2000.

Neither the initial CMMS in 1991 nor the upgraded system in 1998 received full buy-in from all staff. The attitude of the some towards the system was soon adopted by other groups. The perception was that any dollars spent on information and management systems was a waste of money that should be going to hiring more trades persons. Most supported this view. The comments from trades staff on how they felt about a new maintenance system were documented. I discussed these attitudes at my weekly AVP-Director Priorities and Planning management meetings from mid-2000 to October 2003. I also presented these opinions at a facilities conference in November 2004. The comments and opinions I heard about a new CMMS system from some Divisional staff were as follows:

1. “I won’t understand how to use it.”
2. “I don’t need it.”
3. “It’s a waste of money.”
4. “Just give me more men.”
5. “I don’t want to report how I spend my budget.”
6. “This is just a management tool.”
7. “I’ll waste time with computers and paper.”
8. “I need to run an operation, not use a computer.”
9. “It will put work order bureaucracy in between our customers and our service providers.”
10. “We don’t have time to specify a new system.”
11. “There is nothing wrong with our current systems and processes.”
12. “I’ve always come in under budget, why do we need a new system.”
13. “I don’t need a computer to tell me which roofs are bad.”

Some staff clearly did not see the benefits of upgrading the existing maintenance system. They were focused on continuing to do a good job of operating and maintaining the campus utilizing what they believed to be “tried and true” methods.

Work orders were not being used to receive and track service requests or to plan and manage preventative maintenance work. Physical asset and financial account hierarchies, which should have been used to report on expenditures and to identify problem areas, were not created. Not using work order, asset hierarchy, and other system functionality was causing problems for the Division. At their CMMS conference public presentation in May 2004 the project team reflected on these shortcomings and change in the Division by stating

> Organizational changes prompted a re-evaluation of our systems; the existing CMMS system was not meeting the needs of the division; and that we needed a comprehensive system for ongoing monitoring for system improvements based on stakeholder needs.

Output reporting capabilities of the system were also not used. Even if reports had been produced, they would have contained limited information since work orders were not being used to capture work requests and work activity information. The list of reports designed by the

project team members to provide new information for managing and reporting on FMD activities can be found in Appendix E.

The Pressures to Change

Growing pressures from the campus community in 2000 required that the Division design, implement, and begin to use a comprehensive maintenance system. It was believed that this would enhance the Division's stewardship role and improve its reputation on campus. The changes needed to implement successfully a new system were representative of the changes needed to deal with other problems in the organization. The need for change was reflected in the following from the Division's strategic plan, approved by the Board of Governors in May 2001 and brought into the integrated planning process in May 2002:

> Facilities has refocused, reorganized and reallocated many key functions to ensure all programs and services are suitably structured and managed to provide value, efficiency, service and stewardship and to aggressively and collaboratively make any changes for constant best practices and professional leadership and stewardship.

The challenges faced by FMD in 2000, and the changes required to deal with them were complex. The Division had been unwilling or incapable of dealing with these complexities in the past. At the beginning of the study period in 2000, FMD began to sense these change forces and began to learn how to deal with the dynamics of organizational complexity.

Understanding the Challenge: Reflection and Dialogue

The project team did not jump right into designing a new CMMS. They spent months working at understanding the Division's current situation and why a new maintenance system was important. Much of what was happening in the university environment was news to most people in FMD. The project team knew that the better they and their colleagues understood the

pressures on FMD to change, the better they could design a system to help make these changes. The project team also wanted to know what was the wrong with the current system, what caused the problems, and what a new CMMS could do for our organization. They also talked about the risks of not purchasing and installing a new system and what actions were needed to ensure a successful project. Some of the discussion items on the agenda for the September 2001 CMMS project two-day kick-off meeting demonstrated the team's understanding of these risks. They were as follows:

1. Review and discuss Purpose statement and Scope of Work.
2. Review and discuss Software and Services Deliverables.
3. Review and discuss U of S Goals and Objectives.
4. Review and discuss Project Schedule.
5. Review and discuss Project Resources and Responsibilities.
6. Review and discuss Chain of Communication.
7. Review and discuss Project Communication Plan.
8. Review and Discuss Project Goals and Objectives.
9. Distribute Implementation Plan and review structure.
10. Solicit issues for Project Management structure.

At this meeting, the project team also discussed and documented what they believed were the factors needed for a successful project. The project team summarized what they had identified as "key success factors" for the project in their CMMS conference public presentation in May 2004 as

- common agreement for the need for a comprehensive, broad, powerful, useable facilities management tool (CMMS);
- buy-in for the project – this time it had to be USED;
- solid project management expertise;
- understanding of why it failed in the past and how to succeed this time;
- using the CMMS to improve employee job satisfaction; and,
- enhancing divisional reputation.

The project team believed that employee understanding of "why" a new system was needed would help obtain critical staff buy-in for the project. It would also help ensure that all system

functionality was installed and used. A fully working CMMS would then help the Division deal with other organizational challenges.

Understanding and a New Framework for Change

During 2000 and 2001, FMD went through a formal strategic planning exercise. I led this process based on my previous strategic planning training and experience. I had hoped that the environmental scan; the strengths, weaknesses, opportunities, and threats; the mission, vision, goals, and objectives; and the other elements of the plan would have provided a road map for change in the Division. The strategic plan was approved by the university's Board of Governors in May 2001. The Internet location of the strategic plan can be found in Appendix B and the environmental scan can be found in Appendix C.

The CMMS project team told me that they did not want to use the Division's strategic plan to guide their new project. They stated that they felt the plan did not accurately reflect the Division, that it was just a political "business plan" filled with incorrect assumptions and meaningless goals. The project team wanted to create a unique framework of its own upon which to build the project. The project team used its assessment of the previous CMMS projects, and its understanding of the current attitudes towards the system, to develop a new framework upon which to build the new project.

The project team determined that, due to the limited use of the current CMMS capabilities, what was happening in some areas in the Division was a mystery. Some people used shadow systems to manage their budgets. The central system could not be used to report on the work and the financial status in the shops. Not knowing what was happening in the Division, and not being able to report on financial or operational activities, was a problem. The new system

would help the Division deal with these important issues. I explained the benefits a new system would provide in an email to the Division in July 2002 by stating the following:

> The system will provide us with the information we need to explain the tremendous job we do now in spending our budget to protect university assets as well as identify funding shortfalls that impact our ability to plan, develop and maintain the campus. In these days of increased accountability, oversight, tight funding and scrutiny it is very important that the main system we use: to drive our operations; to issue work orders; and to capture and report our costs and the money we spend on buildings, grounds and utilities is powerful and easy to use and provides us with the information we need to justify additional funding and resources.

As well, the initial divisional announcement in March 2003 on why the Division could no longer rely on a non-computerized and personal, memory-based maintenance system included the following factors:

1. To minimize the manual account reporting structure currently used for Capital, Minor Capital and Maintenance budgets.
2. To improve account reporting time through the automation process.
3. Promote the development of effective Asset Management Strategies
4. To better determine asset true life cycle costs via monitoring of repair costs to replacement value.
5. Work flow processes are reviewed in light of best practices and corporate requirements. Past practices may be considered, but should not be the determining factor.

Through the work of the project teams, and their connections to their colleagues, the Division began to understand why a new maintenance system was required and how the system would benefit the organization and individuals.

Explaining Benefits of the System and Creating Purpose

The CMMS product vendor was withdrawing support for older versions of its software. Users were required to keep up-to-date with its newest version which was being supported by the vendor. FMD was three versions behind. The project group felt that the latest upgrade could be used as an opportunity to deal with the intransigence towards some key features of the system. Dealing with the human aspects of the project would also help other organizational problems. The initial announcement from the project team to their colleagues in FMD describing what they believed were the benefits of a new CMMS can be found in Appendix I.

The last time FMD had completed a CMMS needs assessment was for the initial system purchase in 1991. The project team felt a new needs assessment and looking at "best practices" and FMD's business processes would be worthwhile for two reasons: first, it was essential for developing the specifications for the new system; and second, the process of self-reflection would help make Divisional staff aware of the new realities and how the Division needed to change.

Another reason for reviewing the CMMS situation and options had been my arrival at FMD in 2000. I knew that the change at FMD required a fully functional maintenance system and that getting that in place required a new culture, attitude, and approach. I started to get my message out to all in the Division on why a new maintenance system was important. For example, in July 2002 I sent the following email to all of FMD explaining why we were considering a new maintenance system:

1. We had to spend money on our existing maintenance system we wanted to minimize the costs and ensure we were getting the very best system we could to help us achieve our stewardship responsibilities.
2. The process of implementing the new system gives us the opportunities to jointly and collaboratively look at how we do certain things and see if the system can help us do them easier.
3. The system will provide us with the information we need to explain the tremendous job we do now in spending our budget to protect university

assets as well as identify funding shortfalls that impact our ability to plan, develop and maintain the campus.

4. In these days of increased accountability, oversight, tight funding and scrutiny it is very important that the main system we use: to drive our operations; to issue work orders; and to capture and report our costs and the money we spend on buildings, grounds and utilities is powerful and easy to use and provides is with the information we need to justify additional funding and resources.
5. The system comes with work request, work order, project management, preventative maintenance, and stores etc, capabilities based on hundreds of installations around North America. We can use this expertise to enhance our operations and be able to demonstrate world-class facilities management.
6. Everyone should look at the new system as an exciting opportunity to see what new ideas and methods and ways of doing things are out.
7. This is a tremendous opportunity to use the new system to further enhance and champion our crucial leadership and stewardship role on campus by adopting best practices and state of the art facilities management while maintaining and supporting our community service mission.

I followed this email with dozens of informal discussions with many people on the importance of the project. I did not talk about why we needed to change. I talked about the new realities that we were all facing and I hoped people would come to realize that they wanted the new system to work so that they could help the division, themselves, and their fellow workers deal with these risks that they were just now beginning to understand.

The Risks to FMD of a Failed Project

Threats from the academic side of the university to contract-out all of FMD's services were increasing in volume and seriousness. FMD's reputation continued to decline and FMD was receiving more criticism and less funding.

The project team reflected these risks to the Division in their May 2004 public presentation at a CMMS conference as follows:

1. Missing the chance to use technology as a positive catalyst for change.
2. Not being able to demonstrate that FMD is accountable for ensuring life-cycle costing for campus assets.

3. Not fulfilling our stewardship mandate to report accurate and detailed financial and operational information.
4. Not achieving cultural and attitudinal change for organizational transformation (which has serious consequences).

In my conference public presentation in November 2004, I stated that these threats to FMD would become more real without organizational change and without adapted support systems. The risks I presented of not implementing and using a new CMMS included

- privatization of FMD;
- not being able to manage work in order to meet regulatory, code and legislative requirements;
- not being able to show FMD was competitive;
- difficulties justifying funding levels;
- not being able to demonstrate accountability and benchmarking;
- not being able to manage costs;
- having no tool to help inspect, audit and oversee asset condition;
- not being able to defend against budget cuts;
- an absence of critical data and reports; and
- not having a tool to manage large capital projects.

FMD's stewardship and service mandate was complicated and complex. I believed that FMD needed robust support systems to help manage this complexity and that inadequate support systems would put the Division's mandate at risk. FMD's integrated plan expressed this risk as follows:

> If facilities and infrastructure are not properly maintained; if buildings deteriorate internally or externally due to lack of adequate servicing and upkeep and if failure to make repairs on a regular basis, then the strategy of cultivating of an environment of collegiality and trust are put at risk. Critical research work, grants, and teaching programs may be placed in jeopardy. The morale of the faculty, staff and students and their pride in the university itself could be adversely affected and productivity could suffer. (p. 57)

I knew that the funds the Division had reserved to purchase the new CMMS were coming under scrutiny from central university administration. If the funding was not spent in a timely, value-added, and defensible manner it might be removed. FMD had a window of opportunity opening

in 2000 to successfully implement a fully functioning CMMS and manage these risks. I did not know how long that window would remain open.

Roles and Responsibilities: Building Connections and Sharing Purpose

The CMMS project team determined that a new system was required, but that the project process had to be very different from the two previous implementation attempts. Broad-based buy-in and use of the system was critical. FMD could not spend more public monies on an expensive system without clearly describing the benefits of such an investment. The Division was under pressure to start showing improvements in many areas. The system was an essential cornerstone of the changes needed to meet these expectations. A new model of project management was required to address the human elements of the project with the same level of attention paid to the project's technical and financial elements.

The steering committee and the project team were very aware that this attempt at purchasing and implementing a full CMMS had to be successful. For example, at a CMMS conference in May 2004 the project team presented the following items that they believed were needed to successfully select and implement a CMMS:

1. The project has to be properly funded; it can not be done "on the cheap".
2. Constant communication and explanation of the reason "why".
3. What is FMD's picture of what we want to be and how will the CMMS help?
4. The CMMS must be able to work for us and support our mandate; we cannot work for the system.
5. All project teams and team members must clearly understand, know, enjoy, and be capable of fulfilling their role.
6. Staff must have the authority to make their own decisions; no upward-delegating; no passing-the-buck; no avoidance; no blaming; mistakes equal new ideas and are good.
7. All project team structures and processes are designed for maximum support, communications, information flow, and idea sharing; bureaucracy cannot be allowed.
8. We will build in the proper time for inquiry and learning and visiting and talking; this is a people process, not a technical process.

9. Unwavering and consistent message, support, encouragement, protection, authority, and safety were required from the AVP at all times.
10. The AVP must be on all project teams and participate in all workshops, training, staff meetings, and presentations in order to constantly "show the flag" of the project and talk about values and purpose; he must be consistent and open and trusting in all words and actions.
11. Leadership will result in buy-in which will result in transformation of the CMMS and transformation of the organization.

The project team developed a project outline for the project. The outline included completing a needs assessment with maximum staff participation, issuing a request for proposal for public tender, inviting the existing CMMS vendor to bid (a political and potentially legal action mitigation strategy), and evaluating products and vendors. The schedule can be found in Appendix J.

Roles and Responsibilities: Managing Complexity with Connections

The CMMS project involved many complex and dynamic human and technical activities. Some activities could be planned and some could not. The planned activities could, by themselves, create a chaotic project environment. Not being able to deal with uncertain elements in the project also had the potential of creating unmanaged chaos and instability. The steering committee and the project team, therefore, felt that it was critical for all project teams and their members to clearly understand their roles and responsibilities in order to manage the planned activities and to deal with uncertainty. In addition, the steering committee and the project team felt that, from the outset, all CMMS functions needed to be clearly understood and "owned" by the project teams and team members.

Various communiqués were used to ensure everyone involved understood and "owned" not only his or her responsibilities and function but also the roles and responsibilities of other teams and team members. For example, in May 2003, the following information was sent to all project members:

1. The *finance and accounting team and sub-teams* are responsible for budget and account distributions, month-end and year-end procedures, financial reporting, organizing customer accounts, setting shop rates, designing reports, and system security.
2. The *administrative team and sub-teams* are responsible for timesheets and time-codes, employee records, custodial and grounds standing work request development, month-end and year-end procedures, personnel reports, and personnel records security.
3. The *materials management team and sub-teams* are responsible for purchase order system and interface development and testing, stores markup analysis, service and project contract management, fleet systems, grounds procedures, stores counter releases, wireless technologies, dollar conversions, stores stock taking procedures, month-end and year-end stock taking procedures, purchasing reports, materials security, dry run testing, and standard operating procedures.
4. The *project team and sub-teams* are responsible for project numbering intelligence, work codes, planned work requests procedures, the estimating module, work standards, linking data to archival information, project documentation, month-end and year-end procedures, project reporting, system security, dry-runs and testing, and standard operating procedures.
5. The *operating and maintenance team and sub-teams* are responsible for business processes from the new work control center to the shops and back, work request backlog reporting and tracking, searching and reporting on work backlogs, creating new work codes, defining asset hierarchies and categories, setting customer information, analysis of regular performance data, business processes feedback mechanisms, re-defining existing work-flow diagrams and modifications, and creating new key performance indicators.
6. The new *Work Control Center sub-team* (part of the operations and maintenance team) is responsible for work category and work type codes definitions, entering status codes, defining optional fields, populating data fields, entering new work requests, managing standing work requests, supporting demand maintenance and fee-for-service work requests, maintaining outside telephone numbers and email addresses, dry-runs and testing, and standard operating procedures.
7. The *custodial sub-team* (part of the operations and maintenance team) is responsible for business processes review, inputting work requests, scheduling maintenance for custodians, building assignment maintenance for custodians, auto-generating time cards, managing shift differentials, dry-runs and testing, and standard operating procedures.
8. The *shops team* (part of the operations and maintenance team) is responsible for the customer request module, determining receipt and input of work order procedures and policies, setting maintenance and fee-for-service accounts, vs. fee for service account distribution, dry-runs and testing, and standard operating procedures.

9. The *IT sub-team* (part of the finance and accounting team) is responsible for all computer hardware, software, programming, databases, and interfaces.

All teams participated in the CMMS functionality dry-runs and testing within their operational areas. Teams were responsible for determining, implementing, and maintaining their own standard operating procedures (SOPs). The teams were focused on their particular roles and operational areas of expertise but were also engaged in the overall project structure and processes. This ensured that the teams did not get too independent or lost, or off-track. The project included many formal and informal and daily and weekly interactions between groups and individuals. The CMMS steering committee schedule can be found in Appendix F. Problems and solutions, ideas and complaints were able to flow in many directions through the organization. This way concerns did not fester and staff themselves encouraged creativity rather than negativity.

The team leaders served as conduits to carry information among the teams and between the project team and the steering committee. No information arrived at any "node" in the process without discussion and feedback to individuals and teams. The project team identified the following as the *team leaders'* roles and responsibilities:

1. Report biweekly to the project team committee any issues that arise in your area so that they may be addressed by the Team and the Team will become aware of any concerns in your area as other areas may be impacted.
2. Report biweekly to the committee any issues that arise in your area so that they may be addressed by the Team and the Team will become aware of any concerns in your area as other areas may be impacted.
3. Identify as the leader of their appointed area defined in the large bubbles on the project structure chart.
4. Review their tasks and ensure all facets are addressed in time for PHASE 2 deadlines.
5. Include the members identified in the smaller bubble (green text) as supporting members and any others as deemed appropriate for their area.

6. Design a team to complete the directives of Phase 2. This will include directing the population of data, enhancements, bugs/issues, testing, training and development of the SOP.
7. Meet bi-weekly to review the achievements and address issues at the CMMS PHASE 2 FOCUS TEAM Meeting.
8. Meet with their sub groups weekly.

In the same communiqué, the project team identified the roles and responsibilities of the s*ub-team leaders*:

1. Sub-team leaders will meet with their individual teams.
2. Sub-teams must create their detailed task schedule.
3. All sub-team meetings will be coordinated.
4. Sub-team leaders to continue development and implementation of modules.
5. Sub-team leaders must engage all staff.
6. Sub-teams will maintain their own task schedule.
7. Sub-team leaders will report their progress at the project team meeting.

As well, management roles and responsibilities were identified by the project team as the following:

1. Reports to Facilities Management AVP for day to day requirements.
2. Reports to the CMMS Implementation Steering Committee for corporate decisions.
3. Responsibility for the overall project definition, planning, and implementation - including project coordination, scheduling, setting targets/milestones, budget management, communication liaison, change management strategies, benchmarking and user training.
4. Provides direction and support for the CMMS Focus Team, the Maximus Project Partner, and external resources.
5. Institutionalizing all proposed changes.
6. Diagnose potential problems.
7. Involve Facilities Management personnel appropriately in the implementation process.
8. Communicate project progress, decisions and direction to Facilities Management personnel (facilitated through a communication plan & process).
9. Implementation of the Communication Strategy.
10. Development of Standard Operating Procedures.

The roles and responsibilities were discussed and debated extensively by all project members at many team meetings. This not only helped to simplify and to clarify who was to deal with what

technical and logical processes, procedures, and problems; it also provided opportunities for project team members to interact with colleagues: to listen, to talk, to learn, and to take this knowledge and comfort back into the organization.

Using connections. If anyone sensed that something was going amiss, team leaders were immediately contacted. People fixed the problem themselves, involved someone else who could deal with the problem, or brought the issue formally to the project team or to the steering committee. Technical and financial problems were relatively easy to deal with. The more difficult problems were those that were the result of people feeling uncomfortable and uncertain about new CMMS policies, procedures, or tasks.

The change inertia experienced early on in the project, and the frequent asking of the question "why", was replaced with momentum and asking "please show me how". The steering committee, through team leaders made sure that the "how" questions were dealt with in a trusting, respectful, appreciative, and honest manner. The process of supporting the "how" that had replaced the "why" seemed to build upon itself. It seemed to generate further openness and trusting relationships and collaboration. I discussed these growing connections and key dynamics in the project in my public presentation at a facilities conference in November 2004 as follows:

> The dollars, systems processes, project management tendering, evaluation, etc. was essential but not as important as the people; the organizational attitude and behavior; the transformation focus of the project; the trust, respect, honesty, and empowerment of the staff; the vision (what, why, how, where we are going); the communications; and the leadership were the key.

The project team stated in May 2004 at their CMMS conference public presentation that, "System migration can be a tricky business but you must optimize team building, you must celebrated your victories, and you must have fun!" The project team members, and others in

FMD, were using their newly developed connections and relationships to inject a level of stability in their efforts to jointly deal with uncertainty and to avoid chaotic instability.

Resistance, Buy-in, and Change

I had to ensure that adequate project funding was in place and that an expenditure of this type met various review and approval requirements. We needed to find the very best external project consultant to work with our internal team. The information technology and the computerized maintenance management systems people had to be the very best we could recruit. The business process review, documenting the standard operating procedures, and designing and completing the comprehensive needs assessment, were critical activities required to compile a well-crafted request for proposal for the new CMMS and vendor. The transformation in the Division required to collaboratively embark on the CMMS project was reflected in the Division's integrated plan that was approved in November 2003 as follows:

> The Facilities Management Division (FMD) began its transformative journey in 2000. The motivation for what was going to be a difficult process was the need to address real and perceived issues of service and value and to strengthen and champion FMD's important stewardship role on campus. This process of self-assessment, vision-based planning, identifying and responding to factors and trends in the external environment and critically identifying gaps and areas for resource reallocation and reinvestment has not been easy. (p. 10)

Before delving into the technical specifications of the new CMMS, the project team discussed and documented what was required to obtain and maintain buy-in for the CMMS project. The project team presented the following as the most important criteria for ensuring project buy-in at their May 2004 CMMS conference:

1. Senior management's consistent and ongoing championship and communication of the benefits of the project and the risks of not proceeding with the project.
2. Credible project management.
3. A simple and clear process.
4. Many types of CMMS educational opportunities and learning methods.

The team felt that the project should be “top-led, but bottom-fed” and that we should directly and indirectly be answering the question “What’s in it for me?” We needed to convey how the CMMS would make work life easier for all in FMD. The team felt that better explanations of “how”, combined with an excellent training program, would demonstrate that people would not be expected to do their jobs with a “blunter instrument” but rather with a cleaner, simpler, faster, and more interesting tool.

Another example of how the project team and I worked to help people understand the purpose of the new system and how it would benefit us all was my email to all in FMD in July 2002 which stated in part

> We now have the opportunity to get a system that is flexible, powerful, friendly and capable. The process of implementing the new system gives us the opportunities to jointly and collaboratively look at how we do certain things and see if the system can help us do them easier. Our current system did not have the same capabilities to help us achieve our mission, our vision and our goals and objectives. Everyone should look at the new system as an exciting opportunity to see what new ideas and methods and ways of doing things are out.

People were initially afraid that they would not know how to use the new CMMS to do their jobs and that this would result in unhappy customers, discipline, and even job loss. Staff felt strongly that they must be involved in specifying any new system that was so integral to them being able to do their jobs. A management correspondence to the project committees in March 2003 describing how the new work control center was being created explained that

> The Customer Service Centre operation and requirements have not been finalized to date. Training of the Customer Service Centre staff is currently planned for April/03. Finalization of the Customer Service Centre operation should be completed by the end of March 03.

In a July 2003 communiqué to all in the Division it was explained how the new work order process would improve customer service and work order bureaucracy concerns.

> The Facility Focus (CMMS) Team is working hard to finalize the implementation for GO-LIVE on October 1. A new Work Control Centre (WCC) has been set up with 3 WCC Representatives led by P our new Work Control Centre Coordinator. Located at the front desk of FMD our WCC will be the first point of contact for all incoming work requests.

Despite these efforts to engage and reassure staff, not everyone wanted to be responsible for the initial decision to buy the new system or for the decision to use the full work order management function of a new CMMS. People knew that some did not support this CMMS function and although staff were beginning to come to terms with the new system, some did not want to be too closely associated with what they felt was management's decision to "force" new work order functionality.

In some respects, people wanted it both ways: they wanted full empowerment and control but they did not want ultimate accountability for technical, financial, and human difficulties with the project. It was clear then that this was a role I had to fulfill and I did make the final decision on the use of the new work order management capability of the new CMMS in a formal way. I was very careful not to use language that would deter people away from engaging in the project but I was equally careful to make the decisions people needed me to make in a way that encouraged trust.

At the project steering committee meeting in March 2003 I responded to a question about using the system to deal with work requests during the two previous CMMS implementation attempts. I was asked whether or not FMD was going to be using the system to issue individual work requests. I responded

> Yes, we are going to use individual work requests and you are going to be the leader of the work request team and the shops sub-team. You and the teams you will be leading will be expected to design the work order procedures to avoid the problems you have expressed so much concern about. You will be expected to work closely with all the other teams and the system will not be customized or tailored to continue the old work order processing process. You know the process

> so well, you're the best person to lead this function. People will be here to help with anything you or your team need.

Recognizing experience and expertise seemed to be a successful approach. We worked through a compromise on the process that dictated the volume of new work orders created and people developed all new operating procedures and did all the training in the shops.

The March 2003 meeting was followed by with a communiqué later in the month that stated

> A final decision has been made to proceed with individual work requests for all shops work. All work is to be tracked and managed. The Grounds shops staff will now be required to complete daily time sheets as per the rest of the main shops. This means that all tasks performed will be assigned via a work request. The majority of the existing standing work requests will be eliminated. The Customer Service Centre [Work Control Center] staff will process all work requests.

Having made and communicated this decision I also made it clear that as the "why" and the "what" had been addressed, it was now up to them to make it work: the "how" was their to answer. Combined with the principles and values determined by the project team, I had provided an appropriate context for the work order process and a broad vision of what was needed. Within that context, and guided by that vision, people now had the freedom to construct sustainable processes.

I made clear the consequence of not complying with the terms of reference crafted by the project team and approved by the steering committee. Respected team leaders were put in place and senior directors were replaced as necessary. The most critical project buy-in elements included ownership and clear identification of the project champions and their roles and responsibilities. People were given the help and support they needed so they could work at different levels in the organization where they had never worked before. Once we promised to provide clerical help to the shops to deal with increased paperwork, and once the trades

supervisors saw how useful the information provided by the new system was, trades staff willingly accepted the new CMMS.

The initial lack of buy-in was not just from trades employees concerned about a new work order process. Some staff did not want to rely on a computerized work order tracking system to manage their projects. The controls designers did not want to fill in time cards using newly created work order numbers because they felt that they should not have to account for their time. The materials handling group did not want to change a functional system they had spent years customizing to meet their unique needs. Grounds staff did not want to enter asset information about their plants into the inventory module of the new CMMS. The scheduler wanted to continue to use spreadsheets to schedule work, not the project scheduling functions of the new system. The space management group was interested in the new space management capabilities of the new system but it did not want to have to switch from its current drafting program to use them. All of this resistance had to be dealt with by the project team.

Senior management's role throughout the project was to listen, learn, help, and lead. Management was not to dictate or presume. People showed flexibility within reasonable and knowledgeable guidelines and we used in-house staff instead of external consultants as much as possible. CMMS functionality was owned and specified by the final users, not by IT and the financial staff. How the investment would benefit FMD was clearly articulated. The project budget and funding source were fully disclosed. How I tried to find the balance between telling people everything about the project in order to build trust and understanding, while still protecting corporate confidentiality, was shown in my note in June 2002 when I stated

> I don't want anything to be hidden or kept secret from any of our staff. This is a project and a tool to help all our employees. We shouldn't broadcast the financial issues, but the software costing $500k and the implementation and training costing $500k does not have to be a secret. The budget numbers and the

> accumulated costs as the project proceeds should be kept to access by the steering committee and you only. The source of funds is saved up contingencies. This money has NOT been taken out of any budget, especially not taken from any trades or O & M budget. Contractual details with Maximus should be kept confidential but the project schedule, model, milestones, deliverables, timing etc. we can even put on our intranet for staff to see. We can talk about this when we design the communication plan (you can start thinking about this now).

Another important element that helped create support for the project was providing opportunities for people in the Division who had never worked together (many who have never even met before) to do so. People began to recognize the skills, experience, and talents others brought to the project and to appreciate how they could help and support each other. Trust and respect were enhanced, people acknowledged each other's contributions, and a sense of shared purpose developed. Mistakes were made during the project, some of them with technical, time, and cost consequences to the project. No mistake resulted in criticism or punitive actions. Errors were taken as part of the process and solutions were crafted sometimes by people who were not formally involved in that project component.

The project work volume, the hours worked, the number of tasks accomplished, the new terminology learned, and the thinking though new practices and procedures did not result in a frantic or disorganized work environment. People were able to assign priorities and to make decisions on their own with support from their colleagues and without asking their supervisor for permission. They were encouraged and supported by myself and the project team members to develop the skills to deal with complex organizational issues in an already busy work environment.

New roles and relationships that developed for and by the CMMS project were evidenced by the project details produced by these people. The newly formulated and created reports in Appendix E, the benefits articulated by the teams in Appendix F, the implementation schedule

developed by the team members in Appendix J, and the action items in Appendix K were complex and critical details developed by the project team members for and with their colleagues in the Division.

Words, Language, and Knowledge: Building Connections

The project team realized that communications before and during the CMMS implementation were critical to achieving and maintaining project buy-in. However, the project team quickly stopped referring to "communications". They talked instead about how people in FMD, especially those who were quite vocal against a new system, needed to learn why the Division needed a new system and how a new system would help them. The project team saw this as educating and creating awareness, not just communicating. For example, my email to the Division in July 2002 was intended to help the project team start to get FMD to understand and appreciate why we replacing our current system. It explained

> Our current system did not have the same capabilities to help us achieve our mission, our vision and our goals and objectives. Implementing the new system allows us to match the best practices built into the system with our existing operations to make sure we are being as efficient and effective as possible. The new system will allow us to balance work order management needed to capture and report on expenditures with our customer and community service goals which are second to none. Everyone should look at the new system as an exciting opportunity to see what new ideas and methods and ways of doing things are out there.

The project team also felt a need to fully discuss and understand the context and purpose for the project and how this could be communicated to the Division. For example, the agenda for their two day CMMS project strategy meeting in September 2003 included the following items for review and discussion:

1. Purpose statement and Scope of Work
2. Software and Services Deliverables
3. U of S Goals and Objectives
4. Project Schedule

5. Project Resources and Responsibilities
6. Chain of Communication
7. Assumptions and Agreements
8. Project Communication Plan

The project team also treated getting information to the Division not as a communications exercise but as a way for everyone to develop an appreciation for what other units and other people in FMD did. A diagram representing the project team structure and the multi-directional channels for information flow and how person-to-person connections were made can be found in Figure 4.1.

The project team members, therefore, talked about what mechanisms would transmit basic information about the CMMS and what methods would help bring people together to understand what others did. The project team members were able to collaboratively craft their roles, their action plans, their schedules and deal with other challenges because of complementarity and the new connections and relationships developed during the project. The project implementation schedule described in Appendix J, the project actions items shown in Appendix K, and the project team roles listed in Appendix L are evidence of how people came together to help and share.

The CMMS, by design, is a fully integrated system. It was designed to flow work easily though well-lubricated channels from function to function and from person to person. It relies on a common language and a common understanding to send, receive, and process work requests and to track the status of work in all areas. The people using the system, therefore, also needed to be positioned in a connected way (see Figure 4.1) and need to use new language and understanding to collaborate and to change.

Newsletters, web sites, posters, emails, presentations, question-and-answer sessions, and many individual and group sessions were used to explain the project and what it would mean to

groups and to individuals. The newsletter schedule is shown in Appendix M. The communication and education tools were designed to be multi-layered and, although they conveyed different information to different audiences, the theme and project purpose and benefits were consistent and clear. People expected to hear from me on a regular basis. I sent out regular AVP newsletters, I set up an "Ask Paul" web site, and I was available at most formal and informal CMMS information and training sessions.

Through our connections with various facilities management associations, and because the CMMS vendor admired the work FMD's implementation teams were doing, the project team and I were invited to present our project at two international conferences dealing with the challenges involved in developing and implementing a CMMS. The fact that external facilities management units and other universities acknowledged the work we were doing did wonderful things to increase the project's credibility, especially the new work order management system. The CMMS vendor, the project consultant, and other facilities organizations made comments such as, "How did you manage an 840 item request for proposal?", "Who is on the project team?", "To what do you attribute the success of the project?", "How do you recommend we proceed on our project?", and "Can we have your project model, procedures, and request for proposal?"

We used this recognition to celebrate the efforts of our staff. We sent as many people as we could to present at the conferences. We did not have senior staff do the presentations. The presentations were done by members of the project team and the evaluation team. They did an amazing job.

Words, language, and knowledge were used to build connections; connections were used to reinforce relationships and strengthen change forces in FMD.

Using Wholeness and Implicate Order: Selecting the CMMS

The CMMS product selection process involved identifying FMD's needs, completing the request for proposal, issuing the request for proposal, receiving bids, evaluating the bid documents and bidder presentations, designing and completing a product/vendor evaluation process, finalizing the contract and one-time and ongoing costs, and awarding and managing the contract.

The main objective of the CMMS system selection process was to clearly identify FMD's system needs. Clear needs identified succinctly in the request for proposal would avoid unfair and risky ambiguity in the product and vendor selection process. Consultants and vendors commented informally to me that they had never before seen such a comprehensive, intelligent, well-organized, clear, and focused request for proposal. The request for proposal could not have been produced by the "old" FMD. It was the same people, but operating in a very changed manner, that produced the request for proposal that so impressed the external professionals. The request for proposal and the process that created it was evidence of how FMD had changed in many ways.

Although the process of specifying, tendering, evaluating, and selecting a large product such as a CMMS can be a regular activity in some institutions, the historical and cultural conditions in FMD in 2000 made this process unique. A different organizational paradigm was required to make this expensive and risky project possible. The 12 steps in the CMMS selection and implementation process are shown on the timeline in Figure 4.2.

Step 1: Designing the process – September 2001

The first step in the CMMS selection process was to treat the selection as a formal project similar in structure and process to a capital building construction project. An internal project

manager was appointed and an external project consultant was retained. A 33-step project work-plan was developed, which included project objectives, deliverables, schedule, and project team structure as shown in Figure 4.1. The project team structure, the well-defined roles and responsibilities, and the processes and procedures were designed to build a web of relationships and interconnections for the unimpeded flow of information, thoughts, and emotions.

For example, the steering committee's role was to provide direction and to make management decisions. It had seven members: the Associate Vice-President, four directors, and two managers. The steering committee met eight times during the project. The project team's role was to represent all user groups and to define staff needs. It made technical decisions and it evaluated all products. The team recommended the preferred product and ensured buy-in from the user groups. It had 14 members representing each major CMMS function/module. The evaluation team's role was to attend all product demonstrations in order to evaluate to all vendors and their products. It had approximately 30 members from all areas within FMD. The details of the roles of all project teams as created, communicated, and managed by the project team itself can be found in Appendix L.

During the meetings of all teams, roles and responsibilities were made clear and the project objectives were debated and decided. Critical communication channels were identified and the network nature of the project structure and information paths were explained and fine-tuned. Stakeholders and their needs were identified and how the needs would be addressed throughout the project was discussed. The project management process was explained and the project schedule and the detailed work-plan were finalized.

Step 2: Needs assessment – November 2001

Step two in the CMMS selection process was the identification of what FMD needed in its new CMMS. The steering committee and the project committee created the needs assessment process. FMD was organized into teams and sub-teams. Management and the consultant met with each team and helped chose a team leader. Each team then prepared a draft of the functional requirements they needed in their CMMS modules. Teams assigned priorities to their list of desired functional requirements. All teams' functional priorities were then compiled into a master needs assessment list. The needs assessment identified seven mandatory modules, five optional modules, and 847 functional requirements. These were the detailed requirements that comprised the request for proposal.

Step 3: Preparing the request for proposal – January 2002

Step three in the CMMS selection process was preparing the request for proposal for potential vendors of CMMS products. Management and the consultant defined the mandatory and optional requirements for the request for proposal. Background information on FMD and the project and on the existing systems and the needs assessment were included in the request for proposal. The vendors were asked about their corporate capabilities (20 questions), the product capabilities (83 questions), the product pricing (30 questions), and the software technical specifications. Vendors were required to provide a Y/N response for compliance to each functional requirement.

Step 4: Designing the bid evaluation system – April 2002

Step 4 in the CMMS selection process was determining how the request for proposal bid responses were to be evaluated. The request for proposal evaluation model included six major factors and 59 minor evaluation factors. Each factor was linked to specific question in the request for proposal. Each factor had a rating guideline and all bids and the evaluation factors and

guidelines were developed by the consultant and approved by the steering and project committees.

Step 5: Selecting the preferred bidders – April 2002

Step five in the CMMS selection process was determining who FMD preferred to bid on the CMMS tender. The consultant aided the evaluation team in reviewing 35 potential bidders and recommending nine bidders for further consideration. The project committee and steering committee approved the process and the list of nine vendors.

Step 6: Tendering the request for proposal – May 2002

Step six in the CMMS selection process was tendering the request for proposal. The request for proposal was posted in the university's public website with all mandatory requirements. The request for proposal was couriered to the selected, preferred vendors. Vendors were given three weeks to respond to the request for proposal. FMD received six acceptable proposals.

Step 7: Evaluating the bid proposals – August 2002

Step seven of the CMMS selection process was evaluating the proposals. The evaluation involved management first obtaining clarifications from bidders on any questions the evaluation team had. Management then compiled a summary of all proposals, an evaluation of each proposal, a summary of all evaluations, and a computer calculation of the responses to the functional requirements. Management also identified the subjective benefits of each vendor and system and ensured each proposal and evaluation was fair and consistent.

Step 8: Selecting the short list of vendors – September 2002

Step eight in the CMMS selection process included the steering committee and the project committee independently ranking the vendors. The three short-listed vendors selected by the project committee were the same three vendors selected by the steering committee.

Step 9: Product demonstrations – September 2002

Step nine of the CMMS selection process involved demonstration of their products by the selected vendors. Detailed instructions were provided to the vendors and the same format and venue was used for each demonstration. The steering committee and project committee approved the demonstrations evaluation factors and weightings. The product evaluations were completed by 11 user groups and through one large group demonstration attended by 45 people. Team leaders were expected to attend all demonstrations. Vendor and product evaluations were completed at the end of each day's demonstration. Team leaders also consulted with his/her user group before submitting a final scoring.

The software product demonstration process was designed to be an equal opportunity for each vendor. It was fully transparent and it maximized people participation. It was also a good education on CMMS use and good exposure to the latest technology.

Step 10: Finalizing product ratings – September 2002

Step 10 in the CMMS selection process was preparing a total rating of the proposals and demonstrations for each vendor. The steering committee and the project committee independently rated the vendors. The project committee recommended that one vendor would be eliminated and further analysis would be done on the remaining two vendors. The steering committee agreed with this approach.

Step 11: Further information and evaluation – September 2002

Further details were sought on the remaining two products. The user teams prepared lists of additional questions for each vendor. Vendors responded in a three-hour Internet-based demonstration and telephone reference checks were done for each vendor. The project committee also visited another university that was using one of the vendor's products.

Step 12: Selecting the preferred product – October 2002

Step 12 of the CMMS selection process was selecting the preferred product. This involved a three hour workshop with the entire evaluation team. The costs of the products were not provided to the evaluation committee. The selection was based solely on the system performance and technical capabilities. The team leaders voted for his/her user group and a preferred product was selected and recommended to the steering committee. The steering committee accepted the recommendation and the successful and unsuccessful vendors were notified.

The final price was negotiated and all contract documents and requirements were completed. An implementation schedule was developed with the vendor and FMD began to plan the next steps of the project.

A Changed FMD at Work: Implementing the CMMS

By the time the CMMS selection process was complete, the project teams were well established (see Figure 4.1). The project team's structure was not changed since it was designed to operate around the functional implementation elements of the CMMS. FMD was now past the point where people were questioning the work order functionality that had been the biggest sticking-point early on in the project.

All teams were now very keen to get "their" modules up and running. They looked for human resource, communication, education, IT, space, training, and equipment improvements to

support their new system. The steering committee did everything to accommodate these requests. Some of the requests may have been somewhat peripheral to the new system but they were responded to nonetheless. For example, trades shops wanted laser printers installed in every shop. This was not an absolute necessity. However, printing work orders in the shops meant less work for the shop supervisors which in turn helped solidify buy-in of the new work order concept so the steering committee approved the new printers.

People were made captains of operational modules for the implementation phase. An email to all project teams in November 2003, based on approval from the steering committee, explained that team captains were to "report biweekly to the committee any issues that arise in your area so that they may be addressed by the Team and the Team will become aware of any concerns in your area as other areas may be impacted."

A Work Control Center (WCC) was created to manage the new work order process. A work control and administrative clerk was promoted to lead the new work control function. In July 2003 a message was sent to all in FMD announcing the creation of the work control center that said, "A new Work Control Centre has been set up with three WCC Representatives led by our new Work Control Centre Coordinator. Located at the front desk of FMD our WCC will be the first point of contact for all incoming work requests."

A new maintenance planning unit was formed and it prepared to implement the new preventative maintenance module of the CMMS. Team captains met daily with the vendor's representative. Modules were installed one at a time in a "soft" go-live and the old system was run in parallel until the new system was fully functional.

Adapting to Unpredictability

The project was schedule to “go-live” May 1, 2003, the start of a new fiscal year at the U of S. In December 2002, however, the project team recommended to the steering committee that the launch be delayed six months. I was personally very concerned about this. I initially thought this was an indication that FMD had, in fact, not changed as an organization and we were about to fail again at a CMMS implementation due to poor organizational attitude and change inertia.

The reason for the requested delay was that the user groups and the project teams were not certain that the software and hardware systems would be ready by May 1, 2003. They were even more uncertain that new operating procedures, and the training on these new procedures, would be ready by May 2003. The teams were concerned that “going-live” prematurely, without all technical and human elements in place, would have serious impact on the people involved in the project and would destroy the positive feeling and atmosphere currently surrounding the project. The steering committee decided to accept the recommendation of the project team and to delay the “go-live” date by six months to October 1, 2003.

The additional six months was spent finalizing the hardware and software requirements and training everyone on the new work processes specific to the new CMMS. The training schedule can be found in Appendix N. Dry-runs of all systems were held between June 2003 and August 2003. The week before October 1, 2003 was spent with daily meetings of the project team and the steering committee and constant contact between the project team members and their operational units and colleagues. Final training manuals were put in place and the front-line work control and shop staff received extra training, support, and assurance.

Going-live With the New CMMS

At one minute after midnight on the morning of October 1, 2003, the CMMS system was switched over from the old system to the new system. The information technology (IT) team and

the IT staff spent the night making sure all systems were up and running. All members of the steering committee, the project team, and all user groups were at their stations and ready to go when the new Work Control Center officially opened in the morning. All team members spent that first day and the rest of the week walking around helping anyone who had a question or a problem. Evening de-briefing sessions were held by the project team to discuss any problems that had arisen during the day. The IT staff spent the evenings fixing any problems and changing any work procedures that were not working and preparing new documentation and procedures for the next morning. By the start of the second week, project meetings were held once a week and evening work was no longer required.

A party was held at the end of the first week to celebrate the successful CMMS launch. I said a few brief words but the rest of the time people celebrated and laughed with their colleagues, coworkers and team members with whom they had developed new relationships and accomplished so much. The most positive of all were people who had changed so much over the course of the project and who now embraced the new work order system as a tool to help them take better care of their assets and their university. The project team's public presentation at the CMMS conference in May 2004 started with a slide that said, "Our Success Story: Educative Leadership + Buy-in + Ownership = Empowerment and Inclusion" and ended with a slide that said, "A Time for Celebration!!!"

Learning from Phase One and Getting Ready for Phase Two

By November 2003 the steering committee felt that the project design and implementation could be considered a success. FMD could start thinking about the next phase of the project. The steering committee and the project team, however, felt that it was important that a full review of the CMMS project be completed before a new phase of system development was

considered. The project teams wanted to acknowledge all the good things that went right and they wanted to fix the things that went wrong. The teams stated that the project structure, process, and management worked extremely well. They also rated the communications and the training very highly. People stated that they understood the reason why the Division had embarked on this difficult journey and they felt that the CMMS would benefit them and their colleagues and help them do their jobs. A management presentation to staff on phase two of the CMMS project by the project team in September 2004 included the following about the changes in FMD:

1. We now have a solid foundation for growth, based on:
    a. Optimum Performance and Benefits
    b. New Development and Initiatives
    c. Continued Maintenance and Support
2. Our new CMMS is designed for:
    a. Data Processing Functionality And Performance Assessment
    b. Reporting:
        i. Resulting data infers changes to Business Process and where changes or additional inputs are needed
    c. Measure Performance of System
    d. Completeness of Records
        i. Errors – data/human and data query
    e. Configuration and Input of Data
3. On-Going/Orientation Training Plan:
    a. Create user sessions to orient and refresh users.
    b. Allows for education/re-education of users to new processes, or when analysis shows recurring user error, or feedback provides information for a modification that affects workflow.

The project team also identified lessons learned in phase one of the project and areas for improvement in phase two in their conference public presentation in November 2004 as

- not enough time was allocated to learning the new system and that more time in test and simulation mode would have been beneficial,
- there was inconsistency in computer hardware which caused some systems to run faster and more reliably than others; there were also some bad feelings over why some people had better equipment than others,

- if we had done a better job explaining new work request procedures to the campus community, things would have gone much better in the Work Control Center,
- we should not have planned to "go-live" at a fiscal year-end,
- we would prefer not to test the system and train on the new system during the summer months, and
- the shops need clerical help managing the paper volume and help dispatching trades using the new work order system.

Phase Two: Unpredictability and Disconnected Parts

After the successful October 1, 2003 CMMS implementation, the steering committee was ready to prepare an outline for the next phases of CMMS development. The project structures and processes from phase one were to be used but refined with the improvements suggested at the end of the first project phase. By March 2004, the next phase of the project outline was completed and ready to present to the steering committee for approval. A management presentation to the steering committee in September 2004 defined the scope of phase two as being the following:

1. Preventative Maintenance Module.
    a. Information Gathering.
    b. Configuration.
    c. Testing.
    d. Implementation.
2. Asset Hierarchy.
3. Fleet Module.
4. Hierarchical P.O. Signing Authority Matrix.
5. On-Going/Orientation Training Plan.
6. Transition from Citrix Server to Web Environment.
7. Reporting: Workflow Process for Requests/Approval Workflow.
8. Space Module and Utility Module Analysis and Evaluation.
9. Tool Crib.
10. Fuel Control System.

Before the steering committee could consider the project outline of the next phases of the CMMS, the university announced that it was implementing a new financial management system (UniFi) to replace the current financial system. FMD's maintenance system required extensive

interfaces with the central university's financial system. No further changes could be made to our system until the new UniFi system was installed and functional. In a September 2004 CMMS management presentation the following was identified as being required in order for phase two of the project to proceed in harmony with the new UniFi system:

1. Work with the UniFI Project Team to determine modifications that need to be implemented into our CMMS.
2. Scope extends into all modules – affects Chart of Accounts, Distributions, Customer Database, Vendor Database, Property, Procurement Process.
3. Rewrite of Interfaces from Facility Focus to UniFi.
4. Determine "best fit" between UniFi elements to Facility Focus elements.

As of December 2005 the CMMS/UniFi interfaces were not fully functional. Indeed, some of the core functions of the CMMS no longer worked. Despite many meetings and significant pressure from the steering committee and me to central administration, problems persisted with UniFi. For example, my memo to central administration in January 2006 stated in part

> FMD communicated concerns we had with the Unifi system in a memo sent October 7, 2005. To our knowledge, most of the issues identified in the memo have not yet been addressed. Not only is the new functionality not working, some of the key functions of our CMMS implementation in the fall of 2003 are no longer working. This is having a serious impact on the morale and motivation of the entire CMMS project team.

The next phases of CMMS development needed to support further changes in FMD have been delayed indefinitely. This had had an impact on the CMMS project team and the rest of the Division. The complex relationships created for, and by, the CMMS change initiative have begun to erode as fear, worry, and anxiety about the Division's future have started to replace the trust, hope, and enthusiasm created over the past five years.

Synthesis of the CMMS Case Study

The case study and burography, on their own, were not intended to fulfill the purpose of the study to use "New Science" as a lens through which to view change in a university facilities

management division and to determine in what ways “New Science” can help make sense of these changes.

My burography was embedded within the case study so that my role as a key actor in the organization could be identified and so that my recollections and reflections about the changes in the Division could be included in the case study. This was important for the purpose of the study in order to discuss how the “New Science” lens can be used to make sense of change in a university facilities management organization.

I used my personal daily log to help me recollect events in the Division during the study period. The case study material was collected from various text-based archival sources in the Division freely available to me as the Associate Vice-President. Together, the burography and the case study formed the data representing change in the Division. While collecting the case study data, and reflecting on my role as a main actor in the Division during the study period, the foundational “New Science” concepts that framed the key themes emerging from the burography and case study data became clearer. These foundational “New Science” concepts were uncertainty and unpredictability, complementarity, semantic complexity, chaotic complexity, non-linear adaptive networks, and wholeness and implicate order.

The key themes that emerged from the case study and burography data included why previous attempts at implementing a CMMS were not fully successful and how FMD began to understand the need for change. How some people came together to make the project a success was also a key theme that emerged from the case study and burography. Making changes in new ways and sustaining changes in new ways were two other important themes. As well, the fact that some people were not engaged in the project and the expression and detrimental impact of

disappointment and frustration created when the second phase of the project stalled due to the new UniFi system also emerged as themes in the case study and burography.

The following chapter uses “New Science” as a lens through which to view the case study data based on these themes and to determine in what ways “New Science” can help make sense of these changes.

Chapter Five

VIEWING CHANGE THOUGH THE LENS OF "NEW SCIENCE"

The purpose of the study was to use "New Science" as a lens through which to view change in a university facilities management division and to determine in what ways "New Science" could help make sense of these changes. This chapter uses the "New Science" concepts described in the Chapter Two literature review and the methods described in the conceptual framework to make sense of the Chapter Four case study and burography data (see Figure 1.1).

Chapter Two described how "New Science" concepts derived from discoveries about quantum matter can provide a lens through which to view, and a vehicle by which to explore, the nature of dynamic and adaptive facilities management units. The "New Science" concepts included uncertainty and unpredictability, complementarity, semantic complexity, chaotic complexity, non-linear adaptive networks, and wholeness and implicate order. The concepts of "New Science" can be used to help discover how organizations work, how organizations can be simplified, and how organizations can change (Wheatley & Kellner-Rogers, 1996).

This chapter is organized around the key themes identified in the synthesis of the case study data of change in the Facilities Management Division in the previous chapter. These were why previous attempts at implementing a CMMS were not fully successful, how FMD began to understand the need for change, how some people came together to make the project a success, making changes in new ways, sustaining changes in new ways, how some people were not engaged in the project, and the feelings of disappointment and frustration when the project stalled due to changes to the university's financial management system. These themes are analyzed using the "New Science" concepts of uncertainty and unpredictability,

complementarity, semantic complexity, chaotic complexity, non-linear adaptive networks, and wholeness and implicate order.

Previous CMMS Projects: Lack of Success

The Facilities Management Division at the U of S had attempted to implement fully a CMMS in 1991 and to upgrade the system in 1998. Although the hardware and software worked, some important features of the system were never fully implemented.

Some people did not accept the full work order capabilities of the initial system in 1991 or of the upgraded system in 1998. It seemed to me as though some people wanted to protect the system then in place because it allowed them individual authority and oversight over their budgets and activities. A fully implemented CMMS would have permitted others to easily review shops' activities by checking work orders and financial reports; some people did not want this. The purpose of a fully implemented CMMS, and the benefits it would provide to the Division, were not presented in 1991 or in 1998 in a way that convinced some people that a new system was preferred of advantageous.

The previous CMMS project had not been successful because some people did not feel a strong enough sense of new purpose to make them change their past practices. Those responsible for the two previous system implementations could not develop and communicate a compelling purpose for a new CMMS for two reasons. First, the Division did not understanding what was happening in their university environment. This meant that the Division as a whole could not have developed a sense of critical need for a new CMMS. The Division was not looking for pressures or trends in its environment that may have signaled a need for change.

Some staff members had defined their world based on the values, principles, and culture that had served them well for a long time. They had created their own beliefs of their purpose

based on their history and their experience. They looked inwards for self-referential verification of purpose and validation of this purpose. This model, by design, was comforting and reassuring since it was self-defined and self-confirming. It was impossible for some people to understand the need for a new CMMS based on external factors due to the myopic nature of how they viewed their surroundings. A very strong moral purpose would have been required in order to shift these people's gaze outwards through a new lens crafted by an awareness and a desire to see a new reality and to change accordingly. People need to understand and to share a new moral purpose in order to change (Fullan, 1999).

The second reason why the people responsible for the two previous system implementations could not develop a compelling purpose for change was because the Division lacked the internal "infrastructure" needed to convey, to explain, to educate, and to debate the new realities on campus and what the Division needed to do in response to these new realities. Relationships and connections would have been required for the factors, trends, and pressures in a changing university environment to flow around the Division in order to create a new sense of moral purpose for the Division and to deal with uncertainty and unpredictability.

The Division's gaze was not directed towards the campus; there was no transmittal of information of what was happening in the university back into the Division; the lens the Division was using worked only in one direction and was out of focus; and the networks within the Division needed to create new moral purpose and to change did not exist.

Some staff had tacitly and explicitly built and maintained this system because it had served them well for many years. However, when I joined FMD in early 2000 there were many indicators that the prevailing structure of narrow and one-way perceptions of reality required change. Organizations change when logical instrumental-technology rationality rules slowly

make room for subjectivism and hope (Kincheloe & McLaren, 2000). The next section of the chapter describes how the integrated case study and burography revealed how the Facilities Management Division developed a new moral purpose and began to change.

Understanding the Need for Change

The Facilities Management Division did not fully implement a CMMS in its two previous attempts. Except for a few groups in the Division, the Division did not want a fully functioning system. It did not want a new system because some people in the Division did not feel that there was sufficient reason to change their current operations and maintenance practices. They felt that they were fulfilling their purpose adequately and that there was no need to change and no need to spend time and money on a new CMMS in order to do so. They had developed their attitude and their purpose based on how they had designed their engagement with the campus. There had never been any reason why they should review this engagement and assess their purpose or to question whether they were still valid.

People in FMD needed to engage with what was happening in the university environment. Wheatley (1999) explained that, using a quantum view of an organization, there is no objective reality outside the organization; our environment and our future remain uncreated until we engage with the present and understand the need for change.

The people that I asked to participate on the CMMS steering committee and on the project team were people who I sensed understood the new realities on campus and who realized that FMD's past purpose and role was no longer appropriate. In retrospect, I should have perhaps included on the project team more people who did not understand why a new CMMS was needed.

The case study showed how the CMMS project team began to articulate the new campus reality in order to help people in the Division understand the need for change. In my conference public presentation in November 2004 I identified that one of the risks of designing the CMMS with a lack of engagement was “privatization of FMD”. The customer and community survey in 2001 and FMD’s Integrated Plan in 2003 also identified the need for different engagement with the campus. The project team’s May 2000 CMMS conference public presentation stated that a “key success factor” of the CMMS project was that the “Divisional reputation can be enhanced or damaged” by the project. A CMMS project assessment report in January 2000 stated that, “The team determined that FMD’s environment was rapidly changing…that FMD had not adequately responded to these changes.”

“New Science” describes how things in a quantum world are not directly or strongly connected but impact each other nonetheless. These fields and forces are invisible, changing, difficult to measure, can only be predicated to a limited probability, and are somewhat mysterious and indefinable (Heisenberg, 1999). The scientific management practices in FMD prior to 2000 were not based on these concepts; they were based on objective, causal, measurable, and manageable certainties. By definition, a scientific management model means linearity and predictability (Dolmage, 1992). Relying on a model such as this meant that the Division could not have been aware of the subjective, uncertain, and unpredictable characteristics of the university environment. Nor could the Division have understood the need for change, or how to think about a new moral purpose, or how to use these mysterious forces to understand the need for change, or how to go about it.

Engaging and interacting with the campus community was essential if FMD was to understand the need for change and develop a new moral purpose to develop a new vision.

Organizations must interact with the world to see what they might create (Wheatley, 1999). Wheatley also explained that through engagement in the moment, organizations can evoke their futures. The project team stated in their conference public presentation that it was important for FMD to "Understand why the previous CMMS failed in the past and how to succeed in the future".

For some time prior to 2000 the campus community had been signaling that FMD needed to change. These signals included complaints from faculty, students, and staff over costs, services, and attitudes, among them "Your services cost too much and take too long" and "Why can't we use a contractor to save us money who will be here sooner." Senior university administrators had also expressed concerns about FMD's abilities to manage the increase in upcoming capital construction. The signals were there, but FMD had failed to hear or see them. FMD had disengaged from the campus community. It operated in a world of rules it had created. It did not engage with others so did not understand it needed to change much less how to change.

Wheatley (1999) stated that to live in a quantum world, to weave here and there with ease and grace, we need to change what we do. New sciences are filled with tantalizing and hopeful processes that foster change. The processes in the Division after 2000 that fostered change included training programs (see implementation action plan in Appendix K), clear roles and purposeful interaction, and multi-dimensional project committee structure and functionality (see Figure 4.1, Figure 4.2, Appendix H, and Appendix L). "New Science" and quantum theory suggest that we must learn to look past an object or thing into the invisible level of dynamic processes.

The objective approach to CMMS implementation had not worked in 1991 or in 1998. FMD approached the 2000 CMMS implementation very differently. The dynamic nature of the

process was reflected in the project schedule, action items, timeline (Figure 4.2, Appendix J, Appendix K, and Appendix O). The processes were a series of actions, changes, and functions in the Division that brought about the successful CMMS implementation. Compared to the two previous CMMS implementation attempts, the dynamic nature of the project during the study period was characterized by continuous change, activity, and progress in all the project teams on their action items. The activities were marked by intensity and purposeful and forceful action.

I could see this happening during formal and informal gatherings of small to medium size groups of project team members. They would be crowded into an office or boardroom standing at the whiteboard discussing options, plans, problems, flow charts, structures, budgets, or computer program structure.

The previous CMMS project attempts were a series of isolated events that did not demand changes in action or function. The events were static blocks of mechanistic to-do items that did not involve or require a diverse group working through uncertainty and common purpose. Dynamic processes can help develop answers to how life is capable of so much change, so much newness (Wheatley, 1999).

Viewing and engaging the campus differently, understanding the realities of past and changing campus expectations, creating a new sense of moral purpose, and connecting people with non-linear and adaptive networks was the start of change in FMD. People in the Division then began to deal with uncertainty and unpredictability and to use other “New Science” concepts to continue the change process.

People Coming Together for Change

The members of the CMMS project teams came from very diverse areas in FMD; they all had different ages, skills, experiences, talents, worldviews, attitudes, beliefs, and expectations

and yet they came together to change. People did not know what to expect by being part of the project teams and much of the project was uncertain and could not be definitively planned. A project message in March 2003 to the project teams stated "DO NOT BE SURPRISED – TO BE SURPRISED." Fullan (1999) explained that change, planned and otherwise, unfolds in non-linear ways. Paradoxes and contributions abound and creative solutions arise out of interaction under conditions of uncertainty, diversity, and instability.

Coming Together With New Purpose

The successful CMMS project, the many schedule and action items accomplishments, and the CMMS training and go-live support were evidence of the moral purpose that developed in parts of the Division after 2000. Moral purpose acted as a touchstone for many complexities throughout the project. Moral purpose helped control instability by lighting the way through chaotic complexity, through many competing priorities, and through significant initial resistance to change. Fullan (1999) described moral purpose as "making a positive difference in the lives of all citizens is worth striving for as a value in itself because it may eventually be a higher form of evolutionary benefit to humankind and is dynamically complex" (pp. 11-12). The pathway to moral purpose is a perpetual pursuit because pluralistic (self-centering along with unselfish) motives abound. Narrow self-interest and commitment to the common good co-exists. Moral purpose in organizations, too, is complex and problematic and "conflict and diversity are our friends" (p. 22). Understanding the moral purpose of why they existed, what they were supposed to do, and how they were supposed to do it, created a supportive and safer environment for the people of FMD to come together to change. People in FMD now understood the uncertainty and the unpredictability of their current situation, but they were no longer afraid. Once the project teams had developed a new moral purpose to help them understand the need for change, and the

need for a new CMMS to support this change, the teams needed to create new processes and new connections to deal with uncertainty and unpredictability.

The following analyzes the changes in the Facilities Management Division using the "New Science" concepts of uncertainty and unpredictability, complementarity, semantic complexity, chaotic complexity, non-linear adaptive networks, and wholeness and implicate order.

Making Changes in New Ways: Uncertainty and Unpredictability

The CMMS project teams had come together to change the CMMS so that it could support the new moral purpose they had defined based on their understanding of what was happening in and around the university. They realized, however, that the internal and external worlds in which the changes were needed were complex and not as certain as they once thought: they were uncertain and unpredictable. Making changes would have to be done in new ways.

Being Uncertain and Afraid

In the past, the objective and causal management approach in FMD had meant that things were perceived as being certain and orderly. Complex systems and processes were not required since the world was seemingly quite a simple place. Difficult problems could be solved with more effort, with more resources, or with an objective approach to the problem. The Division had always had the comfort of certainty and mechanistic control of what it was doing. The Division did not believe that its world was uncertain.

The Division had been able to ignore the uncertainties of what was happening around it. Dealing with potentially chaotic uncertainties and the complexities associated with new knowledge and information was initially unsettling for the CMMS project team. We did not have

the experience, the skills, the talent, or the self-assurance to live in such an uncertain and complex world: the project team and I were afraid of the uncertainty.

Heisenberg's Uncertainty Principle states that

> Where one can measure the particle aspect, or the wave aspect of quantum matter– either location or movement – we can never measure both at the same time. While we can measure wave properties, or particle properties, the exact properties of the duality must always elude any measurement we may hope to make. The probability of a certain location of movement being accurate is possible, but it is only probable, not absolute. (Wheatley, 1999, p. 37)

There were many uncertainties in FMD during the CMMS project: some uncertainties originated from within the project and some uncertainties originated from outside the project. Internal uncertainties included the capacity of the Division's IT personnel and hardware and software systems to support the new CMMS product and whether the system could be specified, purchased, and tested in order to meet the 2003 deadline. The project team was uncertain about the entire new work order issuance module and they did not know how a product from an American supplier would adhere to Canadian tax law calculations. The team was unsure how the new space management module would work and they were wary about wireless hand-held Stores functionality.

Uncertainties from outside the project included how the interfaces with the university's central financial system would work and how the Division would keep processing external service requests when the new system was being tested. There were also external uncertainties around whether the vendor of the current CMMS would take legal action if their product was not chosen as the new system.

Uncertainty and fear from all sources could have created disordered chaos and instability in the project. Controlling chaos was important for the project teams, but remaining flexible and adaptive in order to deal with uncertainty was also vital. Remaining flexible and learning to be

comfortable with uncertainty was very new for some staff in the Division who, by the nature of their technical and applied science training, expected things to be causal, planned, manageable, and predictable.

People in FMD were uncertain about the claims being made about the new system contained in the various emails, presentations, newsletter, training sessions, and project meetings. There was uncertainty and fear over whether or not the system would work, whether or not it would really make people's jobs easier as I had promised in my emails, whether or not it would make people fail in what they were trying to do, and whether or not a new work order process would harm customer services and the Division's reputation.

Unpredictability and Fear of the Future

Scientific management practices had allowed the Division to be comfortable with how it had designed its place as part of the overall university "machine". The Division believed that a mechanistic and linear world provided useful cause and effect relationships. It also believed that these direct connections could be used to predict and thereby to control the future. As described in the case study, I, too, had believed that this was both possible, and beneficial, for most of my career. I had developed many strategic plans identifying future visions and future goals and objectives based on task lists and action plans (see Appendix B and Appendix C).

Prior to 2000, FMD did not believe that it could predict the future. It simply believed that the future would be the same as the past and the present because the present seemed to be working just fine. The project team and I, though, realized that the past and the present were not "just fine" and that ignoring signals that change was required and sticking to approaches used in the past put the Division at risk.

The Division did face an unpredictable future. The project team realized that there were things that would happen during the project that we could not anticipate in 2000. Fear of the future was very real. Here, “New Science” can again be of use. Similar to the probability of quantum elements being waves or particles, and similar to the probability of quantum elements’ locations and momentum, FMD could not be absolutely sure what it was, whether it had to be many things to many people, where it was going, where it would end up, how fast it was going in the right or wrong direction, and how to answer these critical questions when it had only the right.

According to the physicists of new sciences, trying to predict and control the future by making it the same as the past is not possible. Not understanding this prior to 2000 had put FMD in peril. The CMMS project team understood this, and realized that unpredictability, just like uncertainty, would require them to do things differently during the project.

Making Changes in New Ways: Building Relationships

As the Division embarked on the CMMS project, the project team and I, understanding the uncertainty of our reality and the unpredictable nature of the future and the project, were afraid. We knew we could no longer rely on a static sense of ourselves and on a non-contextualized purpose in order to control and to predict the future.

What we believed was that only if we came together could we deal with the inevitable uncertainty and unpredictability in the university world and in the project. The “New Science” concept of complementarity helped to explain what the project team and I were feeling and what we needed to do. In quantum theory, there is no consistent notion of what the reality may be that underlies the universal constitution and structure of matter (Bohm, 1980). If we try to use the prevailing worldview based on the notion of particles for instance, we discover that the particles,

such as electrons, can also manifest as waves, that they can move discontinuously, that there are no laws that apply in detail to the actual movements of individual particles and that only statistical predictions can be made about large aggregates of such particles (Bohm). If, on the other hand, we apply the worldview in which the universe is regarded as a continuous field, we find that this field must also be discontinuous, as well as particle-like, and that it is undermined in its actual behavior as is required in the particle perspective of relation as a whole (Bohm). This is Bohr's "Principle of Complementarity" (p. 36). Bohm argued that what must prevail in organizations is unbroken wholeness and complementarity between people and ideas. FMD had never viewed its world through such an uncertain and murky lens suggested by Bohm. Indeed, the Division's sense of self was defined by linear and logical matter that could be managed and controlled by cause and effect and by objective truth. The Division did not want to or need to understand the dichotomies of particles as waves or fields, continuity or discontinuity, and predictability or probability.

Few groups within the Division were complementary to each other prior to 2000. This was reflected in some poor service delivery and in the resulting complaints from the campus community. There were two significant groups in the Division who had been working in a complementary manner for a long time, however. These had a true and strong sense of their purpose in supporting the trades operations. They sought help and guidance from each other and they cared for and supported all aspects of the each other's operation. I believe that the reason we had fewer complaints from the campus about building comfort levels (heat, ventilation, cooling, electrical) than about other Divisional services was because of complementarity between these groups.

However, some work units were not connected with, and were not complementary to, the CMMS project people or processes or to other change initiatives in the Division. Some units were not represented on the project teams because we did not expect them to be users of the CMMS and would not be using individual work orders. Trying to be certain about this, trying to predict some staff's engagement with the CMMS and with other CMMS users, proved to be a mistake. The 100% probability and certainty we had that some staff would not need to be connected to the CMMS project turned out to be wrong. Some work units had to use the new project management functionality of the new CMMS. They also needed to use the new CMMS to keep track of their billable hours to meet their group's revenue budget targets. These were both very important professional and administrative requirements. Because they had not been included in the project, when some staff did have to use the CMMS, their comfort with and acceptance of the new system was low.

Complementarity, Harmony, and Enfoldment

The case study portrayed the strong complementarity within the project team. Complementarity was based on understanding common moral purpose and realizing that being uncertain and not being able to predict the future were reality. People engaged in the CMMS project despite coming from diverse backgrounds and despite not being physically located together in the same work environment. Like quantum matter, these people were complementary to each other even though there were physical, intellectual, and emotional gaps among them.

Bohm (1980) argued that our general worldview is itself an overall movement of thought which has to be viable in the sense that the totality of activities that flow out of it are generally in harmony, both with themselves and in regard to the whole of existence. The case study evidence showed how the project team members came into harmony as they worked though the

complexity of the CMMS project. Harmony meant that people knew that they were working for other people in the Division and that these people depended on them to fulfill the role that they and the project team had defined for themselves; harmony meant that people had colleagues to go to when they had problems; harmony meant that people felt safe and could trust each other; and harmony meant that people came to work with the same understanding of their purpose and about what they needed to do. Such harmony is possible only if the worldview itself takes part in an unending process of development, evolution, and enfoldment, which fits as part of the universal process that is the ground of all existence (Bohm, 1980). The CMMS project started as a two dimensional list of tasks. The project developed, however, into a multi-layered and entangled process of information flow, changing relationships, feedback, uncertainty, and learning. This was the enfoldment process described by Bohm.

People Connecting and Building Relationships

It seemed to me that the project team knew that in order to create harmony and enfoldment they had to take advantage of complementarity. Complementarity would come from connecting with each other and building relationships. This would help support the new moral purpose and deal with uncertainty and unpredictability. As shown in Appendix 1, FMD was an organization created and operating as disconnected units, departments, shops, and areas. There were technical and rational connections between these areas based on rigid and hierarchical traditions.

The CMMS project did not rely on these traditional connections and relationships. The location, path, substance, and direction of the connections needed for the project were created anew by the people involved in the project. People from very different places within FMD, and

with very different backgrounds, came together to co-create the network of practical and emotional connections and relationships needed during the project.

There were, however, some Division members that were not building new relationships through the CMMS process. The electrical shop, the space management group, the safety and environmental group, the grounds operation, and initially the construction and renovation group were not initially part of a non-linear adaptive network based on new moral purpose and complementarity. I believe this was due to the people in these areas never fully believing that the CMMS would work better than the system they were currently using. Representatives from these areas were late-comers to the project teams. They did not join until the system selection process had begun, well after the early-on discussions of project justification, team purpose, and individual roles.

Intensive human interaction involving people different than ourselves (diversity) provides us with an evolutionary advantage because (a) interaction is essential to solving problems, and (b) diversity of interaction is most suited to discovering moral and effective solutions to problems presented by turbulent environments (Fullan, 1999). I still wonder how the additional diversity the late-comers would have brought to the project might have benefited the project. There were project problems with work request flow, charge-out rates, time and cost standards, and physical asset hierarchies' definitions in the new system. Having these groups engaged earlier and more intensively in the project would also have helped us further contextualize and better understand the turbulent campus environment. The renovation and construction group, especially, was more closely connected with the campus community than any of the groups on the project team. Having their insights and worldview earlier in the project planning and scoping

process would likely have been very beneficial and would have helped us build stronger and more informed relationships.

"New Science" describes how paired quantum matter is connected and complementary, even over long distances (Bohm, 1980). The relationships between the project team members during the CMMS project were also based on complementarity and invisible connections. The groups that were not connected with the project were not using new moral purpose, complementarity, and semantic complexity to become part of the whole and did not create networks to adapt and to change.

Connecting and building relationships over long distances. The connections and relationships in FMD derived from people's changing perspectives and understanding why the CMMS project was important. Well-communicated and co-created schedules, tasks, and roles provided a context for weaving together thoughts and creativity. Wheatley (1999) stated that we can now see the webs of interconnections that weave the world together. We are more aware that we live in a relationship, connected to everything else. We are learning how profoundly different processes in living systems emerge and change.

It was not clear how far the connections inside and outside the Division went, however. The connections and relationships within the project teams were short, definable, and sustainable. The connections to some groups seemed longer, weaker, and more unreliable. These groups engaged in negative criticism about the project and about some of the project team members. They were not engaged in problem-solving and creativity early-on and throughout the project. Wheatley (1999) explained the behaviors of networks, the primacy of relationships, the importance of context, and new ways to honor and work with the whole ways of life. Despite the purposeful connection-building processes identified and enacted by the project teams, not all

groups within the Division were equally connected and using the networks to build relationships and to craft moral purpose in order to deal with uncertainty and unpredictability.

Connecting and building relationships with identity. Complementarity, relationships, harmony, and enfoldment were essential for dealing with uncertainty and unpredictability in FMD. They require people and groups to know who they are, what they want, and what they aspire to be (Bohm, 1980). Prior to 2000 and the new CMMS project, FMD had identified itself with managing the university's physical plant. People who were not in charge of these activities were not identified as critical to the Division and they did not identify themselves with FMD. Management reports and my burography described how this attitude created an environment where adopting new processes, like the CMMS, was not possible. Very few people within FMD knew what was happening in the university environment of understood what the campus thought of FMD. Most staff in FMD believed they were doing a good job. The Division had never gone through a process to re-define itself in a broader university context. It was aware of itself based on a narrow view of where it had come from and where a few people thought it should go. No information made its way into and around the Division to spark dialogue about the need for a new identify. Self-knowledge was lacking or based on false and dated assumptions. People believed they were more than capable of fulfilling what they believed was the Division's mandate now and into the future. They did not feel that they needed help from the outside or from any non-traditional internal connections to use identity-making as a relationship building process.

Wheatley (1999), however, stated that organizations must develop greater self-knowledge and identity in three critical areas. People need to be connected to the fundamental identity of their organization or community: Who were we? Who do we aspire to become? How should we

be together? People need to be connected to new information: What else do we need to know? Where is this new information to be found? And people need to be able to reach past traditional boundaries and develop relationships with people anywhere in this system: Who else needs to be here to do this work with us? The CMMS project teams and project teams' members indirectly answered these questions by understanding what was happening in the university in conjunction with a new identify to build on strengths and to deal with information and cultural shortcomings. Others in the Division, however, did not use the CMMS project process to answer for themselves these questions of identity and purpose. It was only after the project was completed, and people began to use the system for their own purposes, that their sense of identity began to re-shape.

The sense of a new FMD that had created new moral purpose and new vision-fields for the project team were not used by other groups in the Division to create their identity. They were aware that the CMMS could help ground and enhance their purpose, but my sense was that these groups had developed identities that were not directly aligned with the Division's core identity. I was initially concerned about this but I wonder whether an expectation of such linearly-aligned and objective identification of what groups are, and what they are supposed to do, is contrary to the realities of organizational life as described in much of "New Science". Also, it could be possible that there are different layers and textures to "New Science" identity. These could be provided by connections that go between traditional dimensions and that do not require and, indeed, cannot be built from, planar fields and causal and objective relationships.

Connecting and building relationships by listening and learning. FMD's previous individual-based management paradigm had not required complementary, harmony, enfoldment, or connections created by listening, learning, and new relationships. The uncertainty and unpredictability of the CMMS project, and of life in the Division in general did, however, require

these dynamics. Wheatley (1999) explained that we need to make better sense of fostering relationships and how to nurture growth and development in organizations. She further explained that we need to become better at listening, conversing, and respecting one another's uniqueness, because these are essential for strong relationships. The CMMS project team included people who had never before worked together or talked to each other. These people brought diversity and uniqueness to the project. The co-created project structures and processes encouraged listening and learning and the building of strong and respectful relationships.

The CMMS tender evaluation was a good example of building relationships by listening and learning. The accounting and materials handling staff that had supported the two previous system projects wanted to remain with the current vendor. Other opinions were split between two other product vendors. Despite this difference, these people were able to design an appropriate evaluation system, to evaluate the three short-listed systems, and to choose the final system. Strong relationships built on listening to other's opinions and learning to appreciate other's perspectives supported this process.

Not all relationships in the Division during or after the CMMS project were strengthened by listening and learning. There were some problems with people and groups outside the project team structure and there were some problems within the project teams themselves. There were issues of which project module took priority and there were issues about how the overall project budget should be allocated. On some of these issues, people did not trust the opinion of others. Despite the working relationships developed to accomplish project tasks, the relationships did not go beyond that. There were decisions that I had to make on my own, or with the steering committee.

Wheatley explained that we live in a universe where relationships are primary. Nothing happens in the quantum world without something encountering something else. Nothing exists independent of its relationships. We were constantly creating the world – evoking it from many potentials – as we participate in all its many interactions. This is the world of process, the process of connecting when "things come into temporary existence because of relationship" (p.69). We must create organizations of process and relationships, quantum organizations that work more effectively in this relational universe.

Making Changes in New Ways: The Project Team in Unity

The CMMS project team had become aware of the uncertain and unpredictable nature of the project and of the Division in the changing university context. They had learned how to listen and to learn and how to create identity in order to build connections, relationships, and complementarity. I sensed that the result of these new dynamics in the Division was that the project team was functioning as a unit, but with diversity, flexibility, adaptability, and creativity.

The project team and some areas of the Division were experiencing a wholeness that they had never before experienced. Wholeness meant unity and oneness without direct, identifiable, tangible, and objective connections. The wholeness provided an environment for implicate order defined as order created through intimacy and entanglement (Bohm, 1980). Implicate order also meant that people and processes overlapped and enfolded in a continuous manner. This meant that people and processes were connected at different places, for different periods of time, with different intensities of connection, and with different levels of emotional and intellectual coupling. Layers of enfolded ribbons of implicate order wafted throughout the Division carrying the personalities and the words essential to help order needed chaos. From a distance, the ribbons took the form of the whole of FMD. There were no individual and isolated parts. The whole was

not static, and it could not be defined exactly by everyone at the same time as being the same thing. FMD resembled the wave, particle, field, and force dichotomies of "New Science".

The Division as a Machine With Many Parts

Prior to 2000 and the CMMS project, most of the individual groups in the Facilities Management Division (see Appendix A) had been relatively successful in fulfilling what they believed to be their individual mandates. There were issues in the Division, however, including the changes required to implement a new CMMS, that could not be dealt with by a collection of disconnected groups. Zohar (1990) stated that quantum physics suggests that "we can live in a reconciled universe, a universe in which we and our culture were fully, and meaningful, parts of the scheme of things" (p. 25). The world thus appears as a complicated tissue of events in which "connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole "(Heisenberg, 1999, p. 107). The mechanistic and Taylorist management style in FMD prior to 2000 had encouraged individuals and groups to function as isolated parts connected only through technical connections and causal relationships. Taylorist designed worker-machine processes identify workers as parts of the overall manufacturing machine (Price & Akhlaghi, 1999). The case study demonstrated how the project teams and the project team members accomplished many tasks. The linkages between these teams and people, however, were based on humanism and the sharing of new purpose and new knowledge derived from an understanding of the Division's place in the freshly discovered realities of the university environment.

The Division Performing as a Whole

Before 2000, FMD had dealt with its organizational problems as it had dealt with its technical problems; as if it was a machine that had broken down. Broken parts (people) in the

Division were either replaced or ignored; problems were sometimes dealt with by making the machine bigger or more powerful (more money, more people); and the engine (the unit) was not maintained or lubricated (nurtured, developed, cared for). Wheatley (1999) described this as using reductionism to diagnose problems and expecting to find a simple, single cause for our woes. FMD was good at sifting through all the possible causes of failure searching for that one broken part: a bad pump, a dysfunctional program, a poor trades shop. To repair the organization, all FMD needed to do was replace the faulty part and gear back up to operating at predetermined performance levels. Wheatley suggested that we should lay aside the machine metaphor with its static mechanisms and separated parts. Look, she said, for the underlying processes that give rise to innumerable and different life forms. The evolving processes and structures that supported the CMMS project were not based on individual, isolated, or disconnected people, groups, or needs. They were based on complementarity and the Division performing as a whole.

According to Wheatley (1999), we must account for dynamics operating in the whole system that are displaying themselves in these individual moments. Even though the CMMS project team members were focused on their roles on their teams, they were always aware of the dynamics back in their home unit, or in the lunch room, or in Colleges and departments. They frequently returned to their project teams with concerns about attitudes and opinions being produced by the changing dynamics in the Division. The project teams, and ultimately many people in dispersed and distant areas within the Division, provided touchstone purpose, vision-fields, and support, not to quell these dynamics, but to reframe them in the context that surrounded the CMMS project. The more this happened, the more comfortable the Division became with uncertainty and with the disorder it used to defend against. Bohm (1980) stated that

when we shift our vision from the parts to the whole, what looks like chaos reveals inherent order. What seemed like an aberration of Newtonian laws became lawful: paired electrons refused to act individually and exhibited their inseparable wholeness across vast distances. A system world can not be understood by looking only at discreet events or individuals (Wheatley).

We must attempt to develop an overall worldview (Bohm, 1980). The CMMS project teams would not have been able to connect the many pieces of the project without constantly reaffirming their view of the world around them. I felt that I helped provide this "reality check" and explanations of the pressures from the campus community. I am not convinced that my providing the majority of the information used by people in the Division to change, or to reaffirm their view of what was happening around and to the Division, was enough. The level of trust required by the people in the Division to believe all that I was telling them could not have been adequate, especially since I was new to the Division and very much an unknown entity. Upon reflection, perhaps it was the other change initiatives in the Division that required other people, and not just senior staff, to become more engaged outside the Division that helped create understanding, purpose, connections, and wholeness. People brought new information and new interpretations about what was happening on campus and how these forces could impact the Division. People in the Division had never before had to pay attention to what was happening on campus, or beyond, and the previous Associate Vice-President of the Division, who reported directly to the university president, did not bring back to the Division important facts about what was really happening in other areas in and around the university.

Sustaining Change in New Ways

The project team had been able to develop wholeness and implicate order using complementarity, semantic complexity, complementarity, non-linear adaptive networks, and

chaotic complexity in order to deal with the uncertain and unpredictable nature of the CMMS project. The project team needed to sustain this new dynamic state. If it did not, and if it allowed itself to succumb to the fears and confusion created by uncertainty and unpredictability, it would return to an ossified and isolated state, or it would move to a state of disorder and chaos.

In order to sustain the new way of making changes in the Division during the CMMS project, the project team used the non-linear adaptive feedback networks that it had created through complementarity, connections, and relationship-building. Knowledge, information, words, thoughts, ideas, values, and creativity flowed along these networks to sustain wholeness and the changes in the Division. The networks were also used to provide different types of control and to distribute different enlivening forces that also helped sustain the changes in the Division. The following discusses the different uses of the non-linear adaptive feedback networks created in the Division between 2000 and 2005.

The Flow of New Knowledge

It was essential for the project team to be able to share complex new knowledge, information, and ideas with each other and with the rest of the Division. Knowledge, information, and ideas were able to flow around the Division on networks created by connected people listening, learning, talking, and sharing. The science of complexity studies the fundamental properties of non-linear feedback networks and complex adaptive networks (Stacey, 1996b). Complex adaptive systems consist of a number of components, or agents, that interact with each other according to sets of rules that require them to examine, and to respond to, each other's behavior in order to improve their behavior and the behavior of the system they comprise (Stacey). Some members of the project team, for example, spent many days explaining how their shops' budgets would be restructured in the new system. Operations staff came to talk to the

materials handling people to learn how they had incorporated bar-coding into their equipment inventories. The project management team members worked together with the work control team to design a new work request flow process. Some of these people had never talked to each other before. Most had never considered the need to talk to other people because they believed that they had nothing to offer. The connections developed were not fleeting or superficial. People realized that what they were learning and developing would be used every day. The CMMS was integrated, the work processes required integration, the system development required integration, and using the system required ongoing integration. Not recognizing this in earlier CMMS implementations partly explained why they were not successful.

The "rules" in FMD for the CMMS project were based on the "why" of the project and the moral purpose articulated early on in the project. For example, the project team reported in their May 2004 conference public presentation how they had identified the "why" of the project and how this information was used as a benchmark for checking expectations and behavior throughout the project. The project team explained

> Organizational changes prompted a re-evaluation of our systems; the existing CMMS system was not meeting the needs of the division; and that we needed a comprehensive system for ongoing monitoring for system improvements based on stakeholder needs.

Many communiqués were issued describing the benefits of the project. This information flow served as a bounding field to help control instability, to allow people to examine what they and their colleagues were doing, and to help them adapt as necessary. A January 2005 report described the adaptive nature of the CMMS project and the many project team meetings, the multi-dimensional connections, and the dynamic nature of the information flow during the project.

The two-day CMMS project strategy meeting in September 2003 was an example of how the project teams came together to interact and to check purpose, goals, objectives, and responsibilities and to plan how to flow this information around the Division. This was a process of checking and learning and adapting in a very non-linear way. The project teams did this without top-down instructions. They themselves sensed that constantly reviewing, discussing, cross-checking, and adapting to new problems and opportunities was essential. FMD did not change in order to do this, FMD changed during the process of doing this. This, then, facilitated the flow of new knowledge throughout the Division.

Communicating New Knowledge

Before 2000, FMD had been able to communicate about technical problems, solutions, and decision-making quite well. The problems it was facing in 2000, were more subjective and more humanistic. The failure of the two previous CMMS implementation attempts was the result of approaching a change project from a purely technical perspective. In the past, the Division had been incapable of hearing and responding to internal and external subjective and interpretative challenges involving new knowledge, language, and words about the dynamic university environment and the need for the Division to change.

The project team had to learn how to communicate new knowledge and information about the project to the Division. This was a complex and challenging process. Biggiero (2001) defined infinite complexity (versus trans-computational complexity and rational complexity) as having two components: chaotic complexity and semantic complexity (see Table 2.1). Semantic complexity is created by new knowledge, language, words, spirituality, and intuition. Semantic complexity can create unstable conditions in an organization or it can create creativity, aliveness,

and adaptability (Biggiero). The CMMS project team needed semantic complexity to deal with both instability and creativity.

Semantic complexity cannot be observed, quantified, or ordered. Fullan (1999) stated that due to the subjective and contextual nature of semantic complexity, the link between cause and effect is difficult to trace. However, I believe that there was evidence in the case study that language, words, and intuition did play a significant role in the CMMS project. For example, in my email to FMD in July 2002 I used words such as “opportunity to get a system that was flexible, powerful, friendly, and capable”, “opportunity to jointly and collaboratively”, “to explain the tremendous job we do”, “to identify funding shortfalls”, “expertise to enhance our operations”, and “balance work order management”. The information conveyed in the project team’s announcement in March 2003 of the benefits of the system to FMD used words and information to contextualize the project. The words and language, both verbal and written, were heard and interpreted by the people in the Division. The words had intuitive, emotional, and historical meaning for the people in the organization. Actions that were consistent with what was being said transmitted confirming and reassuring meaning back to listeners. Semantic complexity used and helped sustain non-linear adaptive networks for the flow of new knowledge about new realities.

The members of the CMMS project teams, and their colleagues in the Division during the project, had difficulties understanding how the system could help them do their jobs and why the project and their involvement and buy-in was important. My emails to the Division in July 2002, the newsletter from the project team in November 2002, the project team announcement in March 2003, the divisional announcement in March 2003, and my and the project team’s

conference presentations used very specific words and tone to explain why the project was important to the Division.

The collaborative thought that went into preparing, issuing, and responding to queries from these communiqués laid a solid purpose foundation for communicating new knowledge. The project team used words such as “celebration”, “inclusion”, “ownership”, “solid foundation for growth”, “understanding”, and “satisfaction”. I used words such as “collaboration”, “the tremendous job we do”, and “help”.

Managing Risks

The CMMS project needed to remain flexible in order to deal with uncertainties and it needed to remain adaptable in order to deal with unpredictability. Complementarity, connections, relationships, and semantic complexity were some of the building blocks that helped support the project. As well as the complexity created by knowledge, language, and words the very nature of such a large project with so many human, technical, and logistical issues was risky. The project team sensed that the project could quickly and very easily spin out of control resulting in a chaotic mess.

Fullan (1999) explained how chaos theory and its application to organizational complexity can be important for controlling chaotic disorder and unpredictable change forces in organizations. Chaotic complexity can be observed, quantified, and ordered. (Biggiero, 2001). Brown and Eisenhardt (1998) argued that “complexity theory began with an interest in how order springs from chaos” (p. 14). According to complexity theory, adaptation is most effective in systems that are only partially connected. The argument is that too much structure creates gridlock, while too little structure creates unbounded chaos (Fullan).

Although the project team seemed to have moved into an area between order and disorder somewhere in a band of chaos, this was not the case for all groups in the Division. Some groups did not feel comfortable being expected to spend some time in their regulated and ordered technical world and then be expected to fully engage in a project where fluidity, flexibility, and creative uncertainty were the norm.

The project teams had learned that it was easier dealing with the complexities of the project in an iterative and adaptive way. Some people never did embrace this style of project development or the style of personal networks and connections being created in the Division. At the end of the study period, I believed tension between some groups in the Division remained strong. Groups in the Division had an important role to play, they could not be ignored. I behaved in a more direct and authoritarian manner. The lens provided by "New Science" was still well-focused, but it viewed some groups through a sub-lens focused by different managerial optics. The optics were honed by technical requirements, accountable employee expectations, and risky design and financial rules. The rules viewed through the "New Science" sub-lens provided bounding elements bringing some stability to what could be otherwise uncontrollable activities. People moved from a stagnated chaos location closer to the edge of chaos where creativity and innovation was possible. By the end of the study period, however, the some people were still not balanced on the edge of chaos.

The risks of unmanaged chaos. Instead of allowing the many technical, human, and financial components of the project to get out of control, they were ordered and shaped into an ever-changing but identifiable project scope. The form of the project was created by the processes and the adaptation that responded to new chaotic forces and complexities. The interactions between project teams and project team members (see Figure 4.1 and Figure 4.2),

and the clear roles and responsibilities identified in management messages helped people understand who was to do what and how they were all working together to deal with what could appear as disorder or chaos.

The interactive nature of the project teams meant that they could deal with complex items before they became disordered chaos, but they could also use the complexity to stay flexible, adaptive, and responsive. Wheatley (1999) stated we can organize chaos through our creativity and that chaos is always partnered with order. Chaos is "the last state before a system plunges into random behavior where no order exists" (p. 115). Wheatley described chaos containing order as an essential, nourishing element of systems that fall apart. The layers of complexity and the sense of things being beyond our control and out of control are but signals of our failure to understand a deeper reality of organizational life and of life in general (Wheatley).

Since its inception, FMD's mechanistic and applied science worldview had been about control and the reality of physical things and the linear and objective problems and solutions inherent in such a world. Disordered chaotic complexity and the unfamiliarity of semantic complexity were anathema to FMD. FMD perceived these complex conditions to be risks to be designed against and avoided. According to Wheatley, however, changes to human systems require understanding and embracing the uncertainties and the complexities of the reality of organizational life in order to thrive and to re-generate. These were not the conditions I found in the Division in 2000.

Sullivan (1999) argued that the strategy is to ride positively the crest of chaotic and disorderly change dynamics, making small adjustments on the way and eventually achieving a renewed and ordered system. The iterative nature of the CMMS project meetings and the

incremental approach to learning how to deal with the technical and human risks in the project were demonstrated in the case study evidence.

Managing the risk of unpredictability. FMD could not have predicted that the university would implement a new financial system (UniFi) that required difficult interfaces with FMD's system soon after the CMMS went live in October 2003. Instead of responding to the unpredictability of the UniFi project by either hunkering down back into a static state, or allowing the unpredictability to break the forces that were bounding chaos, FMD initially responded to the UniFi project by relying on the moral purpose, the understanding, the collaboration, the trust, and the sharing of knowledge and understanding of another change force in its environment in order to manage the risks of the unpredictable UniFi project. A project summary in September 2004 on the project team's response to the UniFi projects stated that the project teams had to do the following:

1. Work with the UniFI Project Team to determine modifications that need to be implemented into our CMMS.
2. Scope extends into all modules – affects Chart of Accounts, Distributions, Customer Database, Vendor Database, Property, Procurement Process.
3. Rewrite of Interfaces from Facility Focus to UniFi.
4. Determine "best fit" between UniFi elements to Facility Focus elements.

The points above demonstrated how FMD was taking the new information about the UniFi project and feeding it back into the organization to manage the risks of unpredictability. The information was incorporated into processes that would help to strengthen adaptation, flexibility, and further renewal and change in the Division.

Cartwright (1991) stated that the shape of chaos materializes from information feeding back on itself and changing in the process. This is the familiar process of iteration and feedback described in much of "New science". The UniFi project required people from the project team to venture outside the Division to gather information about the UniFi project. People brought this

new information back into the Division, into the new adaptive networks built from complementarity, semantic complexity, and moral purpose. They changed and adapted the CMMS to accommodate the UniFi financial and computer program requirements. This process resulted in self-organization and autopoiesis in the Division. The process succeeded in creating newness because it took place in a system that was non-linear, it was flexible but with boundaries to prevent unmanaged chaos and disorder. The recognition of non-linearity and the new mathematical tools of chaos theory have made it possible to see more clearly how life works (Cartwright).

The UniFi project was the first significant external unpredictable pressure that impacted on the Division since the start of the CMMS project. The details of what had to be done to interface the CMMS with UniFi were fed into the network of CMMS project team members. Project team members took this information and immediately started to change computer databases and programs and work flows to accommodate the UniFi requirements. People used their new relationships and networks to do this and in so doing, strengthened the understanding, the trust, the respect, and the flexibility and the adaptability of the network.

The unpredictable risks for the CMMS project team and for the Division can be further described by “New Science” concepts. The results of millions of iterations of a chaotic process can be predicted, quantified, and modeled by powerful computers (Bohm, 1980; Greene, 2003; Wheatley, 1999). Chaotic systems have natural states that they move towards (attractors) and their changing but repeating shapes are called fractals (Wheatley, 1999). However, in human systems and organizations, obtaining the data and developing the algorithms to help define a common, although changing, shape and to predict future conditions is not possible or practical. If the organization is not prepared for unpredictability, instability will result and the organization

will slip over the edge of chaos (Fullan, 1999). In its past, the Division had not let this happen. By the very nature of the mechanistic approach to the physical and human world in which the Division had been comfortable for many years, physical and human systems were not permitted to become random, unstable, or unpredictable. There were unpredictable internal and external human moments, of course, but these were tacitly ignored or dealt with in a mechanistic and logical manner.

Prior to 2000, the Division focused on its self-defined purpose and activities. It "managed" the risk of external unpredictability by being unaware that anything but observable causality existed. Newtonian methods of cause and effect do not have room for unpredictability. Formulas and analyses can provide exact outcomes based on specific input. Everything is predictable.

During the CMMS project, however, the project teams realized that internal and external and interconnected technical and human problems could not be predicted. The project teams realized that the only way to deal with the inevitable, and real, and unavoidable unpredictability was to draw on each other and each other's knowledge. This process strengthened the networks and leveraged the new knowledge that came from learning to deal with the unpredictability. The knowledge flowed around the networks strengthening capabilities and increasing creativity and adaptability.

Using unpredictability. The concepts of "New Science" can help one understand resistance to change and the novel new order that can emerge through chaos and unpredictability (Wheately, 1999). Management considered resistance to computerized information and management systems in FMD during the two previous attempts at implementing a CMMS. Wheately further explained that "New Science" makes us more aware that our yearning for

freedom and simplicity is one we share with all life. Order and form were created not by complex control, but by the presence of a few guiding formulas or principles repeating back on themselves to the exercise of individual freedom. Wheatley also explained that the survival and growth of systems are sustained by a few key principles that express the system's overall identity combined with high levels of autonomy for individuals within that system to deal with an unpredictable environment. The roles and responsibilities of the various CMMS team leaders described the autonomy and freedom the team leaders had to constantly contextualize goals and tasks and to help their diverse teams maintain stability and flexibility in order to use unpredictability as a positive change force.

Many Activities and Creative Control

Daily operations continued in the Division while the CMMS project was being developed. The project involved dozens of people, an 840 item project scope, and great uncertainty. Daily operations included hundreds of people working on thousands of work requests involving millions of dollars and great unpredictability. The likelihood of this complex, difficult, uncertain, and complicated activity creating confusion and disorder, referred to in "New Science" as unmanaged chaos, was high. However, unmanaged chaos did not happen during the CMMS project. The project implementation schedule shown in Appendix J, the action items shown in Appendix K, and the project success report presented by the project team in May 2004 at the CMMS conference were evidence that instability and disorder did not take over during the project.

The evidence seemed to show that the successful project was not just due to good project management or to top-down instructions or to simple technical competency. Some members of the project teams had never before worked together. These people were not part of any pre-

existing network in the Division. The lack of networks, combined with 840 project technical requirement items, had the potential of creating a chaotic project. Networks were also required to facilitate learning and to feedback information between people working on different but related aspects of the project. The form and order of the CMMS project were created by the language and the words people on the project teams used to create non-linear adaptive feedback networks. Non-linearity meant that the networks in the Division were not one-to-one, permanent, or consistent in style or function. Adaptation meant that people were learning to deal with uncertainty and were changing who they talked to, how they talked, and what they said depending on the co-constructed need of the network at the time. Feedback meant that there was multi-directional flow of knowledge and information between people and groups in the Division. The many activities in the project used the networks to creatively control disorder and chaos.

The project team newsletters and emails, my communiqués, formal and informal personal and group interactions, and constant explanations and coaching, helped calm instability by providing reassuring words and information. Wheatley (1999) stated that order and form are created not by complex control but by the presence of a few guiding formulas or principles repeating back on themselves. The survival and growth of systems are sustained by a few key principles that express the system's overall identity. These combine with high levels of autonomy for individuals within that system (Bohm, 1980). The repetition of the CMMS project's core themes and values, and listening and responding directly to challenges, questions, concerns, and worries helped creatively control the many potentially random and disordered activities.

Work in the field of "New Science" has lead to a new appreciation of the relationship between order and chaos (Fullan, 1999; Wheatley, 1999). Order and chaos are now understood

as mirror images, two states that contain order. A system can descend into chaos and unpredictability, yet within that state of chaos the system is held between boundaries that are well ordered and predictable. FMD had been comfortable with its mechanistic and predictable state for a very long time. It perceived its internal and external world as stable, ordered, and without uncertainty. Things were predictable and there was no support for changing maintenance systems in 1991 and 1998. Unfortunately, this un-chaotic and overly-ordered state had created an organization unwilling or incapable of changing to deal with new pressures and new realities.

In 2000, the Division did not have any historical, spiritual, emotional, or practical experience in opening itself up to uncertainty and to the potential of disordered chaos needed to implement a new maintenance system. And yet the Division was able to complete the CMMS project successfully by 2003. Moral purpose created by words and relationships provided vision-fields that encouraged a dynamic and creative state that bounded chaos and that maintained order. Without the partnering of these forces, no change or progress was possible. Chaos is necessary to new creative ordering (Wheatley, 1999). Managed instability and a dynamic project process were needed in the Division in order to control creatively the many activities throughout the CMMS project.

Renewal and Rejuvenation in the Division

The two previous CMMS projects were developed by Divisional information technology (IT) and financial staff. The projects were technical in nature and were executed in a linear and technocratic manner. The projects did not require additional human energy or emotion in order to complete. The projects provided no feeling of accomplishment or celebration for the Division.

The CMMS project launched in 2000 was different. Substantial human energy and enthusiasm was needed to sustain the project and energy and joy were created by the successful

project “go-live” in October 2003. The positive energy from the project was created by the accomplishments of the people and by the multi-directional flow and fluctuation of information and ideas throughout the project.

Wheatley (1999) argued that fluctuation and change are essential to the process by which order is created. Life is about creation. This ability of life to create itself is called autopoiesis. Autopoiesis is life’s fundamental process for creating and renewing itself, for growth and change. A living system is a network of processes in which every process contributes to all other processes (p. 12). Autopoiesis and renewal and rejuvenation were working within the CMMS project teams. For example, there were aspects of the CMMS that required FMD to use new facilities management concepts. One of these concepts was using the system to record building, system, and equipment asset details (manufacturer, size, year, specifications, and location). Individual work orders would then be coded or assigned to a particular asset. The work history of the asset could then be tracked by using the CMMS built-in work order asset reporting features. Previously, Division staff had only entered buildings as assets to which work orders were assigned. Therefore, regardless of the type of work being done or which shop was doing the work, the work history was attributed to the building, not to the building system, piece of equipment, or building component. The project team realized that this level of detailed information, and therefore a new asset hierarchy definition system, was needed. The process that defined the asset hierarchy need and that built the asset hierarchy “parent-child” structure resulted in renewal of the asset management system and rejuvenation of the junior maintenance planning staff. In the past, the maintenance planning staff had only been involved in issuing and filing work orders; they were not permitted to change the system or to do things differently to better manage asset costs and work order history. With the new system, however, and the new

asset hierarchy structure, the maintenance staff went to facilities conferences, they talked to colleagues at other universities, they retained maintenance planning consultants, and they used trial and error to build the new asset hierarchy structure in the new CMMS. They were encouraged by the project team and their work was an important component of the new system. The maintenance staff came alive through this process. They recreated themselves and they grew into experts in CMMS maintenance planning design. They became part of the CMMS project network and extended their network to include trades supervisors and trades persons. They set up maintenance planning groups with each shop and built relationships. Their processes contributed to other processes and their knowledge and their enthusiasm and passion enfolded and melded with other emotions in the Division. This was the process of autopoiesis.

Autopoiesis was not working in other key areas with the Division. For example, the Information Technology (IT) group in the Division was not properly staffed or skilled at supporting the CMMS project to the extent required by such a large systems project. Despite being as integrated into the project process as other personnel in the Division, the IT people on the project teams experienced significant decline in morale and increased stress, unhappiness, worry, and disappointment throughout the project. It seemed as though no amount of purpose, collaboration, or words could compensate for the fact that they felt overwhelmed by the project and under-supported by me and their colleagues on the project teams.

Learning to Live in a Dynamic and Busy State

FMD had been comfortable in a stable and non-dynamic state since its inception. The Division was very good at dealing with technical and operational problems with the physical plant. The organizational paradigm was based on regulation, predictability, and functionality.

Such a stable state was not conducive to responding to new realities that were emerging from the campus environment. The Division's future success was at risk due to these conditions.

The uncertainty and unpredictability of the CMMS project created dynamic and busy conditions that had the potential of pushing the Division into a disordered and random state. The non-linear adaptive networks through which new knowledge and relationship-building elements could flow helped bound the potential disorder in the Division. Complex systems can acquire the ability to bring order and chaos into a special kind of balance. The balance point, often called the edge of chaos, is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence either (Fullan, 1999; Waldrop, 1992). The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo and where even the most entrenched old-guard will eventually be overthrown (Fullan). The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive. FMD learned to live in a dynamic and busy state by using complementarity and adaptive networks to accommodate uncertainty and unpredictability.

Before 2000, and as previously mentioned, FMD was not in a chaotic or random state. The reason the Division was not able to implement fully a CMMS, or to make other significant changes, was because it was in a rigid and linear state. It was not near the edge of chaos. The Division was not flexible, responsive, adaptable, creative, dynamic, or vibrant. This was reflected in the opinion the campus had of FMD and was reflected in how the Division had stagnated and was unable to change. The CMMS project team, though, overcame these static factors and located itself near the edge of chaos. The edge of chaos was made of technical and human elements. The technical aspects of the project could quickly get out of control and the

human elements of the project could also become chaotic. The technical issues could increase in volume and complexity and become unmanageable resulting in database and computer program disaster. The human issues could become so complex so quickly that project team ability could be destroyed. People's activities would become random and purpose would disappear. Project deliverables would not happen and morale and participation in the project would decline. Unmanaged activities over the edge of chaos would also create confusion, frustration, and inefficiencies. People would not want to be part of a system operating in this fashion.

The CMMS project did not go over the edge of chaos into a random and unstable state. Every conversation, project meeting, and activity had the potential of moving over the edge of chaos and perhaps bring all or some people and activities with it. The non-linear adaptive networks used to maintain wholeness and implicate order were used to keep the CMMS project, and the CMMS project people and activities, balanced on the edge of chaos. It was the people and what they said and what they did that maintained this balance. The moral purpose understood by the people on the project, and the complementarity they used to connect themselves, provided the bounding vision, the answers, the tone, and the words used to avoid going over the edge of chaos. If someone felt that they were getting confused, or overwhelmed, or lost, they had open and safe and comforting paths to other people with the same empathetic values, principles, vision, and moral purpose to whom they could talk and re-position on the healthy side of the edge of chaos. Everyone on the project teams, including me, went over the edge of chaos, and back again. Sometimes, it was just people asking how things were going that pulled you back from over the edge of chaos.

Learning where to locate the Division. Stacey (1996b) described the essence of complexity theory in organizations by stating that, "organizations are webs of non-linear feedback that are

capable of operating in stable and unstable equilibrium or between these states at the edge of chaos" (p. 349). Organizations can be powerfully pulled toward stability by the forces of integration, maintenance controls, staff desires for security and certainty, and adaptation to the environment. Organizations can also be powerfully pulled to the opposite extreme of unstable equilibrium by the forces of division and decentralization, by staff desires for excitement and innovation, and by isolation from the environment. If organizations give into the pull of stability it fails because it becomes ossified and can not change easily. If organizations give into the pull of instability, it disintegrates (Stacey).

Success lies in locating sustaining organizations in the borders between stability and instability (Stacey, 1996b). This is a state of chaos, a potentially difficult to maintain dissipative structure. The dynamics of a successful organization are those of irregular cycles and discontinuous trends, falling within qualitative patterns, fuzzy but recognizable categories taking the form of archetypes and templates. FMD began to emerge from ossification once the project structure was formed (Figure 4.1) and the project team's and project leader's roles and responsibilities were debated and put into practice. The project team meetings and action plans used fuzzy categories of purpose and vision created by words and connections to order disorder, but not drift over the edge of chaos.

I did not attempt to control the project or the project teams in order to try and avoid chaos or uncertainty. The evidence shows the limited role I and other senior staff played in the project. Stacey (1996b) argued that agents within an organization can not be in control of the organization's long-term future. Long-term development of an organization is a spontaneous self-organizing process from which new strategic directions may emerge (Stacey). The project

team organized the sub-teams and together they developed processes, procedures, and policies that located the Division in a unique place in the order-disorder continuum.

Understand the meaning of operating on the edge of chaos is critical in understanding change (Fullan, 1999). Collaborative cultures are anxiety provoking and anxiety containing and organizations should attack incoherence to ensure connectedness and knowledge creation. The anxiety about me, the new Associate Vice-President, and what I was saying about a new CMMS in 2000 was high. People could not trust what I was saying about where FMD should be located. The anxiety turned into hope and enthusiasm in 2001 to 2002 as people became connected and understood the need for the new system. Knowledge about campus expectations, and how the CMMS system would help the Division change in order to deal these pressures, helped contain anxiety and create new behaviors. The anxiety and new behaviors helped locate the Division somewhere in a band of chaotic opportunity. Chaos theory implies that very simple dynamical rules can give rise to extraordinarily intricate behavior (Waldrop, 1992).

Learning to follow shifting purpose. The evidence showed that the CMMS project teams were constantly checking purpose and goals. This was especially evident between phase one and phase two of the project. Organizations need to consider their goals as continuously evolving (Sullivan, 1999). Organizational policies and plans need to be presented and implemented with the understanding that when and if goals are reached, goals will always remain just one moment in the organization's evolution (Sullivan). After 2000, FMD realized that controlling their chaotic and unpredictable world was impossible. Sullivan stated that being able to manage on the edge of that chaotic and unpredictable world, and being able to respond and adapt to shifting purpose is freeing and inspiring. FMD used these dynamics for learning how to deal with shifting

purpose and for creating and using moral purpose to bound instability and to shape organizational transformation.

A Sustaining and Sensitive Approach to Change

The project teams in FMD did not approach the CMMS project in a heavy-handed manner. They spent many hours trying to understand what they needed to do and why. They also split the project into two phases sensing that the first phase must generate the most benefits for the people in the Division. This would help gain further buy-into the new system. The project team seemed to intuitively know how hard to push changes and in what areas. For example, the people who had participated in the previous system implementations (accounting and materials management) could deal with large and direct system changes where the benefits were mainly program and database related. The operations and maintenance group, however, needed to see gentle and creative solutions that reflected concerns over work order bureaucracy. Sullivan explained that chaos theory tells us that the obvious or expected place to attack a problem may not always be the most effective. Aggressively implementing the new work order functionality, for example, was initially the most obvious place for immediate attention and change. The project team, however, had a keen sense that this was probably not the most effective place to concentrate the initial efforts of the project teams given the sensitivity in the trades shops around using individual work orders to track work and monitor work.

Sullivan (1999) described chaos theory and the change process that can transform an organization into a new order. Organizations need to be able to understand themselves better. Organizations need intuitively to feel the simple small changes within it and to apply gentle creative action in the appropriate places to effect change.

Sustaining Change Leadership

The only role I played in the CMMS project was to chair the steering committee and to authorize funding. The CMMS team members were respected staff persons. The team and sub-team leaders were people from throughout the Division. My sense was that, although the roles and responsibilities of team "leaders" were well defined and documented, they did not function as hierarchical and superior persons on the project teams. They served to facilitate and to coordinate and the "leadership" of the teams' tasks was shared and "owned" by all team members. It seemed that a hierarchical leadership model would only permit complex or chaotic aspects of the project to be dealt with by the person who, by nature of being the "leader" was, supposedly, the most experienced and capable person on the team. A complex and difficult project such as the CMMS could not have been managed by only a few "leaders" dealing with all issues in an upwardly delegated manner. When this happens, an individual, as the sole leader, does not have the knowledge, words, skills, and talents to control all instability forces or to provide a broad and holistic vision-field to bound chaos and avoid disorder.

Thoughts, ideas, creativity, passion, and empathy from as many people co-constructing project purpose and struggling through uncertainty and disorder are required to create and encourage diversity, debate, and conflict (Rost, 1991). FMD was able to tacitly shape and bound these forces with meaning, purpose, and understanding. This helped to order disorder and to locate the Division and the CMMS project on the edge of chaos.

Leadership as a construct has been illuminated by the "New Science" concept of chaos theory (Rost, 1991). Leadership is not reduced to the leadership behavior of a key position holder or team of top people. Leadership is conducted throughout the organization, through all agents. The project structure in Figure 4.1 and the roles described in Appendix L were evidence of the shared, or conducted, leadership that developed during the project. Rost stated that leadership is

broadly conducted precisely because in chaotic systems, all agents have potential access to vital information from the environment. The case study evidence shows how people were very careful to communicate as much information as we could throughout the project. I conveyed information from the university environment and many staff conveyed vital information from their and their colleagues' perspectives and compared this to my information for coherence or dissonance.

Although there were team "leaders" assigned to each project team, the leadership needed to sustain the change was shared amongst all team members based on common moral purpose, sensitivity, knowledge, and understanding. Though leadership is broadly distributed, it is specific in function. Burns (2002) stated

> That leadership first functions to inspire continuously agents to revisit the ultimate purpose and core values of the system to ensure that all agents comprehend and hold those values and purposes as indelible core schema. Secondly, leadership requires continuous assessment of environmental demands as they relate to the primary mission and values of the organization and then forwarding adaptive schema from the shadow systems that satisfy those demands. As an organization goes through this process, its ultimate purpose and core values become clearer because they were viewed from multiple perspectives over time. This clarity of ultimate purpose and core values liberates the organization from becoming trapped in unhealthy dependence on past policies and procedures, an expression of defensive single loop learning. Instead it is freed to become creative as it responds to the current environmental challenges. The ability to conduct these functions of leadership is not uniquely located at the top of a hierarchy. (p. 47)

Burns' description of leadership was applicable to how the CMMS project leadership sustained the project. Leaders did not focus on operational, objective, and day-to-day problems. Transporting the values underpinning the "New Science" conceptual foundations of the project throughout the Division via language and listening became the prime purpose of these leaders. Indeed, the leadership function, as a defined functional box on FMD's organizational chart, disappeared (see Figure 4.1 and Figure 4.2 versus Appendix 1). Centralized and top-down management was not required – it was replaced with sustaining and sensitive shared leadership.

There were many "leaders" in the Division during the CMMS project: some people were temporary leaders, some people shared reciprocal leadership roles, and some people switched from leader to "follower". However, in order for leadership in the chaotic CMMS project to be broadly conducted as suggested by Rost (1991), all people in the Division would have needed access to vital information from the university environment. The case study described how many people became engaged in the CMMS project and how many people took on temporary and reciprocal leadership roles. Some of these people took on these leadership roles because they did have access to vital information that helped them understand the uncertain and unpredictable environment. Most people, however, did not have the access to this information. I remained the most influential leader due to my access to, and interpretation of, knowledge about the Division's uncertain and unpredictable future. This was a practical reality or my role as the key actor in the Division during and after the study period. The concepts of "New Science" helped frame my practical role, but access to information also helped to strengthen the power and authority of my position. I do not believe that these two ideas are contradictory. I believe that the lens of "New Science" can be a "master" lens through which other managerial and leadership lenses can be crafted. People engaged in the CMMS project used me as a source of information to confirm or to support their thoughts and ideas. Some people, though, did not believe the information I was conveying. They did not acknowledge the uncertain and unpredictable nature of the Division's environment. My knowledge, words, and passion did not create a new sense of moral purpose for some people in the Division. My role in the Division was constantly being questioned.

People in the Division Not Engaged in the Change Project

As described above, the project team members were extremely engaged in the project. They had used non-linear adaptive webs to deal with semantic complexity and to locate chaotic

and busy conditions somewhere between order and disorder. There were, however, those in the Division that did not embrace the CMMS project or other changes in the Division.

Prior to 2000, the Division had been managed by long-term staff. They had managed the Division and had defined and instilled in the Division a sense of purpose based on their technical training and experience. The focus of their activities was on the operations, the maintenance, and the protection of the university's physical plant. Activities were regulated and objective and individuals defined themselves, and their positions of power, authority, and influence, as they saw fit. These people were not going to embrace the moral purpose of the CMMS change project and the risk of losing their privileged positions.

At the project team meeting in October 2001 management believed, "To introduce people to a common CMMS application and expect them to commit to it, accept it, contribute and work with one system, can be a tremendous feat and … destined to fail – if forced." The reasons for the resistance to change were based on strong personal emotions for some in the Division. They had learned to focus on themselves as individual parts of a bigger technological system and they felt no compelling purpose to think or feel differently. How a CMMS would impact them and their job status or their ability to do their job had never been explained to them. It was impossible for some people in the Division to understand and to embrace Divisional change when they had only ever had to focus on their individual world and their own interests.

Kuhn (1970) stated, "Novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation" (p. 64). The novelty, the creativity, and the newness created in some parts of the Division were significant indicators of change in FMD. Wheatley (1999) argued that we think we are being helpful to others when we manage change so carefully because we believe that people do not like change. We have not thought that we might

work with the forces of change and keep it under control every cautious step of the way (Wheatley).

The resistance from some staff was a good example of avoiding change because of tacit and explicit expressions of change resistance from people in an organization. These people had defined their role, their authority, and their power based on managing their operations with no Divisional oversight and with no appreciation of the common purpose of individual units. People were not connected to any broader purpose and some promised stability and certainty if left alone to do things the way they saw fit. People predicted the future based on how they interpreted the campus needs and anything that challenged their view of reality was portrayed as creating instability in the Division. This was how they initially positioned the lack of value and the risk of a new maintenance system. I was therefore very cautious when, in March 2003, at a project team meeting, I stated that, "Yes, we are going to use individual work requests and you are going to be the leader of the work request team and the shops sub-team." Some staff would not have participated in the CMMS project without this direct instruction. This instruction was not based on collegiality, collaboration, trust, or respect; it was based on my positional power and the threat of consequence if my instructions were not followed. The worldview was now what I told people it must be.

My positional authority, and the power I gained from being the main actor in the Division responsible for defining the uncertain and unpredictable university and Divisional environment, was used to instruct people to participate in the CMMS project appropriately. I do not believe that the use of positional power as a realistic management tool was contrary to "New Science" concepts. I believe that the issue was how positional, referential, or knowledge-based power was used. Except with some work units, I believe that I used the power I had as the Associate Vice-

President of FMD to increase people's awareness and understanding or uncertainty and unpredictability, to create moral purpose and complementarity, to use semantic complexity, and to build wholeness and implicate order in the Division with chaotic complexity sustained by non-linear adaptive networks.

Feelings of Disappointment and Frustration: Things Out of Your Control

The implementation of the university's new financial system (UniFi), and how the case study described how it impacted the CMMS project and the CMMS project teams, was a good example of a change initiative that was attempted without moral purpose, complementarity, and networks. The uncertainty surrounding the UniFi project, and the unpredictable nature of all aspects of the project, were created by an absence of adaptive networks, complementarity, relationships, and connections. Even though FMD's CMMS project team was using new "New Science" concepts to deal with the UniFi project, these concepts were nonexistent between FMD and central administration. Despite the best efforts of the CMMS project team members to build connections and relationships in order to help the UniFi project, the UniFi project remained disordered and random.

As identified in the case study, the CMMS project team had to put the CMMS phase two project on hold due to the UniFi project. The team members felt frustrated and disappointed that their dedication and engagement with a new moral purpose for FMD, and their engagement and enfoldment with their colleagues together to complete the CMMS project, seemed for naught.

My Role as the Main Actor in the Division

I began my job as the Associate Vice-President of the Facilities Management Division at the U of S with the objective and scientific perspective that I had brought to my previous jobs. I believed that I could be certain about what FMD should do and how it should do it. I also

believed that linear, causal, and well-planned strategies could control the Division's future if it adhered to a plan and if it functioned like a "well-oiled machine". The burography and case study described how my view of how organizations work, and how organizations can be transformed, changed during the study period. This was in no small part due to my desire not to replicate what had happened at UBC.

In 2000, as the main actor in the Division, I began to understand the uncertainty of the U of S environment and the unpredictable nature of the Division's future. Initially, I was the only person bringing these realities from the university environment into the Division. I tried to convince the project team that the CMMS was critical for the Division's survival. Not only did I discuss how uncertain and unpredictable the external environment was, I also talked with the project team about how the CMMS project was uncertain and unpredictable.

I remember sensing how people started to believe what I was saying what the Division needed to do. As I encouraged more people to become engaged in the campus community they began to get a deeper sense of the Division's current position and how it needed to change. The uncertainty and unpredictability that I talked about, confirmed by other's non-naïve interpretation of what was happening around them, created a sense of complementarity within the CMMS project team. Complementarity became the foundation for the CMMS project and for change in the Division.

I realized that the words I used to talk about the status of the Division were very important. For example, in my first week in the Division I made a joke. The joke was taken as an insult. These feelings did not change for many years. Everything I said, and the tone by which I said it, traveled around the Division in a few hours. The words I used, and the passion, emotion, or fear conveyed within these words, either supported or damaged the closeness and

complementarity between me and people in the Division. People who I had never met became aware of what I had said and everyone in the Division had an opinion of what they thought I meant.

My words alone did not create complementarity within the Division. In fact, I believe that my words had the potential of creating unmanaged chaos. I could not personally talk to all staff in the Division at all times about all issues. Those that wanted to use my words for their own ends could do so. What helped move the Division into a zone of creative chaos was more staff understanding and believing what I said. They could then build complementarity within their work areas and between their and other work areas in the Division. A critical mass of people with the same moral purpose was needed to use uncertain and unpredictable realities, in conjunction with semantic complexity, to create complementarity.

Once the CMMS project was well under way, I sensed that the Division had developed many networks created by different complementary needs. There were networks created by professional working relationships, there were networks created by empathetic and emotional connections, there were networks created by common purpose and common problems, and there were mechanical and operational networks created by formal structures, processes, and procedures. My role was to recognize these networks and to support and nurture their continued development. For example, I approved people doing things outside their normal duties and I adjusted pay scales and job descriptions accordingly. I increased funding for professional, technical, and personal employee development training and education. I made sure that I attended informal and formal social events and I made a point of spending time every day in most areas of the Division listening and answering questions.

My presence, my words, my decisions, and my behavior were all chaos-bounding and network-building processes. I could use complementarity, and the semantic complexity that supported this, to sustain my own non-linear adaptive feedback networks that helped shape exciting and creative chaos within the Division. My networks had energy in the form of new knowledge, new ideas, and new passions from others coming into my network that helped me avoid my own chaotic state and that helped me stay enlivened and enthusiastic. I, in turn, could transmit this energy back into the Division for further energizing and renewal.

Even though I was the main actor in the Division, I was only one member of the ensemble. I felt part of a new whole in the Division. I felt an intimacy with some people in the Division and closeness with those who were "in it together". Even though I came into the Division with a strong sense of what I thought needed to be done, by the end of the CMMS project I was learning in a simpler way. The Division and I were part of a new wholeness and a new implicate order sustained by non-linear adaptive networks. The networks were shaping chaos and using semantic complexity, complementarity, and moral purpose to deal with uncertainty, unpredictability, and change.

Viewing Change in FMD Through the Lens of "New Science" Summary

The purpose of the proceeding burography and CMMS case study data analysis was to view the changes in the Facilities Management Division through the lens of "New Science". The analysis was organized based on the CMMS project team's and the Division's change journey during the CMMS change project between 2000 and 2005 as described in the burography and case study data. The change journey included understanding the need for change and people coming together for making and sustaining change in new ways. The analysis also included a discussion of people in the Division who did not engage in the change process. As well, what

happened in FMD when a central university change project went amiss was also included in the analysis.

The analysis showed that the impetus for change in FMD was created by a new appreciation of uncertainty and unpredictability and by understanding the risks and opportunities associated with these organizational factors. The project teams developed new connections and relationships and they used complementarity to build non-linear adaptive networks to flow information and to manage semantic and chaotic complexity. The complementarity, the networks, and the semantic complexity were used to avoid disordered or random chaos. The networks were also used for rejuvenation through iterative idea-sharing and co-constructions.

The people in the Facilities Management Division had never before co-created a process where so many people from so many diverse and potentially conflicting areas within the Division could come together. “New Science” concepts of relational holism and wholeness and implicate order in the Division were responsible for the successful CMMS project. My role as the main actor in the Division changed during the CMMS project. I, too, became part of a new order in the Division described well by the concepts of “New Science”.

FMD did not evolve entirely into the sort of organization described by Wheatley (1999): many tensions, issues, and questions remained. Some people never did buy into the purpose and the justification for the CMMS. They did not help design the system and they did not want to learn how to use the new system. Some people and groups remained isolated from others and non-linear adaptive feedback networks did not exist everywhere in the Division. Some units continued to have difficulty dealing with uncertainty and they only accomplished explicit and objective tasks where cause and effect were clearly identified.

The CMMS project team experienced great joy when the system went live in October 2003. They were also very proud to be presenters at the CMMS conference in May 2004. These feelings, unfortunately, were short-lived. The university's UniFi project stalled phase two of the CMMS project and the project teams disbanded. The messy UniFi project, and the stalled CMMS phase two project, were the result of no connections, no relationships, and no wholeness or implicate order between the people in FMD and the central university administration.

Chapter Six

SUMMARY AND CONCLUSION

In this chapter I discuss my findings and summarize my analysis of how "New Science" served as a lens through which to view change in a university administrative organization. I summarize the background and purpose of the study and provide a summary of the procedures used and a summary of my findings. This is followed by conclusions and implications for theory and further research. I then suggest alternate ways in which the study could have been approached. The chapter ends with my concluding remarks.

Background and Purpose of the Study

Newton's theory of the universe and the belief in the rational approach to human problems in the eighteenth century were central to the "Age of Enlightenment". Science has now progressed well beyond Newton through thermodynamics, electromagnetism, geology, biology, and relativity. The discovery of evolution in biology forced scientists to abandon the "Cartesian" conception of the world as a machine. Instead, the universe had to be viewed as an evolving and ever-changing system in which complex structures developed from simpler life forms. Evolutionary concepts also emerged in physics. However, whereas in biology evolution meant a movement toward increasing order and complexity, in physics it came to mean just the opposite – a movement toward increasing disorder; something the laws of thermodynamics addressed with the concept of entropy.

Physics may now be converging on what the science refers to as "New Science". "New Science" includes the concepts of quantum mechanics, complexity theory and chaos theory, uncertainty and probability, order and disorder, indeterminacy and unpredictability,

complementarity and relationships, string theory, multi-dimensions, and interconnectedness. The "New Science" can be used to help discover how organizations work, how organizations can change, and how organizations can be simplified (Wheatley & Kellner-Rogers, 1996).

Organizational theories and management styles grounded in Newtonian-based philosophies continue to dominate the practice of facilities management, including facilities management in universities. The concepts provided by the philosophy of "New Science" can help one understand resistance to change and how a novel new order can emerge through chaos and unpredictability (Zohar, 1990).

The uncertain yet connected behavior of quantum particles suggests a new, non-fragmented worldview. "New Science" has shown that implying an undivided wholeness of the universe provides a much more ordered and contextualized way of considering the general nature of reality in organizations. Complexity, chaos, wholeness, and implicate order are "New Science" ideas that may provide an alternate lens through which to view change in organizations.

The Research, Author, and Participant

I have spent most of my academic and work life participating in different organization and managerial paradigms. I have an undergraduate degree in applied science in mechanical engineering and a combined business administration and educational administration masters degree. I have worked in recreation, in steel plants, in offshore oil exploration, in computer simulation consultancy, and in industrial engineering in both mail processing and university administration. I have worked in increasingly responsible positions in facilities management in Canadian medical-doctoral universities since 1990.

I was hired into my first administrative position in a university facilities management (physical plant/plant operations) organization to apply my industrial engineering expertise to

improve organizational efficiency and overall performance. I spent many years applying mechanistic, objective, causal, and positivistic theories to all aspects of facilities management operations.

I was hired as the Associate Vice-President of the Facilities Management Division (FMD) in January 2000 by the Board of Governors of the University of Saskatchewan (U of S) based on the recommendation of the university President. I was the senior leader of the study organization (FMD) during and after the study period. My mandate was to change the Facilities Management Division.

Universities, Facilities Management, and Change

Canadian universities are facing many political, economic, societal, technological, and cultural challenges. Universities are not able to meet these challenges unless their non-academic administrative units efficiently and effectively support, protect, and enable the academic mission. However, many university administrative units were perceived as not adequately fulfilling this supportive role. The pressures on university administrative units to change had never been greater. The changes are in response to new realities, to new knowledge, and to increasing demands for improvements from the organization's internal and external environments.

The facilities management unit at the U of S was chosen as the study organization because these units are the largest and most complex non-academic units in most Canadian medical-doctoral universities. Facilities units also include a wide array of systems, structures, and processes against which many organizational paradigms and theories can be tested.

Facilities management units in most universities are responsible for more non-academic resources than any other administrative unit. Facilities management operations receive more comment and pressure for improved efficiencies and change than most other administrative

functions. Facilities organizations can therefore be relevant "laboratories" for studying post-secondary administrative organizational issues, including the need for change, and using "New Science" as a lens through which to view these changes.

The study included one significant change initiative in the Division between 2000 and 2005: the implementation of a new *computerized maintenance management system* (CMMS). After two previous failed attempts at implementing a CMMS, a system was successfully implemented in the Division during the study period. The study views the changes in the Division that supported the successful project using the concepts of the "New Science".

Summary of Procedures

First, a research method that gathered data on the CMMS change initiative in FMD between 2000 and 2005 was needed. Second, due to my significant role in FMD, a way of analyzing my role in the change process was also required. Therefore, a case study research method was used to gather data on the CMMS change initiative in FMD and a burographical research method was used to help me analyze my role in the case study change initiative. Together, the case study and burography evidence provided the data for the study.

I used burography as a method by which to include my role in the changes in the Division and as a mechanism to provide my recollections and reflections about the changes in the Division. Burography was not used as a method to make me a direct subject of the study.

Burography portrays an intersection of personal reflections and text based on a study of one's own group (Denzin, 1999; Johnson, 1989). Burography seeks to aid understanding of organizational processes and relates the organizational experience and meaning from the actor's perspective (Denzin, 1999). As the Associate Vice-President in the Facilities Management Division during and after the study period, I was the actor whose perspective was reflected in the

case study and burography data. The burography data included my personal, education, and work experience prior to and at the beginning of the study period. It also included my reflections on the changes in the Division during the study period. The reflections were based on my archived personal daily schedule. I then applied the concepts of "New Science" to the burographical data to try and make sense of the organizational changes in the Division during the study period of the change initiative. The purpose of the study was to see how I, as a key actor in the study, viewed the changes in the Division using "New Science" concepts and how these concepts relate to other organizational and leadership concepts.

The case study involved a narrative of the CMMS change initiative in FMD between 2000 and 2005. I found, collected, sorted, analyzed, and categorized archival text-based evidence of change in the Division that dealt with the CMMS project. I then described the evidence in the narrative. Data consisted of correspondence, agendas, presentations, processes, and policies. As I did with the burography, once the data were collected and organized, I applied the concepts of "New Science" to the data to try and make sense of change in the Facilities Management Division.

The analysis in the study involved overlaying the properties of "New Science" onto the case study and burography data to determine if this mapping can provide a meaningful framework to describe and make sense of change in a university facilities management division. The "goodness-of-fit" between the properties of "New Science" and what happened in FMD between 2000 and 2005 determined how well the concepts of "New Science" defined a meaningful framework for making sense of change in a university facilities management division.

Authenticity of the Research Product

Ontological authenticity criteria refer to the extent to which individual respondents' constructions are improved, matured, expanded, and elaborated (Guba & Lincoln, 1989). It is, literally, "improvement in the individual (or group's) conscious experiencing of the world" (p.248). Ontological authenticity can be enhanced through the provision of vicarious experience, which enhances the opportunity for individual respondents (stakeholders and others) to apprehend their own worlds in more informative and sophisticated ways.

I believe the changes in FMD did enhance people's opportunity to perceive the Division's internal and external environment differently. The data and evidence included language and action that demonstrated how the Division adapted to the realities of its changing world. Adopting a non-naïve realistic sense of the campus environment, and implementing more sophisticated and coherent purposes, structures, and systems to deal with these realities, confirms the ontological authenticity of the research.

Documents showed that some individuals and groups in the Division attested to the fact that they now understood a broader range of issues and that they could now make sense of issues that they had previously failed to understand. These included the need for organizational change and the need for changed supportive systems and structures. The case study data included entries of individual constructions throughout the study period that showed progressive subjectivity and sense-making.

The other authenticity criterion suggested by Guba and Lincoln (1989) was educative authenticity. Educative authenticity represented the extent to which people's understanding of, and appreciation for, the constructions of others outside their stakeholder group in the Division were enhanced. The people in the Division were confronted with constructions that differed from

how they viewed the world. Initially, I discussed a re-construction of the Division based on new realities and new purpose. Soon, though, the project team leaders, started to explain to others how the parts of the CMMS project fit together to support a unified FMD. Management reports and the project team's CMMS conference public presentation described how people who had never before been involved in such a process constructed the new system with fresh ontological parameters and how people engaged colleagues in a co-constructing process. The CMMS reports, the training programs, and the go-live week, conveyed a newly constructed CMMS vision, purpose, and reason to some colleagues who initially held very different perspectives and worldviews.

The most obvious piece of educative authenticity was the CMMS project itself. It would not have been completed successfully without authentic co-constructions and without constructive dialogue and diversity. Data and evidence that demonstrated the adaptation and construction processes were included in the study.

As well as ontological and educative authenticity, a form of checking and triangulation was used to help ensure the quality goodness and authenticity of the research study. I relied on my advisor, Dr. Patrick Renihan, a senior faculty member at the U of S, and someone who was familiar with FMD and its change history and culture, for cross-checking specific data items of a factual nature. Burographical and case study data and evidence were discussed with Dr. Renihan throughout the research and study process. Cross-checking was particularly important because of my role as the Associate Vice-President of the Division and the biases and values I brought to the study. My observations, similar to how Heisenberg and Bohr described the impact of the observer in quantum experiments, were not value-free. The cross-checking by Dr. Renihan was invaluable to me and to the quality of the research.

Summary of Findings

The purpose of the study was not to write a management report on the changes in my facilities management division at the U of S; nor was the purpose to write an essay on "New Science". I also did not want the process of developing a new organizational framework based on "New Science" to be seen as another management fad for higher education. Management fads in the academic sector continue to be created or reinvented despite the absence of data suggesting that they have been successful (Birnbaum, 2001).

It is also important to note that the study did not work backwards from knowing that I had used "New Science" concepts to implement and manage changes in FMD and that the study simply reported on this process. This was not the case. Indeed, as described in the burography, my worldview and that of 2000 were based on what could be considered anything but a "New Science" view of organizational life.

The uniqueness and significance of the study was reflected in the purpose statement. In response to the purpose of the study, *"the ways in which 'New Science' can be used as a lens through which to view and make sense of change in a university facilities management division are to use uncertainty and unpredictability concepts as the motivation to develop moral purpose, and to use complementarity and semantic complexity to create wholeness and implicate order sustained by non-linear adaptive networks and managed chaotic complexity"*.

Burographical and case study were interwoven in Chapter Four. The findings of the study were based on how well the analysis in Chapter Five demonstrated that the concepts of "New Science" mapped onto the changes in FMD as described in the data chapter. Chapter Five involved overlaying the properties of "New Science" onto the data to determine if this mapping can provide a meaningful framework to describe and make sense of change in a university

facilities management division. The “goodness-of-fit” between the properties of “New Science” and what happened in FMD between 2000 and 2005 determined how well the concepts provided by “New Science” defined a meaningful framework.

The framework used in Chapter Five was based on a synthesis of the key themes that emerged from the CMMS case study and burography data in Chapter Four. The key themes that emerged from the data included why previous attempts at implementing a CMMS were not fully successful and how FMD began to understand the need for change. How some people came together to make the project a success, how changes were made in new ways, and how the changes were sustained in new ways were also important themes that emerged from the case study. How some people were not engaged in the project and how the project team experience feelings of disappointment and frustration when the project stalled due to the university’s new financial system were other themes identified in the case study.

“New Science” concepts could then be used to frame these themes derived from the data. Concepts included uncertainty and unpredictability, complementarity, semantic and chaotic complexity, wholeness and implicate order, and non-linear adaptive networks. This was the first time that I am aware of that a new framework based on a developing sociological paradigm – “New Science” – has been used to help understand complex organizations issues such as change in a university administrative environment.

Before 2000, FMD had managed based on an “engineered” approach to dealing with technical, financial, and human issues in the organization. This was not surprising since FMD had been created and run by certain groups since its inception more than 45 years ago. FMD had done a good job in taking care of the university’s physical plant. Applying the same functional approach to internal and external human issues, however, had not worked as well.

FMD's traditional approach to all problems had been mechanistic, individualistic, causal, logical, and objective. The data described how this approach was not working in the Division in 2000. The Division changed in many ways between 2000 and 2005. The CMMS project was used as an exemplar of how areas in the Division changed in order to successfully complete a complex project. The following discussion refers to Figure 6.1.

The uncertainty and unpredictability of quantum matter are the foundational concepts in "New Science". These concepts describe the behavior of quantum matter. A researcher cannot be certain about the particle, wave, or field form of quantum matter. The current and future location, orientation, speed, and pairing of quantum matter is equally as uncertain and unpredictable. The analysis of the case study applied these quantum behaviors to the Facilities Management Division to try and make sense of change in the unit.

In 2000, the Division faced many uncertainties and an unpredictable future (A). Prior to 2000, the Division had defined its purpose based on how it viewed the university environment (B1). This view was based on looking backwards at how the Division believed it had performed in the past. The image the Division had of its future, based on how it valued its past, was formed by the Division's familiarity with mechanistic and objective activities. When I joined the Division in 2000, it was located at B2 in Figure 6.1. B2 was a state of ossification, stagnation, and rigidity where people and groups functioned individually based on their own purposes and ideals.

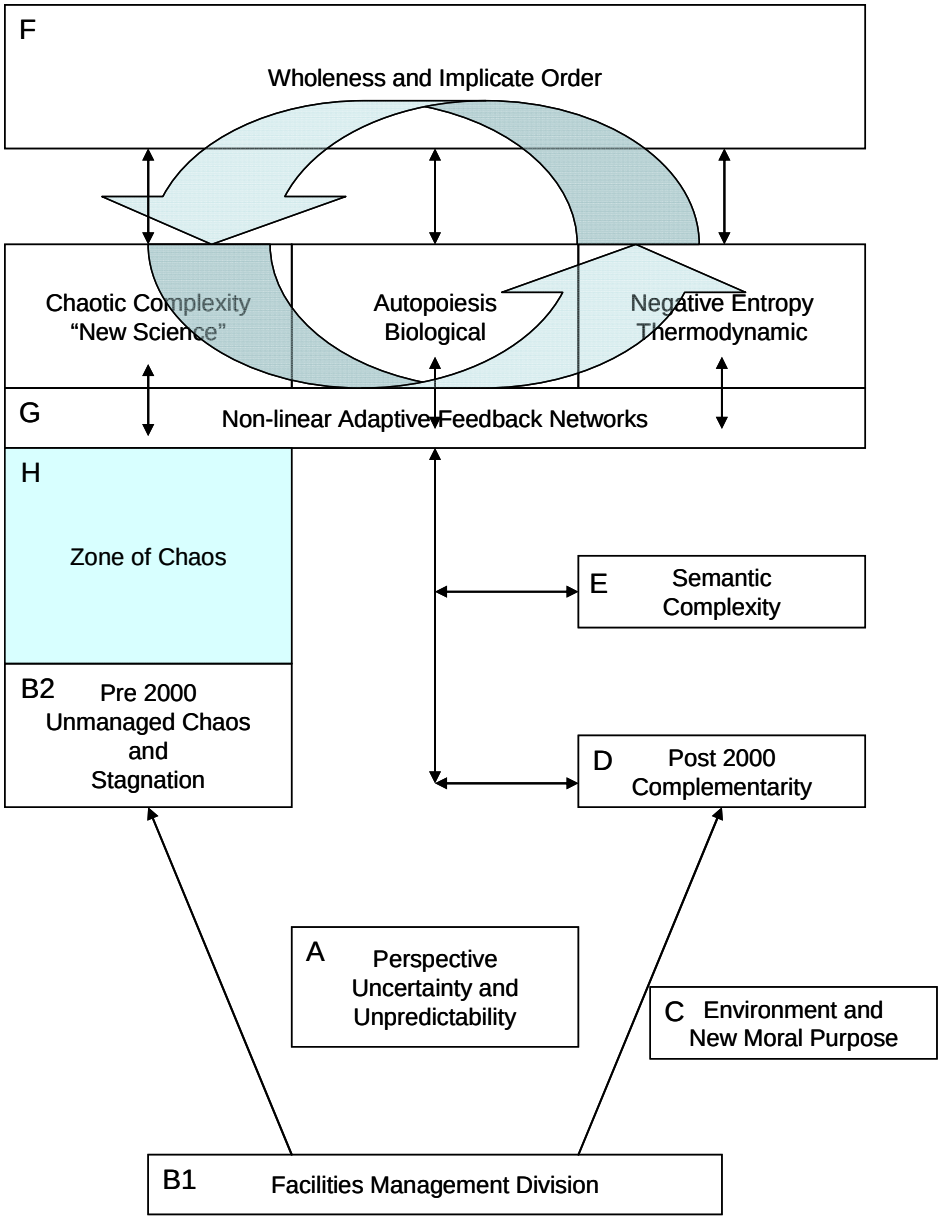

Figure 6.1. *Change in Facilities Managed and the Concepts of "New Science"*

The Division began to change during the CMMS project. The people on the project team began to understand the uncertainty created by a dynamic university environment (C). They also began to understand that factors in their environment and in the CMMS project could not be predicted or controlled. The new perspective on the university environment helped the people on the

project team develop a new moral purpose for why they and the Division existed and how they needed to change.

Another foundational concept in “New Science” is complementarity. Complementarity is the result of the mysterious and unexplainable connections between quantum matter, even when matter is a universe away from its counterpart. Quantum particles, fields, and forces complement each other through invisible and unexplainable connections. Complementarity is a very powerful “New Science” concept that can be used to make sense of organizations.

Like quantum matter, the people in the Division were diverse and very far apart in many ways. However, the people on the project teams did become complementary to each other and to others in the Division (D). People used language, words, knowledge, and understanding to develop complementarity (E). This is the “New Science” concept of semantic infinite complexity. The Division’s new moral purpose, working with complementarity and semantic complexity, was used to create wholeness and implicate order (F), another strong “New Science” concept. Wholeness and implicate order was the sustained and continued state that persisted throughout the CMMS project. It was sustained by non-linear adaptive networks (G). The networks used moral purpose and complementarity to facilitate the “New Science” process of chaotic complexity, the biological process of autopoiesis, and the “old” science concept of negative entropy.

Chaotic complexity meant that the Division could operate in a zone of chaos (H) between its old state of instability, randomness, and stagnation and its new state of flexibility, adaptability, creativity, and learning. The new quantum-like forms, paths, and locations of the Division were constantly evolving, but always with similar function and form. These are the fractal and attractor concepts described by “New Science” that can be found in many places in

the physical and natural worlds. Chaotic complexity joined with the biological concept of autopoiesis and the thermodynamic concept of negative entropy to enliven and rejuvenate parts of the Division. The following discusses uncertainty and unpredictability, complementarity, and chaotic complexity in the Division in more detail.

Uncertainty and Unpredictability in FMD

In Chapter Five, I was able to "map" the uncertainty and unpredictability "New Science" dynamic properties on to some of the human systems and activities in the Division. I found that the case study and burography data described how the CMMS project was successful due to FMD's new-found ability to deal with uncertainty and unpredictability. Chapter Five demonstrated how the functional, objective, and regulatory practices that had defined FMD for many years were replaced with subjective and adaptive systems that enabled it to learn how to cope with uncertainty and unpredictability by re-constructing and self-organizing without creating disorder and un-managed chaos.

Complementarity, Relationships, and Interconnectedness in FMD

Quantum particles and waves are related through complementarity. They are interconnected by invisible fields that, although difficult to identify and measure, are nonetheless powerful forces that can bind from afar and shape micro- and macro-processes. The CMMS data included many examples of how complementarity was working in FMD between 2000 and 2005.

I found that the "New Science" principle of complementarity mapped with some of the changes in some of FMD as described in the data. It was clear that the new relationships and connections developed by a changing FMD starting in 2000 were critical to the CMMS (and many other) projects. Sharing meanings and understandings needed to deal with disorder, uncertainty, and unpredictability would not have been possible without organizational webs

created from new relationships and new knowledge transfer paths. The thoughts and words that created this relational holism conveyed empathy, collaboration, caring, respect, and common moral purpose. This, in turn, connected people and functions and created a system of complementary activities and complementary worldviews. FMD was more homologous than homogeneous and, indeed, diversity was an important component of dynamic relationships and creativity.

Complexity and Chaos in FMD

Chapter Five described how complexity and chaos "New Science" concepts could be used to frame some of the organizational changes in FMD. The new framework enabled FMD to understand what it could foresee in its environment, and what it could not, and how it could adapt to these conditions.

Previously, FMD had used logical, objective, and very functional approaches to dealing with problems in the organization. This had resulted in ossification and the inability to deal with complex and chaotic technical and human problems. The two previous attempts at implementing a CMMS had failed due to these conditions. The new approach to the latest system project was very different: the project team did not try to control all aspects of the project and the project team did not attempt to deal with all issues at one time. Rather, the team dealt with chaotic events in an iterative and creative process informed by the well-understood purpose of the project and people's new appreciation of the important role they played in the university. This permitted people to set priorities amidst a newly contextualized view of their lives in FMD.

The moral purpose some staff used to bound and channel the many chaotic events associated with the CMMS project included a deep understanding of the meaning of collaboration; an appreciation of the complexities of sharing and transferring knowledge; and a

desire for intellectual, political, and technical integration. Change in "the new" FMD, planned and otherwise, unfolded in non-linear ways. The Division avoided random chaos and it did not try and protect itself from chaotic uncertainty with rigidity and isolationism. The creativity needed to make the project a success arose out of interactions under conditions of chaotic complexity, uncertainty, diversity, and instability.

The moral purpose that FMD used to bound chaos was created by people talking and sharing ideas about problems and opportunities in an equal and respectful manner. Narrow self-interest made way for common good and diversity in some areas of the Division. Debate increased due to a safer and more trusting environment.

Staff did not perceive the large and complicated CMMS project as an "un-managed mess". Staff no longer avoided uncertainty or looseness in planning and project management. In fact, the dynamic and chaotic pace of the project proved to be a nourishing element for revitalizing the Division. The layers of complexity in the project, and a sense of things being beyond FMD's control and out of control, were dealt with by staff having a deeper appreciation of the internal and external realities and by staff developing an understanding of what their work lives in FMD meant. Traditional "strategic planning workshops" were replaced with daily feedback and reaffirmation from the vision-field and the moral purpose that guided action in the Division.

The complex systems, processes, and structures that FMD staff themselves put in place helped them acquire the ability to bring order and chaos into a special kind of balance. This "edge of chaos" was where the CMMS project activities never quite locked into place, and yet never quite dissolved into turbulence either. The "edge of chaos" was where new ideas and creativity replaced the status quo in FMD and where even the most entrenched old-guard

engaged in meaningful ways in the CMMS project. The "edge of chaos" in FMD was a constantly shifting battle zone between stagnation and anarchy, the one place where the Division could be spontaneous, adaptive, and alive.

FMD was able to keep disorder ordered and was able to deal with the possibility of unpredictability creating un-managed chaos. New knowledge, new abilities, new relationships, and new purposes facilitated information feeding back on itself and changing in the process. This is the familiar process of iteration and feedback described in much of "New Science". It was this process that helped the Division self-organize and, in doing so, enabled people to incorporate unforeseen and chaotic pressures into their daily lives in a positive rather than a fearful way. FMD was able to understand itself better and to realize that controlling a chaotic and unpredictable world was impossible. The project team presentations and celebrations referred to in the data showed an organization that was feeling freed and inspired.

Shortcomings in the "New Science" Findings

The Facilities Management Division did not turn into an organization described by Wheatley (1999), nor did it use change forces to find a perfect location on the edge of chaos as recommended by Fullan (1999). Yet "New Science" concepts of uncertainty, unpredictability, complementarity, semantic complexity, non-linear adaptive networks, chaotic complexity, and wholeness and implicate order described the ways in which the CMMS project teams came together to complete the project. I could not, though, use "New Science" to explain why some groups remain disconnected from the rest of the Division. The same quantum-like opportunities existed for some groups, but they were never engaged or enfolded into the change processes like others in the Division. "New Science" did not provide any help to me in making sense of this. I believe that my inability to make sense of the pragmatic and realistic aspects of managing an

organization was a shortcoming of the “New Science” results in the study. The positive and laudatory aspects of the CMMS change process were relatively easy to describe with the subjective concepts of “New Science”. Attributing the lack of engagement of some groups simply to their lack of understanding of uncertainties and unpredictability in the university environment was too simple and too convenient an explanation. I believe that the use of my positional power to achieve appropriate behavior was a chaos-bounding moment in the CMMS project. I had the support of complementarity from many places in the Division and we were comfortable with uncertainty and unpredictability. “New Science” concepts acted as a “master” or “meta-” lens through which to view change and other organizational and managerial dynamics.

Reconceptualization

With respect to methodology, I believe that studying the organization of which I was the senior manager during and after the study period was, perhaps, not the ideal approach. Even studying another division or department at the U of S would have been problematic. Investigating the application of “New Science” as a tool by which to makes sense of organizational dynamics and systems, and as an organizational multi-paradigmatic theory by which to study complex university administrative environments at another institution, may have enhanced the research.

Although I believe that the findings and conclusions were authentic, and burography and case study were chosen to comprehensively address my role in the study, interviewing and/or surveying people at another university would be a worthwhile research method. Interviewing people to get a sense of connections, uncertainty, complexity, and chaos in relation to their past,

their present, and their possible futures in their dynamic organizational environments would be informative.

I believe that my very mechanistic approach to managing organizations developed over many years prior to becoming the Associate Vice-President at the U of S in 2000 did provide an interesting backdrop to how I personally changed along with FMD during the study period. This would not have been as apparent had I used a non-biographical interview or quantitative research method at another institution.

Focusing on the CMMS change initiative in FMD in order to manage the breadth of the study proved to be a challenge. If I had knows at the beginning of the research project what I know now about the relational holism that developed in the Division during the study period, I would not have designed the study isolating the CMMS project from other change dynamics in FMD.

On a personal level, I found it difficult to apply "New Science" concepts to my burographical reflections. Perhaps this was due to trying to live, research, and reflect about my own personal changes and development while learning about complexity and scientific humanism. The burography did, though, help me reflect on and contextualize the scientific management perspective I brought to my new job in FMD at the U of S. "New Science", then, helped me interpret the burographical data. If I had located the study at another institution, I still would have had to address my biases and values, but not in the same challenging manner required by the burography. I would have addressed my observer role in the study organization in a different way.

With respect to the burographical method itself, I did not find the "bureaucracy" component of the dialogue strong enough to distinguish burography from autobiography. I do not

believe that this distinction negatively impacted the quality of the research product. Nor do I think that the distinction contributed significantly to the study. I will be discussing this with Dr. Johnson, the researcher who I read about and with whom I talked about using burography as a research method.

The conceptual framework described using "New Science" and complexity science to develop a new framework for making sense of change in a facilities management organization. After the study, however, I believe that the original conceptual components can be reframed to better reflect what was discovered during the research. How semantic and chaotic complexity fit into the overarching concept of "New Science" and complexity science became clearer during the study. The "New Science" foundational concepts of uncertainty and unpredictability that were so important during the analysis should have been defined differently in the original conceptual framework. Complementarity, wholeness and implicate order, and non-linear adaptive networks, and how all these fit together should also have been presented in a clearer and more organized way in the original conceptual framework. As well, the original conceptual framework did not describe the major importance complementarity and relational holism could have in an organization undergoing change. The original conceptual framework did not adequately include human systems theory and it relied too heavily on complexity as a science rather than a seamless integration of humanism and scientism.

Implications for Theory and Research

The struggle within educational administration for its epistemological foundations and the development of a position to shape its intellectual and conceptual boundaries is not new (Dolmage, 1992). Dolmage described how Griffiths, Greenfield, Ribbons, Willower, Forsyth,

Hoy and Scheruch, among others, have commented on the nature of the epistemological struggle. Many of these discussions have occurred in forms provided at UCEA, NCPEA, and EAQ.

Kuhn (1970) and Burrell & Morgan (1979) described debates of this nature as paradigmatic where no amount of discussion would have been adequate to produce compromise and understanding. Kuhnian paradigmatic monism or hegemonic monism contains within it the seeds of the epistemological conflict that were manifest by Griffiths and Greenfield. English (2001) argued that the alternative to paradigmatic monism is to move towards a multi-paradigmatic approach with competing perspectives. Such an approach required a suspension of the quest for a short-term empirical meta-criterion which supported a line of demarcation defining legitimate "science activity and hence truth from non-truth" (p. 25).

The Greenfield/Griffiths debate is an example of rigid polarizing that obscures efforts to know or to understand. The disciples of the two paradigms can find little upon which to agree; each presents an epistemological argument concerning what constitutes valid knowledge in educational administration. There is definite need for a more relativist attitude toward knowledge, theory, science, and research (Kendell & Byrne, 1977). The field of educational administration must foster and sanction modes of inquiry that exceed the limitations of positivism. The binary opposition of naturalistic and phenomenological approaches is wrong-minded; a much more useful approach is to see them as complementary (Gibson, 1977).

On this basis, both theorizing and the preparation of researchers and practitioners in educational administration could be advanced by a conceptualization that formulates social action as a dialectical synthesis of scientific and humanistic modes of analysis. This approach may be captured under the broad label of scientific humanism (Gibson, 1977). I believe that the

organizational theories derived from the application of “New Science” can help advance the scientific humanism as defined by Gibson.

“New Science” leaves the Griffiths/Greenfield debate well behind. It is based on a realistic (non-naïve neo-realism) ontology and a relativistic, perspectivism-based, and morally pragmatic epistemology. The Facilities Management Division at the University of Saskatchewan was historically a mechanistic and positivistic organization. It was in an environment of increasing objectivity and reinforced scientific management practices. And yet, FMD thrived as it changed in order to implement a complex change initiative. It learned to be more realistic about its environment, it understood the context of what it needed to do, and why based on a new perspective, and it developed moral purpose and coherence as it learned how to change. With ontological and educative authenticity, the study used organizational complexity and new science concepts to make sense of this change.

Organizational theory and research can perhaps be informed by the non-foundationalist nature of scientific humanism. It can perhaps find in complexity science flexibility, applicability, and authenticity that go beyond the positivistic requirements of parallel criteria such as internal and external validity, reliability, and objectivity.

I believe that the value of “New Science” to organizational theory and research extends beyond just stating that “New Science” uses science itself against traditional scientific management concepts to argue for a more subjective approach to leading and managing organizations. First, the main quantum science concepts of uncertainty and unpredictability have relevance for all organizations and leaders of those organizations. Leaders must be aware that the world is uncertain and that things can not be predicted. Many political, societal, economic, environmental, technological, and cultural factors impact organizations. These external factors

are real, they are changing, and one cannot be certain about their form, their timing, or their impact. Leaders must position the organization and the people in the organization to realize the uncertainty of things and to be able to response appropriately.

Similarly, the future can not be predicated. Applied sciences can predict with almost 100% probability the future state of most structural, mechanical, and electrical systems using proven mathematical principles. However, the current or future state of quantum matter cannot be predicted with the same high degree of probability. I believe that this unpredictability better describes human systems and organizations and is therefore a more useful concept upon which to base theory and research.

The second “New Science” concept that can inform organizational theory and research is complementarity. Complementarity derives from the interconnectedness between quantum matter (particles, waves, and fields) regardless of proximity or expected conditions (complementary electron spin, location, and velocity, for example). Theory and research should therefore take a holistic and systems view to organizational analysis. One should look for connections and factors that may not initially be at hand or readily identifiable. Researchers should look for how factors creating complementarity in an organization are transferred around the organization. What webs or networks may be in place, how are these webs created, what are they made from, how are they maintained, and how robust or fragile are they?

The third “New Science” concept that can inform organizational theory and research is complexity. Complexity is comprised of chaotic complexity and semantic complexity. Chaotic complexity is tangible and can be modeled and managed. Semantic complexity is based on words, language, knowledge, and emotions and can not be modeled and managed. Chaotic and semantic complexity related directly to the realities of uncertainty and unpredictability in

organizations. If theory and research is to consider uncertainty and unpredictability, then theory and research must also consider the chaotic and semantic complexity that result from these conditions. Researchers can use complementarity concepts to help make sense of ordered or disordered chaos and how networks use complementarity to create a whole organization.

The fourth and summarizing "New Science" concept that can inform organizational theory and research is how the previous concepts can be brought together to study the wholeness or brokenness of organizations and how people in organizations come together or how people in organizations can become isolated. Some "old" science concepts from biology, thermodynamics, and electromagnetism plus "New Science" concepts encourage organizational theory and research to adopt a relationally holistic and systems view of organizations. An interesting element of "New Science" from an organizational leadership theory and research perspective is how to deal with uncertainty and unpredictability by using only probabilistic complementarity and invisible networks amidst a pragmatic world that demands accountability and measurable outcomes. Can a leader lead and survive while trying to balance subjectivity and objectivity?

Recommendations for further study

Within a "New Science" framework, the following are some theoretical research questions that warrant further study:

1. Where is "New Science" going and are there further concepts that can inform organizational theory?
2. How can quantum concepts of "strange attractors", "fractals", and "string theory" be applied to organizations?
3. How applicable are "New Science" philosophies to other non-academic organizations and to academic organizations in universities.

4. Can “New Science” theories be turned into management techniques and the impact or results of these theories measured?
5. What is the correlation between the technical or social background of people in organizations and their style of management and leadership?
6. Can an organization deal with internal and external positivistic realities in a humanistic manner; which comes first?
7. Is there a time in an organization where no amount of moral purpose, coherence, complementarity, and wholeness and implicate order can manage the uncertainty, chaos, and disorder and randomness will take over?
8. What organizational realities preclude a wholesale adoption and application of full “New Science” concepts of fields, and complementarity, and can “New Science” be considered a postmodern approach to organizational sociology?
9. Are the organizational concepts provided by the philosophies of “New Science” just a recombination of critical theory and postmodern theories?
10. Are there factors in educational administration in universities that do not conform to “New Science” organizational concepts and how can administrative units deal with these forces?
11. What other organizational theories is “New Science” similar to and is “New Science” just a re-packaging of various sociological paradigms in a scientific framework in order to benefit from the support of value-free and more quantitative research?

As well as the questions above that could lead to further study of “New Science”, other areas indirectly related to “New Science” could also be studied. These are areas dealing in more depth

with the use of language for organizational leadership and change and how micro and macro organizational elements were connected (FMD and the rest of the U of S, for example).

A Theory of Everything?

The ideas discussed in the study were derived from the foundational "New Science" concepts of uncertainty, unpredictability, and complementarity. They were based on the behaviors of quantum matter described by physicists and as interpreted by social scientists. The ideas included uncertainty and unpredictability, semantic complexity, complementarity, non-linear adaptive feedback networks, chaotic complexity, and wholeness and implicate order. "New Science" concepts may lead to a theory of everything (Greene, 2003). Indeed, current research beyond quantum mechanics, and beyond the discoveries of Heisenberg and Bohr, is suggesting that the foundational concepts of "New Science" could lead to theory that could be used to literally explain everything.

However, I found that "New Science" concepts as applied by Wheatley, and others, to be similar to other social and organizational paradigms. The ideas of relationships, double-loop learning, hermeneutics, diversity and dialogue, flexibility and adaptability, egalitarianism, and pluralism are not new ideas unique to "New Science"; critical theory and postmodernism address many of these concepts. What "New Science" has done is to avoid the Griffiths/Greenfield debate by claiming that scientism has now discovered uncertainty and relationships that were concepts traditionally claimed by humanism. A message of "New Science" seems to be that it is science, but science that has moved beyond traditional Newtonian science and Einsteinian relativity.

Therefore, I would not recommend using "New Science", on its own, as the definitive social paradigm by which to try and make sense of organizations. I believe that a benefit of

"New Science" is that it can be used to question using only traditional scientific management concepts by stating that, if management theories can only be based on pure science (the only way to find objective truth), then adherents of scientific management must pay attention to "New Science", including the subjective principles it shares with other single and multiple sociological paradigms. This is referred to by some as scientific humanism (Gibson, 1977).

Conclusions

"New Science" can be a useful lens through which to view change in a university facilities management division. The concepts provided by the philosophy of "New Science" did "map" onto most of the change dynamic in FMD as described in the case study and burography data. "New Science" can be used to specify a new framework for making sense of change in a university a facilities management division. This was demonstrated in Chapter Five.

The positivistic concepts from Newtonian science provide the foundation for scientific management theories and techniques. Organizations such as FMD have relied upon and, in fact, continue to embrace these objective and functional paradigms to manage their activities. This mechanistic approach was incapable of dealing with many human issues in the Division prior to 2000, including the need to change in order to respond to new realities and to new expectations from the university.

In 2000, the Facilities Management Division at the U of S was facing increasing demands to improve its stewardship and service role in the institution. The political, environmental, societal, technical, and cultural pressures on the Division were very real. FMD needed to change while recognizing and valuing its traditions and strengths that defined its stewardship role on campus. The successful CMMS project, and the many other success stories in FMD, were made possible because people had learned, together, and in a collaborative and trusting way through

new relationships and connections, to deal with uncertainty and to thrive in a chaotic world. The answer to the question "why" became part of a vision-field that people used to make sense of things and to contextualize what they needed to do, or what they could not do.

As in the quantum world, parts of FMD were drawn together by a process of internal connectedness. The "goodness of fit" shown in Chapter Five between "New Science" and the representative change data demonstrated that. People and groups in FMD moved and merged and connected for short or long periods of time, forming new wholes, being forever changed in the process.

The main themes from "New Science" encourage facilities management organizations to build relationships and connections, to create vision-fields and purpose-fields, to use complementarity to deal with current uncertainties and to be able to adapt to the unpredictable, to constantly bring in new realities and new knowledge into the organization, to use this knowledge for constant learning and adaptation, to use intimacy and entanglement to create wholeness and ordered disorder, and to encourage chaotic infinite chaos and autopoiesis to renew and to enliven the organization.

I believe that the findings in this study, and how "New Science" could be used to draw conclusions in other organizational and leadership analysis, depends upon the relationship one assumes that the "New Science" conceptual lens has with other possible lenses through which to view, interpret, and lead organizations. In other words, is "New Science" a pure and only lens through which to view organizational complexity, or can it be used in conjunction with other lenses? If so, are these parallel constructs, or, does "New Science" provide a "meta-lens" through which to view through other lenses to make sense of and to lead organizations. I believe the latter to be true.

Not all people and not all groups in FMD changed during the study period. As described in the case study, authoritative and positional power dynamics on my part were required to make sure these people behaved appropriately. However, this did not mean that complementarity, semantic and chaotic complexity, and non-linear adaptive network "New Science" concepts were not present. I believe that more authoritative and pragmatic leadership behaviors, and possibly other management and leadership theories and practices, do not preclude overarching "New Science" concepts to be in place. Indeed, when I was instructing people to participate in the CMMS project, or dealing with some groups' isolation from the project, I used the fact that things were uncertain and unpredictable and we needed complementarity in the Division to support my actions. I was able to explain how their attitudes were negative feedback forces in the new networks in the Division and that this I could not allow. I could explain what an unmanaged and chaotic mess would result from having them "sabotage" the project. As people became involved in the CMMS project, there were supportive relationships (complementarity), safe and reassuring words and language (semantic complexity), many formal and informal sessions (adaptive networks and managed chaos), and a sense that people were working for the benefit of the entire Division (wholeness and implicate order).

Referring to Figure 6.2, "New Science" as a "meta-lens" could also accommodate very regulated and rational requirements in the organization. For example, there were many code, regulatory, and legal requirements that FMD had to comply with. These requirements acted as bounding forces to help define the edge of chaos and to spread moral purpose to help order disorder. Once again, uncertainty, unpredictability, complementarity, semantic and chaotic complexity, non-linear adaptive networks, and wholeness and implicate order could be applied to, and help focus, a different sub-lens, a sub-lens of regulation and rules.

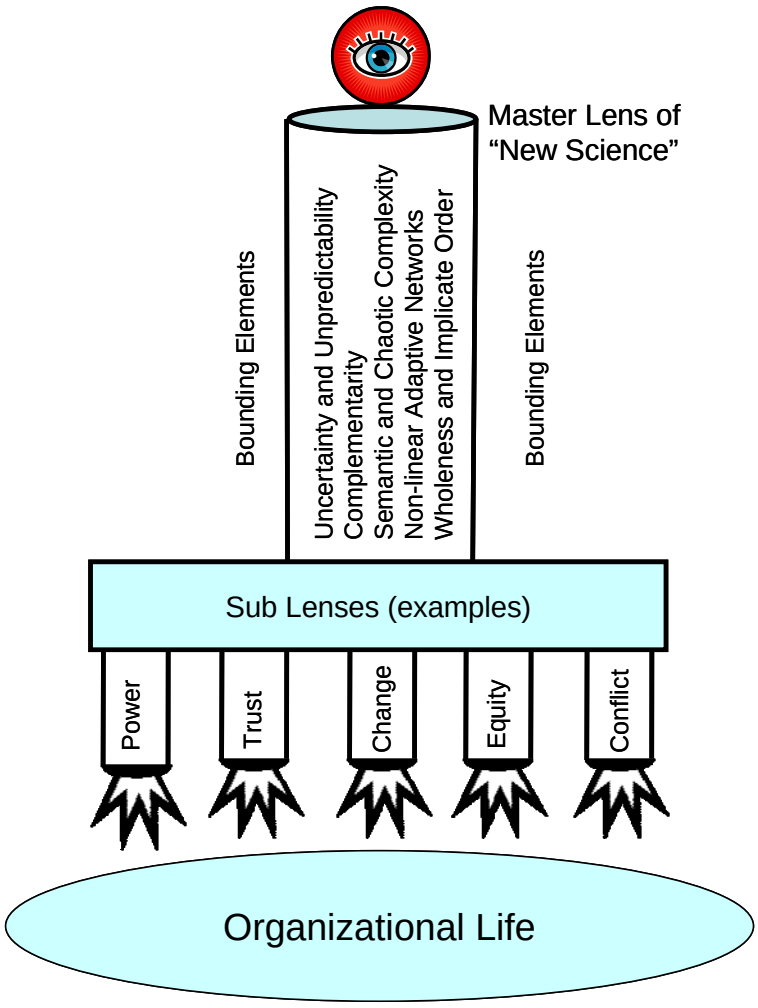

Figure 6.2. *"New Science" as a Master Lens*

Critical Reflections of a Senior University Administrator

I have spent almost 25 years trying to grow my career and advance in primarily scientifically managed organizations. I have been very successful applying objective and causal management theories to private and public sector organizations. There have been three major events that have dramatically changed my perspective of managing and "leading" university administrative organizations. The first event was being the senior person instructed to turn a university administrative organization into an "entrepreneurial" ancillary unit of the University

of British Columbia by imposing strict Newtonian and Taylorist practices on everyone and everything in the organization. The second major event was, once again, being mandated to change a university administrative organization. Although I began my time in the Facilities Management Division at the U of S relying on my safe and comfortable industrial engineering management practices, the UBC "ancillarization" experience was fresh enough in my mind that I did not make the same mistakes at FMD that I did at UBC. The third major event was my pursuing post-graduate studies in education administration. My reading, thinking, and learning about different organizational theories helped me to understand my past work experiences and to come to terms with dichotomous views of organizational life. I believe that I have authentic and credible experience in creating, leading, managing, and explaining failed and successful happenings in organizations. I now have a better understanding of why I have succeeded, and why I have failed.

I perhaps did not articulate my changing personal worldview with enough humanism in the burography component of the case study and in the analysis. Even though I strongly believe that "New Science" concepts provide a relevant and useful tool to help make sense of and to collaboratively lead organizations, I have been trained and rewarded for 25 years by using very different management paradigms. It is perhaps not surprising then, that despite my wonder at the organizational metaphors provided by the philosophy of "New Science", the case study and the burography may have seemed somewhat linear and mechanistic. This was not my intent, but I was not capable of anything else.

I have changed during my post-graduate work and during this study. I still have a long way to go to be able to fully overcome my inclination to use mechanistic analysis and to list events. Still, the successful CMMS project in the Facilities Management Division, and many

other changes there, were not just the result of changed people in a changed organization. I, as the senior person and a major actor in the Division, clearly changed as well.

I struggled with what I emotionally and intellectually knew about humanism versus scientism based on my newly discovered "New Science" concepts and my scientific foundations as a mechanical engineer with many years imposing objective truth onto people in organizations. I would not attempt to undergo what I felt was a significant personal transformation as the leader of the same organization that a case study and a personal burography research project was based on again.

I believe that university administrative organizations now work in a very difficult environment. As Canadian universities continue to experience competition for faculty, students, and funding they will continue to look inward for resource reallocations, efficiencies, proof of value-added services, and evidence of strategically-aligned purposes from all non-academic units.

Most Canadian universities are moving more authority and control over human, financial, and physical resources to senior academic positions. Understanding, recognition, trust, and respect for non-academic activities and organizations seem to be decreasing. As a senior university administrator in Canada, I do not know of a university where "New Science" concepts of wholeness and implicate order are tacitly or explicitly recognized as important organizational theories or management practices.

Indeed, the move to adopt more "balanced scorecard", "entrepreneurial", "benchmarking", and other management fads are moving universities, at least non-academic units, in an even more positivistic, objective, and mechanistic direction. These Taylorist management concepts are not being applied equally to academic and non-academic parts of the

institution. By design, this produces isolation and disconnection. Unrealistic strategic planning and false measurement activities become the focus. Fear and distrust take over and complementarity is impossible. There is nothing to help bound chaos and random disorder becomes the norm. An entropic process begins and the institution can stagnate.

"New Science" concepts should not be abandoned because an institution appears to adhere to "old" scientific management concepts. I believe that, in these situations, "New Science" can be an even more important tool for units trying to survive and thrive in these potentially contrary and threatening environments. Uncertainty and unpredictability will be very real. The unit will need all people to understand moral purpose, to be complementary to each other, and to use common knowledge and words (semantic complexity) to be whole, unified and implicately ordered. The Facilities Management Division at the U of S was able to use its newly developed non-linear adaptive feedback networks to shape and bound chaotic and unpredictable events to avoid a disordered mess. The Division was able to change using "New Science" concepts as a "master" or "meta-" lens to deal with the more objectifying and more isolating forces in its environment. As a main actor in the Division during the change period, I could see the Division using its "New Science" lens to view and interpret the view of internal and external life moments through various sub-lenses (Figure 6.2). I believe that the "master" lens crafted by "New Science" concepts can help make sense of individual or multiple organizational paradigms.

I realize that there will always be a heterogeneous nature to academic and non-academic organizations in post-secondary educational institutions. The organizational concepts provided by the science of complexity, however, do not require homogeneity in order to be of use; a homologous relationship would suffice. Based on my observations, this does not seem to be the

pattern being pursued by many universities. Universities must come to realize that their futures depend on their ability to create wholeness and implicate order based on common purpose, knowing, and vision-fields facilitated through non-linear adaptive webs of relationships, caring, and trust.

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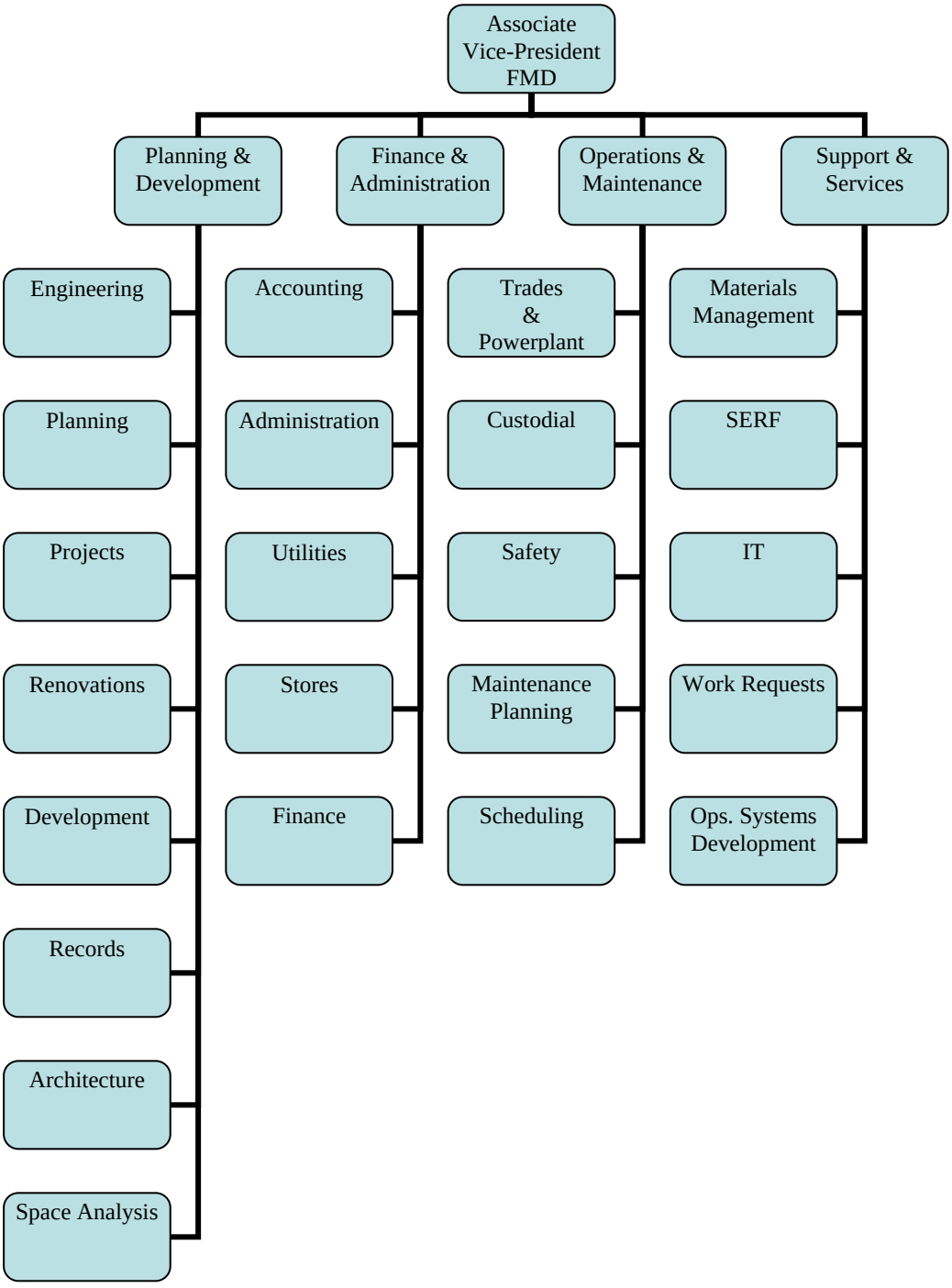
Appendix A

FMD 2005 organizational chart

FMD 2005 organizational chart



Appendix B

FMD management information

FMD management information

The following management data were used in the dissertation:

1. FMD's initial Strategic Plan (May 2001).
2. FMD's Integrated Plan (2003 – 2007).
3. FMD's Customer Survey (2001).
4. The AVP's daily schedule log from 1/1/2000 to 12/31/2005.
5. The project team's conference public presentation (May 2004).
6. Management information.
7. The author's conference public presentation (November 2004).

The following can be accessed directly at the Internet address indicated:

1. The author's FMD public forum presentation at
   http://www.usask.ca/vpacademic/integrated-planning/plandocs/03-apr-10b.php
2. The university's Integrated Planning process and documents at
   http://www.usask.ca/vpacademic/integrated-planning/plandocs/index.php#action

Appendix C

FMD’s 2001 environmental scan

FMD's 2001 environmental scan

Environmental Scan & SWOT Analysis:

A thorough scan of FMD's environment has identified, and has helped develop strategies to cope with, external competitive social, economic, political, cultural and technical factors that were difficult to recognize but that can't be ignored. The scan also identified emerging situations, hazards and opportunities in society, particularly those that were difficult for some people or the organization to absorb or turn to advantage. Organizational strengths and weaknesses identify the transactional and organizational elements that require a strategic administrative response. They identify what should be leveraged and used for support and where work was required. They identify constraints, mandates, obligations and limits on authority and flexibility.

Organizational Strengths:

Strengths were positive attributes of FMD that can be taken advantage of, or leveraged, to advance the strategic mandate of the organization. The internal strengths of FMD were as follows:

1. Employees who feel pride, ownership and dedication in what they do.
2. A highly skilled and knowledgeable workforce.
3. An awareness of environmental factors and a willingness to strategically plan.
4. Good electronic communications systems.
5. Good location on campus and good mobility and access to the customer.
6. State of the art work management systems.
7. Good personal relationships with customers.
8. Recognition as stewards and keepers of the public asset.

Organizational Weaknesses:

Identifying the weaknesses of FMD reveal areas that must be changed to improve the organization through strategic gap analysis and planning (www.borg.lib.vt.edu). The organizational weaknesses of FMD were as follows:

1. Cultural and attitudinal inertia.
2. Inadequate financial, physical and human resources.
3. Unclear goals, roles, responsibilities and reporting.
4. Conflicting priorities and no strategy.
5. Lack of strategic plans.
6. Poor reputation.
7. Internal arrogance.
8. Poor internal communications.
9. Lack of collaboration.
10. No succession planning.

11. No performance measurement or benchmarking.
12. Poor management systems.
13. No employee development or management or leadership programs.
14. No sales, marketing or communications plans.
15. No service or stewardship standards.

Opportunities in the External Environment:

Demographic and perception changes and new knowledge opportunities exist in the external environment (Drucker, 1998). FMD needs to consider coercive and other opportunities that may move us forward. They will describe what we should be taking advantage of - where is the "low fruit". The opportunities in the external environment as follows:

1. Increased campus planning and development activities.
2. Increased capital funding.
3. Consulting business opportunities selling unique expertise.
4. Public-private partnerships for supply of goods, services and construction of new assets.
5. Enhanced community engagement and enactment.
6. Improved reputation.
7. New rates models and increased revenues and fees.
8. New operating and communications technologies.
9. New employee development programs.
10. Energy reductions and reinvestment.
11. Writing and presenting at conferences and increased outreach and profile.
12. Sustainable development initiatives.
13. Closer ties to government partners.
14. Being the provincial facilities expert for government for a fee.
15. Land sales and development.
16. New market housing and residence developments.

Threats in the External Environment:

The local community has sent signals to FMD that service improvements were urgently required. This needs assessment of the local community, a dependent/user stakeholder indicates strong support for the plan and immediate strategic thinking and planning. These threats identify where FMD is at risk - what do we need to watch out for; what strategic and tactical action should be taken; and what might hold us back. They consider political influence; constraints; sources of coercive power; market forces; public scrutiny; narrowing scope; ownership control; and authority networks. Threats in the external environment that might threaten the success of survival of FMD as follows:

1. Suggestions of privatization.
2. Increased regulatory, code and legislative requirements.
3. Competition from alternate service providers.
4. Increasing collective agreement constraints.
5. Decreases in funding.

6. Increased accountability and unfair benchmarking.
7. Increasing costs.
8. User and other service providers wanting to do our work themselves.
9. Increased inspection, auditing and oversight from government ministries.
10. Targeted funding from government.
11. Increase in special interest groups coercive power and influence.
12. Private FIMPs lobbying government to provide services.
13. Pressures to lower capital cost but increasing life-cycle costs.

Industry and Competitive Conditions:

Condition	High	Neutral	Low
Threat of new entrants: - Private FIMPs were constantly offering their facilities services to senior management and the Board - High cost of entry; collective agreements, NDP government		XXX	
Bargaining power of customers - Academics complain of monopoly and want outside options - Some contracting out protection in collective agreement - Clients can choose not to do the work, or complain	XXX		
Bargaining power of suppliers - - The university is a large purchaser in a small market and can command competitive prices on all goods and services			XXX
Threat of substitutes - Clients can choose to spend their money on other things other than our services		XXX	
Intensity of competition -Monopoly on some services			XXX X

The business environment and industry conditions:

Condition type	Opportunities	Threats
Political	- Government wants to see better physical planning and concentration on protecting existing, not just building new	- Change of government - Targeted and special envelope funding
Economic	- Special economic funds at all levels of	- Operating funds continue to shrink

	government were being created for infrastructure -Focus on life-cycle costing is increasing	- Academics want to control capital allocations
Societal	-Faculty, students, parents, public want attractive, safe and comfortable environments - Health and safety concerns were increasing - Demand for high quality space is increasing	- Students want money to go to their programs, not bricks and mortar - Ivory tower criticisms hurting funding
Technological	- Opportunity to upgrade systems and staff education and training	- Poor auditing and compilation systems and knowledge currently

Operational size-up:

Issue	**Strengths**	**Weaknesses**
Operations process	- Dedicated staff	- Huge cultural and attitudinal inertia - Poor/no use of technology - Poor productivity - Unwillingness to change
Risk management issues		- Insurance, safety and purchasing procedures not in place - Poor health and safety programs - Poor project management processes
Legal issues	- Longstanding relationship with downtown FIMP	- Purchasing and construction law suits pending - No in-house counsel
Location issues	- Good location	
Use of technology	- Some computerized systems - Good space management system	- Fear and unwillingness to adopt new methods and technologies

Stakeholders:

The environmental scan also identifies salient internal and external stakeholders who provide input – affect – and themselves were affected by output of the organization. The plan must identify the intrinsic and extrinsic stakeholders that hold power and have the intent to impose their will upon the organization. The environmental scan has identified the following stakeholders with varying degrees of power, legitimacy and urgency. A detailed list and analysis of all salient stakeholders and their attributes is listed in Appendix IV. They were summarized as follows:

Employees	**Unions**
• Faculty and their committees	• Students and their committees
• Staff	• The surrounding business and public communities
• Senior university leadership	• Regulatory agencies
• The Board of Governors	• Aboriginal community
• The province	• The media
• Employees	• Suppliers of goods and services & contractors
• Natural environment	• The City
• Tenants-Theological-Hospital	• Private partners

Values and Gap Analysis:

Our values were the foundation of common beliefs that FMD's employees hold in common and share and that we endeavor to put into practice to guide all staff in performing their work. They were based on moral purpose, complexity and diversity (Fullan, 1999) and identify what is important to the stakeholders and partners. They also help identify what we should be doing versus what we were doing and helps develop strategies and tactics to close the value-gap. The values of the Facilities Management Division, therefore, were:

We value *Integrity*.

- This means we strive to ensure that our work is done and is seen to be done in an accountable, trustworthy, honest and professional manner.

We value *Collaboration*.

- This means we will work together, with clarity of purpose, organized and efficiently, in an open and trusting environment which fosters sharing, helping, and team building.

We value *Creativity*.

- This means that our work practices will be innovative, we will use leading edge technology concepts, and we will encourage continuous staff development.

We value *Excellence*.

- This means we intend to satisfy ourselves and our customers that our work is done in a safe, efficient, innovative, and professional manner which produces sustainable results of the highest quality and reliability and the lowest life-cycle cost.

Detailed working teams will assess these values, compare them to current practices, identify significant gaps between the two, and identify strategies and tactics to close the value-gaps.

Organizational Principles:

Principles provide guidance and direction to lead and focus initiatives and actions. They help balance contractor, user and authority issues. They were open for participatory debate and review and help define the scope of our impact. The following were the principles by which we lead and manage our stewardship responsibilities:

1. *Products* ~ we provide our services to support the university mission and vision and to sustain our operations with their high-contribution potential.
2. *Direction* ~ we follow our strategic plan and provide clear direction to our employees.
3. *People* ~ we hire, train, educate and maintain a highly qualified work force.
4. *Ethics* ~ we operate to the highest standards of integrity and moral purpose.
5. *Community* ~ we develop and maintain long-term community/customer relationships.
6. *Structure* ~ we were prepared to change our environmental, transactional and organizational processes to ensure success.
7. *Communications* ~ we communicate thoroughly to our employees and to the community.
8. *Investment* ~ we reinvest in our people, our operations and in our asset.

Assumptions:

The following were the assumptions that the plan is based on; if they change, so must the plan:

1. Competitive and market pressures will continue to increase.
2. Our stewardship role will not change.
3. Funding will continue to decline.
4. New revenue sources need to be found.
5. Student demographics and therefore the physical environment will be dynamic.
6. The customer base and demands will continue to increase.
7. We will become more reliant on technology.
8. Our employees will remain our most valuable resource.
9. Collective agreements will not change.
10. Performance expectations and benchmarking comparisons will increase.
11. Cultural and attitudinal inertia is strong.
12. Competition for high quality staff will increase.

Key Success Factors and Driving Forces:

Key success factors define what Facilities needs to be successful. Driving forces define what forces and pressures impact and possible alter Facilities' direction and strategies.

Key success factors	**Driving forces**
- Buy in and involvement of staff - Embrace new technologies - Empowerment and inclusion - Autonomy & authority - Support from other units - Adequate resources - Job satisfaction - Employee development - Support, approval and adherence to policy - Scheduling and standards integrity - Clearly defined roles and authority	- Lack of understanding of what we do - Funding levels - Political issues - Coordination and leadership - Unplanned "emergencies" from community - Environmental(natural) conditions - Legislative - Unclear direction and roles & responsibilities - Campus development

Appendix D

Ethical Review exemption

Ethical Review exemption

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Investing in Ideas
U OF S RESEARCH

Office of Research Services

Dr. Valerie Thompson, Chair
Behavioural Research Ethics Board
University of Saskatchewan
Room 210 Kirk Hall, 117 Science Place
SASKATOON SK S7N 5C8 CANADA
Phone: 966-2084 Fax: 966-8597
Email: Valerie.thompson@usask.ca

MEMORANDUM

To: Paul Becker

Date: October 17, 2005

Re: A Case History and "Burography" of change in a University Administration Department

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The Project pertaining to "A Case History and "Burography" of change in a University Administration Department" is exempt from the Research Ethics Board review process. This decision is based on the information you provided to our office on October 12, 2005.

Your project does not require ethics review because:

- You are using publicly available information.
- You are not interacting with subjects.
- Your study is directly assessing the performance of an organization (TCPS, Section 1.1)

It should be noted that though your project is exempt of ethics review, your project should be conducted in an ethical manner (i.e., in accordance with the information that you submitted). It should also be noted that any deviation from the original methodology and/or research question should be brought to the attention of the Behavioural Research Ethics Board for further review.

I wish you an informative and successful study.

Sincerely,

Dr. Valerie Thompson, Chair
Behavioural Research Ethics Board

Appendix E

New CMMS reports

New CMMS reports

1. Report Instructions
2. How to enter Selection Criteria to filter data for Reports
3. Accounting / Finance Reports
4. Account Entry Report—FIN101
5. Manual Transactions – FIN102
6. Account Balance – FIN103
7. Transaction Register – FIN105
8. Inventory and Equipment Reports
9. Class Codes – INV101
10. Enterprise Inventory Data – INV102
11. Reorder Point – INV103
12. Warehouse Bin Listing – INV104
13. Inventory Kitted/Child – INV105
14. Usage By Line Item – INV106
15. Warehouse Value – INV107
16. Cycle Count Schedule – INV201
17. Physical Count – INV202
18. Material Request – INV301
19. Warehouse Transfer – INV304
20. Inventory Adjustment – INV305
21. Material Request Classification – INV306
22. Material/Equipment Return – INV307
23. Vendor Part Number – INV401
24. Vendor Catalog with Lead Time – INV402
25. Inventory Bids – INV403
26. Standard PM Reports
27. PM Checkpoints – PMI104
28. PM Template – PMI107
29. PM History by Equipment/Serial # – PMI108
30. PM Requirements – PMI109
31. Standard Equipment Reports
32. Shop Person Equipment and PM Template Assignment - EQM101
33. Detailed Equipment Inventory – EQM102
34. Equipment Route – EQM103
35. Key Control Reports
36. Key Cut – Key 101
37. Key Hook –Key102
38. Key Transactions / Statuses – Key103
39. Purchasing Reports
40. Credit Card – PUR101
41. Blanket PO – PUR102
42. Purchasing Petty Cash – PUR103
43. Item Delivery Report – PUR201
44. Back Order Report – PUR202
45. Purchase Order – PUR203
46. Purchase Receive – PUR204
47. Purchase Order Vs. Purchase Receive – PUR205
48. Purchase Order Vs. Disbursement – PUR206
49. Post AP Invoicing - PUR207
50. Rejection Report – PUR208
51. Contractor Catalog – PUR210
52. Bank Summary Info – PUR211
53. Bid Definition / Bid Awarded –PUR212
54. Bid Maintenance – PUR213
55. Project / Contract Management Reports
56. Contracts – CON101
57. Contractors – CON102
58. Past Due Analysis by Status or Due Date – CON110
59. Work Management Reports
60. Past Due Analysis - WR101
61. Work by Property, Shop, Person and Contractor—WR102
62. Percent of Time by Shop – WR103
63. Percent of Time by Cost by Shop - WR104
64. Work Backlog Age by Type/Category - WR105
65. Customer Service - WR106
66. Cost by Property - WR107
67. Work Request Status by Priority - WR108
68. Work Request Pending – WR109
69. Unassigned Work Request – WR110
70. Project Entry - WR111
71. Work Request - WR112
72. Time Card - WR113
73. Work Request Schedule - WR114
74. Customer Request - WR116
75. Work Request Quality Rating - WR117
76. Related Document Listing - WR122
77. Work Request Status History - WR123
78. Work Request Listing - WR126
79. Work Request Phase Listing - WR127
80. Work Request Checklist - WR128
81. Actual Labor Hours by Person - WR129
82. Actual Labor Hours by Person - WR130
83. Actual Labor Hours - WR131
84. Facility Work Completed History - WR140
85. Work Request Pending – WR109
86. Unassigned Work Request – WR110
87. Work Management Standards Reports
88. Lease Reports
89. Property Appraisal – LSE101
90. Property Estimate – LSE103

Appendix F

Researcher’s AVP daily activity log

Researcher's AVP daily activity log

Date	AVP-CMMS meetings
10/25/2001	CMMS WG/FMD Conference Room
11/23/2001	CMMS WS/FMD Conference Room
11/28/2001	CMMS Steering Committee Meeting/Paul's Office
12/7/2001	CMMS WG/FMD Conference Room
12/12/2001	CMMS Steering Committee/R Office
12/14/2001	CMMS Steering Committee/R Office
7/16/2003	CMMS Focus Team Meeting
7/23/2003	CMMS Focus Team Meeting
8/6/2003	CMMS Focus Team Meeting
8/13/2003	CMMS Focus Team Meeting
8/20/2003	CMMS Focus Team Meeting
8/27/2003	CMMS Focus Team Meeting
9/2/2003	CMMS - Work Requests Overview
9/2/2003	CMMS Finance & Work Requests Overview
9/3/2003	CMMS Projects & Work Requests
9/4/2003	CMMS Time Cards & Human Resources
9/5/2003	CMMS - Purchasing & Materials Management's needs
9/26/2003	CMMS -- Go Live (Finance)
9/26/2003	CMMS - Go Live (Human Resources)
9/26/2003	CMMS - Go Live (Time Cards)
10/27/2003	CMMS Team Meeting
6/9/2004	CMMS next phase planning
10/4/2004	CMMS Focus Team Phase II
12/13/2004	CMMS Focus Team Phase II
2/21/2005	CMMS Focus Team Phase II

Appendix G

Researcher AVP committees

Researcher AVP committees

1. Administrative Committee on Integrated Planning
2. Administrative Council
3. Academic Health Science Committee
4. Associate Vice-Presidents' committee
5. Human Resources Division search committee
6. Board resource officer
7. Campus Advisory and Business Information Systems committee
8. Capital Planning committee
9. Communications committee
10. CUPE local working committee
11. Enrolment Plan committee
12. Extended President's Committee
13. FMD Services Check-up Committee
14. Information Technology Steering committee
15. Land & Facilities Committee of the Board Secretary/Coordinator
16. Naming committee
17. Occupational Health Committee
18. Out of Scope committee
19. Operations Forecast team
20. President's Advisory Committee
21. Planning committee
22. Policy review committee
23. Research Plan committee
24. Saskatoon District Health/Royal University Hospital and U of S Joint Planning Committee
25. Strategic committee on Integrated Planning
26. The Kenderdine Beamish Endowment Fund Committee
27. The Meewassin Valley Authority board member
28. University Emergency Preparedness Committee
29. UserNet committee
30. Vice-President's Space Strategy Committee
31. Vice President Executive Group

Appendix H

CMMS project team meetings schedule

CMMS project team meetings schedule

Date	CMMS Project team meetings schedule
10/12/2001	CMMS WG meeting – Facilities Management Conference Room
10/25/2001	CMMS WG/FMD Conf Room
11/23/2001	CMMS WG/FMD Conf Room
11/28/2001	CMMS Steering Committee Meeting/Paul's Office
12/7/2001	CMMS WG/FMD Conf Room
12/12/2001	CMMS Steering Committee
12/14/2001	CMMS Steering Committee
3/17/2003	CMMS Project Team Weekly Meeting
3/24/2003	CMMS Project Team Weekly Meeting
3/31/2003	CMMS Project Team Weekly Meeting
7/9/2003	CMMS Focus Team Meeting
7/16/2003	CMMS Focus Team Meeting
7/23/2003	CMMS Focus Team Meeting
8/6/2003	CMMS Focus Team Meeting
8/13/2003	CMMS Focus Team Meeting
8/20/2003	CMMS Focus Team Meeting
8/27/2003	CMMS Focus Team Meeting
9/2/2003	CMMS - Work Requests Overview
9/2/2003	CMMS Finance & Work Requests Overview
9/3/2003	CMMS Projects & Work Requests
9/4/2003	Time Cards & Human Resources
9/5/2003	CMMS - Purchasing & Materials Mgm't
9/23/2003	CMMS Projects & Work Requests
9/26/2003	CMMS - Go Live (Finance)
9/26/2003	CMMS - Go Live (Human Resources)
9/26/2003	CMMS - Go Live (Time Cards)
10/27/2003	CMMS Focus Team Meeting
12/15/2003	CMMS Focus Team Meeting
6/9/2004	CMMS Focus Team Meeting
6/22/2004	Managing Banner & CMMS

Note: the time between meetings 12/14/2001 and 3/17/2003 was spent tendering and purchasing the upgraded CMMS system. This process was not part of the study.

Appendix I

CMMS benefits announcement

CMMS benefits announcement

Date: March 2003
Description: *Initial Division announcement on the benefits of the new CMMS.*
Data:

Account Reporting:

- To minimize the manual account reporting structure currently used for Capital, Minor Capital and Maintenance budgets
- To improve account reporting time

Alerts:

- Provides the ability to flag when business rules are out of the norm (i.e. budgets over budget or approaching critical limits, etc.)
- Provides online asset warranty information, current status and milestone flagging.
- Provides automated authorization alerts for work flow and purchasing authorization

Assets:

- Promote the development of effective Asset Management Strategies
- To better determine asset true life cycle costs via monitoring of repair costs to replacement value

Benchmarking:

- To establish benchmarking of the maintenance operation in order to investigate maintenance improvement opportunities
- Benchmarks the new CMMS installation to justify return on investment and ensure we maximize it's value and capability
- Through benchmarking - to ensure maintenance best practices levels are being performed and met

Best Practices & Triggers & Standards:

- To foster maintenance best practices over the long term
- To provide system triggers so maintenance functions are not ignored, but instead prioritized and if failing the quantified to be able to quickly bring to the attention of upper management
- Provides the vehicle to achieve high quality work standards that are cost effective and process opportunistic
- Provides the vehicle to determine craft wrench time and where improvements maybe required (i.e. staff training, employee motivation/direction, improved craft utilization, etc.)
- Allows maintenance processes to move from scheduled or breakdown maintenance to predictive maintenance
- Provides management with the tools to determine reliability of equipment, parts to improve/repair/replace decisions

Budget Accountability:

- Provides for greater accountability for craft labor and parts/materials
- Increased level of accountability of the overall maintenance budgets
- Replacement decisions can be supported by current/accurate cost information
- Improve annual budgeting projections due to availability of current and historical data. Budget's can be based on predictive budget projections (by need) instead of past budgeting levels.
- To flag deferred maintenance budgeting requirements

Work Flow Processes:

- Work flow processes are reviewed in light of best practices and corporate requirements. Past practices may be considered, but should not be the determining factor.

Customer Service/Satisfaction and Performance:

- To improve customer satisfaction generally
- To provide a facilities management central contact point for customers to access
- To provide consistent customer work request feedback/updates
- To provide a vehicle for on line Web customer service requests & customer feedback comments
- Provides a vast source of maintenance information to allow more effective measurement of maintenance performance and service
- Provide measurement of improvements in areas such as craft labor productivity, PM compliance, downtime, store inventory control, work backlog, level of maintenance, service, reliability, etc.

Data Collection & Availability:

- Provides the vehicle to turn data into information for managing maintenance as an internal business
- Extensive data availability through a complete data collection implementation strategy
- Improved historical data availability in turn allowing for analysis to determine maintenance and service improvements
- Reduced manual data and error entry by increased utilization of the technology & software tools provided in the CMMS package
- Timely availability of data due to input of real time data enabling staff to have current cost/labor reports at their fingertips

Materials Management:

- Provides a management tool for the control of maintenance parts and material inventories
- Provides data to make decisions on inventory increases/reduction, parts usage, excess inventory levels, obsolete inventory
- Improved inventory control through the use of bar coding in stores for inventory management including withdrawals and returns
- Provides a well organized stock room with accurate inventory records
- Provides a stock locator system, accurate stock levels and store room stock catalog

Planning & Scheduling:

- Systems and procedures to establish a more effective day to day maintenance planning and scheduling process
- Contributes to improved craft labor utilization and customer service
- Provides the vehicle to plan for maintenance excellence

Preventive & Predictive Maintenance:

- Provides for the automatic scheduling of repetitive PM activities
- Documents the inspection frequencies and procedures
- Provides a method to monitor failure trends and highlight major causes of equipment breakdowns and unscheduled repairs
- Improved Preventive Maintenance descriptions and Standard Operating Procedures & process for new employees to follow

Procedures:

- Capture senior employee experience and pass to junior employees through written Standard Operating Procedures embedded in the CMMS

Reliability Analysis:

- Ability to track work order and equipment history data related to types of repairs, frequencies and causes for failure
- Provides information on failure trends that leads to eliminating root causes of failures and improved equipment reliability
- To measure and track downtime to determine where improvements may be implemented

Mobile Computing:

- Provides remote computing for the purposes of,
- accessing stores inventories,
- parts withdrawal,
- field work order generation,
- access to WHMIS & safety information in the field,
- field access to drawings.
- completion of work orders directly in the field and automatically complete time sheets accordingly,
- track an increased number of work orders without increasing shops overhead,
- read equipment and stores inventory barcodes directly reducing time and improving accuracy/tracking, and
- receiving of service request information throughout the working day while staff are working in the field.

Resource Requirements:

- To better quantify current staffing requirements and project future requirements
- To utilize existing staffing resources more effectively
- Better determine staff resource allocations (maintenance, construction, other)

- Measure craft performance against estimated time to repair with a view to investigate methods for improvement of processes & time lines

Return on Investment:

- To provide return on investment initially and in the future through improved work flow process
- Total data input implementation to allow for ongoing data analysis which may provide opportunities for maintenance process improvement and resource utilization.
- Reduction in Operating Costs (Cost Avoidance) by increasing staff wrench time and productivity

Standards:

- Formalize work flow processes so practices and standards are consistent across the division
- Standardize common data sources within the division so common data resides in only one location (i.e. building names/numbering, equipment numbering, etc.)
- Improving core competence by drawing on existing employee expertise and including written Standard Operating Procedures, Safety Documentation, drawing access and maintenance procedures in the CMMS for one point of access to information

Work Control/Flow:

- Better work management with improved control over work requests by craft
- Improve maintenance workflows for daily/weekly scheduling of work
- To improve maintenance/construction work flow scheduling
- Being able to determine priorities
- Being able to make better scheduling decisions for overtime
- Full accountability of craft time/labor cost to work orders (which accrues to asset history)
- To better determine the total scope of maintenance work backlogs
- To better prioritize maintenance work backlogs
- To be able to determine maintenance work loads versus construction work loads and assign resources accordingly
- Data are available to review current work flow practices which can lead to the implementation of opportunities that are of benefit to the employees, section, department, division & University
- Elimination of the extensive creation and processing of paperwork by increased utilization of the CMMS technology & software tools provided

Appendix J

CMMS project implementation schedule

CMMS project implementation schedule

Date: October 2002
Description: *Project implementation schedule.*
Data:

TASK	DAYS	START	END
Implementation Plan Development	2 days	Fri 8/2/02	Mon 8/5/02
Implementation Timeline Development	2 days	Tue 8/6/02	Wed 8/7/02
Begin First Trip		*Thu 9/12/02*	
"Project ""Kick-Off"" Meeting"	2 days 2 days	Thu 9/12/02	Fri 9/13/02
Revise Implementation Plan	2 days	Sat 9/14/02	Sun 9/15/02
Conceptual Training	3 days	Mon 9/16/02	Wed 9/18/02
Software Installation and Configuration	5 days	Mon 9/16/02	Fri 9/20/02
System Administration Training	1 day	Thu 9/19/02	Thu 9/19/02
Data Conversion	1 day	Fri 9/20/02	Fri 9/20/02
Business Process Analysis	4.5 days 4.5 days	Mon 9/23/02	Fri 9/27/02
System Set-up and Configuration Phase 1	4 days	Mon 9/30/02	Thu 10/3/02
End First Trip			*Thu 10/3/02*

SOP Draft Development	3.5 days	Mon 9/30/02	Thu 10/3/02
Entry of Customer Specific Data	17 days	Fri 10/4/02	Mon 10/28/02
Data Conversion (times are estimated - conversions to be charge based on time and materials)	15 days	Fri 10/4/02	Thu 10/24/02
Uof S Holiday (Thanksgiving)	1 day	Mon 10/14/02	Mon 10/14/02
Begin Second Trip		*Mon 10/28/02*	
System Set-up and Configuration Phase 2	6.5 days	Mon 10/28/02	Tue 11/5/02
Process review and Financial Transactional Training	3 days	Wed 11/6/02	Fri 11/8/02
End Second Trip			*Tue 11/5/02*
Process review and Financial Transaction Review	25 days	Mon 11/11/02	Fri 12/13/02
MAXIMUS Users Conference	4 days	Sun 11/10/02	Wed 11/13/02
Entry of Customer Specific Data	15 days	Thu 11/14/02	Fri 12/6/02
Software Modification Specifications & Development Add a calculated inventory avg value with to include markup Add auto-generation of restock purchase orders Add flag to disable PO update of vendor catalogue Modify the PO to generate email approval notification Add a line item status to the PO		Fri 8/2/02	Fri 8/30/02
Review Mods in SA Add a calculated inventory avg value with to include markup Add auto-generation of restock purchase	0.75 days	Thu 11/14/02	Thu 11/14/02

orders Add flag to disable PO update of vendor catalogue Modify the PO to generate email approval notification Add a line item status to the PO			
Software Mod development for Ext Cust Tax	0.25 days	Thu 11/14/02	Thu 11/14/02
Revise Mods based upon review	10 days	Thu 11/14/02	Mon 12/2/02
Modify the billing program to calculate external customer taxes	19 days	Fri 11/15/02	Fri 12/13/02
MAXIMUS Holiday (Thanksgiving)	2 days	Thu 11/28/02	Fri 11/29/02
Deliver Modified Facility Focus Software Code Add a calculated inventory avg value with to include markup Add auto-generation of restock purchase orders Add flag to disable PO update of vendor catalogue Modify the PO to generate email approval notification Add a line item status to the PO External Customer Tax	0 days	Fri 12/13/02	Fri 12/13/02
Begin Third Trip		*Mon 12/9/02*	
System Set-up and Configuration Phase 3	2.5 days	Wed 12/11/02	Fri 12/13/02
Software Setup Milestone		Fri 12/13/02	Fri 12/13/02
Interfaces Specification Meetings	3.5 days 3.5 days	Mon 12/16/02	Thu 12/19/02
End Third Trip			*Tue 12/19/02*
Interfaces Specification Development	24.5	Mon 12/23/02	Fri 2/14/03
UofS/MAXIMUS Holidays (Christmas & New Years)	10 days	Mon 12/23/02	Fri 1/3/03
UofS Interface spec review	35 days	Thu 1/9/03	Thu 2/21/03
Interface Software development	30 days	Fri 2/21/03	Fri 4/4/03
Interface Software Testing and Revisions	10 days	Fri 4/4/03	Fri 4/18/03
Software Interface Milestone			Fri 4/18/03
Begin Fourth Trip		*Mon 4/1/03*	
Workflow Walk Through & SOP Verification	4 days 4 days	Tue 4/1/03	Fri 4/4/03
End Fourth Trip			*Fri 4/4/03*
SOP Modifications and Finalization	2 days	Mon 4/7/03	Tue 4/8/03
SOP Review	5 days	Mon 4/14/03	Fri 4/18/03
Begin Fifth Trip		*Tue 4/22/03*	
Facility Focus End-User Training	7 days	Tue 4/22/03	Tue 4/29/03
Data Refresh	1 day	Wed 4/30/03	Wed 4/30/03
Go-Live Milestone		Thu 5/1/03	Thu 5/1/03
Desktop Training/Go-Live Assistance	2 days	Thu 5/1/03	Fri 5/2/03
End Fifth Trip			*Fri 5/2/03*

Appendix K

CMMS project actions items

CMMS project actions items

Date: March 2003
Description: *CMMS implementation focus team action items.*
Data:

NO.	ITEM
1	Accounting Issues **a)** Shops Accounts –Building Maintenance Budgets consolidation with new shops accounts **b)** Grounds Shops Accounts – combination of Grounds shops – Finance currently analyzing
2	Interface Development **a)** #2 Accounts Payable Voucher Feed **b)** #3 Accounts Payable Voucher Feed Encumbrance **c)** #1 Customer Monthly Billable – Specification development to start week of Feb 17/03 **d)** Human Resources interface to PeopleSoft – Phase 2 issue.
3	Enhancement Development **a)** Progress Report
4	TO DO's List **a)** Progress Report **b)** Critical Issues before June 1/03
5	Work Requests – Operating & Maintenance – PM **a)** Setup meetings on Work Request Codes **b)** Work Request Building/Campus asset development (based on Uniformat system) – requires final validation
6	Shops Printers **a)** C to work with staff to determine shop printer number and location **b)** Electrical has scheduled the associated wiring for March/17
7	Stores - Bar Coding & Tetherless Operation **a)** Priority needs to be discussed relative to all other issues trying to get on line May 1/03
8	Software Bulk Purchase – PO Released to Maximus **a)** Mobile facilities management – Docking Station **b)** Tetherless – Stores Wireless Operation **c)** Space Management **d)** Facility Focus Site License
9	Telephone Management System **a)** Any issues
10	Customer Care Centre & Work Control Centre

	a) Areas of responsibility **b)** Training
11	Report Generation **a)** Crystal reports Training – minimal self training at this point – CD'S are available – if you need assistance to install, etc.
12	Human Resources – Employee Reporting **a)** Testing of Enhancements
13	Facility Focus Field Hyperlinking **a)** No feedback to date
14	User Training e) F working on Training schedule – Starting May 21/03 to be held in RM 161 Library – Tentatively 1 week duration. Need 2 qualified people to help in large sessions – any volunteers? f) Not addressing training for Space Management or Preventative Maintenance at this time. g) Draft Available on the CMMS/Training Schedules
15	Work Request Reference to FRS a) Mini Project to research process to reference a work request to internal campus charges at FRS
16	New Business

Appendix L

CMMS project team roles

CMMS project team roles

Accounting
Account Distributions
Month End and Year End Procedures (with IT)
Financial Reporting
Organizations, Customers and Account Numbers
Craft Rates (Regular and Agency)
Reports
Security

Administration
Timesheets and Timecodes
Employee Records
Custodial and Grounds Standing Work Request Development
Month End and Year End Procedures (with IT)
Reports
Security

Materials Management
PO's
PO Invoices
Interface Development
Markup
Service Contracts
Project Contracts
Fleet
Grounds
Counter Releases
Auto reorder
Tetherless Testing
US Conversion
Stores Stock Taking Procedures
Month End and Year End Procedures
Reports (PO Report, etc.)
Security
Dry Run
Testing
SOP

Projects
Project Numbering
Work Codes
Planned Work Requests

Project Manager Listing
Estimating Module
Using RS Means
Linking data to archival information and Pre-Project
Documentation (Contract documents, bids, drawings)
Property Information
Month End and Year End Procedures
Reports
Security
Dry Runs
Testing
SOP

Operations
Business Processes from WCC to Shops and Feedback
Reports
Saved Searches/Queries
Work Codes
Types and Categories
Customer Information, Names and Contact Info
Analysis of data Weekly, Monthly, yearly
Feedback for modification of codes, status', business processes
Re-defining existing work-flow diagrams and modifications
Key Performance Indicators
Manager/Director Reports

Work Control Center
Category and Type codes
Status Codes
Optional Fields – uses
Defaulting/Auto-Population of Information
Work Codes
Standing Work Requests
Demand Maintenance, WIRF, Fee for Service
Outside Telephone Number(s) and email to advertise
Dry Runs
Testing
SOP

Custodial
Business Processes
Inputting work requests (green sheets)
Schedule Maintenance for Custodians (with Val)
Building Assignment Maintenance for Custodians
Auto-generating time cards
Shift Differentials

Shops
Customer Request Module – exploring other options
Receipt and Input of Work Orders
Maintenance vs. Fee for Service Account Distribution Default
Dry Runs
Testing and SOPs

Appendix M

CMMS project communications schedule

CMMS project communications schedule

Date	Objective
September 30	Bulletin Board unveiled - to be updated every couple of weeks, or as necessary
October 1	Brochure to be released
October 4	Workshop #1 - describe major objectives and timelines - answer questions arising from brochure and bulletin board
End October	Newsletter #1 - answer questions arising from October workshop
End November	Newsletter #2 - User Conference report
1st week of December	Workshop #2 - User conference report - answer questions arising from November newsletter
1st week of January	Newsletter #3 - answer questions arising from November workshop
1st week of February–May	Newsletters - to report status and new information
March	Workshop #3 - to report status and new information - discuss training

Appendix N

CMMS project training schedule

CMMS project training schedule

	May 21, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers
8:30 am to 12:00 pm & 1:30 pm to 5:00 pm	PROJECTS & WORK REQUESTS Project Entry Planned Work Request Planned Work Request Estimate Entry Work Request Entry Estimate Entry MSProject Interaction Purchase Order Basic Searches Inventory Searches Estimated Time = 7 hours	Staff Names Here	Staff Names Here

	May 22, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers
8:30 am to 12:00 pm & 1:00 pm to 4:30 pm	PROJECTS & WORK REQUESTS Project Entry Planned Work Request Planned Work Request Estimate Entry Work Request Entry Estimate Entry MSProject Interaction Purchase Order Basic Searches Inventory Searches Estimated Time = 7 hours	Staff Names Here	Staff Names Here

	May 23, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers
8:00 am to 12:00 pm Noon	WORK REQUESTS Customer Request Entry Get Customer Request Work Request Entry - Searches Purchase Order Basic Searches Inventory Searches Estimated Time = 4 hours	Staff Names Here	Staff Names Here

	May 23, 2003		

Time	Facility Focus Module and Key Functions	Hands On	Observers
1:00 pm to 2:00 pm	TIME CARDS Time Card Entry Time Card Approval Estimated Time = 1 hours	Staff Names Here	Staff Names Here
2:00 pm to 4:30 am	HUMAN RESOURCES Employee Records Leave Usage Entry Leave Usage Approvals Leave Balance Maintenance Auto Generate Time Cards Estimated Time = 3 hours	Staff Names Here	Staff Names Here

	May 26, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers
9:30 am to 12:00 pm & 1:30 pm to 4:30 pm	PURCHASING Purchase Order Entry Purchase Order Invoice Entry Purchase Order Invoice Adjustment Service Contract Entry Service Contract Invoice Entry Service Contract Invoice Adjustment Project Contract Entry Project Contract Change Order Project Contract Invoice Entry Project Contract Invoice Entry Adjustment Estimated Time = 6 hours	Staff Names Here	Staff Names Here

	May 27, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers

8:00 am to 12:00 pm Noon	<u>MATERIALS MANAGEMENT</u> Part Entry Bin Edit Contractor Catalog Counter Release Counter Return Inventory Adjustment Warehouse Transfer Receives Disbursement Reverse Disbursement Estimated Time = 4 hours	Staff Names Here	Staff Names Here

	May 27, 2003		
Time	Facility Focus Module and Key Functions	Hands On	Observers
1:00 pm to 5:00 pm	<u>FINANCE</u> Financial mapping in FacilityFocus Manual Adjustments Work Request Journal External Charges Customer Billing Setup Work Request Billing Transaction Billing API Maintenance Estimated Time = 4 hours	Staff Names Here	Staff Names Here

Appendix O

CMMS project timeline of events

CMMS project timeline list of events

Date	Activity
December 1, 1991	CMMS 1
December 1, 1998	CMMS 2
January 1, 2000	New AVP starts, evaluation begins
May 1, 2001	Board of Governors and Strategic Plan
September 1, 2001	CMMS 3 starts
September 1, 2001	Step 1 appoint PM and consultant
October 1, 2001	Initial project team meeting
November 1, 2001	Step 2 needs assessment
December 1, 2001	Customer survey
January 1, 2002	Step 3 prepare RFP
April 1, 2002	Step 4 design RFP evaluation
April 1, 2002	Step 5 decide on preferred bidders
May 1, 2002	Strategic Plan into Integrated Planning
May 1, 2002	Step 6 tender RFP
June 1, 2002	AVP on information
July 1, 2002	My email on why
July 1, 2002	AVP email on why
August 1, 2002	Step 7 eval proposals
August 1, 2002	Implementation plan
September 1, 2002	Step 8 select short list
September 1, 2002	Step 9 vendor demos
September 1, 2002	Step 10 summarize evals
September 1, 2002	Step 11 further evals
October 1, 2002	Step 12 select and purchase
November 1, 2002	Newsletter
November 1, 2002	Message to project team
December 1, 2002	Growing pressures
March 1, 2003	Action items for initial training
March 1, 2003	Project lead duties
March 1, 2003	Work control email
March 1, 2003	AVP answer on work orders
March 1, 2003	Message re work orders
March 1, 2003	Message on printers and work orders
April 1, 2003	Integrated Planning forum
April 1, 2003	Workflow walk through
April 1, 2003	Training
May 1, 2003	Message on roles

May 1, 2003	Project team project team roles sent out
July 1, 2003	WCC email
August 1, 2003	Standards Operating Procesdures finalization
September 1, 2003	2 day kick off
September 1, 2003	Project team meeting
October 1, 2003	Go Live
November 1, 2003	Project team leader roles
November 1, 2003	Project ream sub team leader roles
November 1, 2003	FMD approved Integrated Plan
May 1, 2004	Project team conference presentation
November 1, 2004	AVP conference presentation
November 1, 2004	AVP presentation
January 1, 2005	Project management report
January 1, 2006	UniFi problems, phase two stalled