ETM ENGINEERING & TECHNOLOGY MANAGEMENT

Title: A Study of Information Systems Project Management and the ODOT Experience

Course: EMGT 520
Term: Fall
Year: 1996
Author(s): M. Arora, M. Coleman, R. Gagnier, P. Ghavami, M. Guntrum and B. Stratton

Report No: P96063

Abstract: This paper looks at the application of project management to large information systems projects. A model was developed that indicated the failure causing oversights that frequently occur during the development of an information systems project. This model formed the basis for comparing the Oregon Department of Transportation (ODOT) Information Systems Reengineering Project with the methods for successful computer systems management cited in the literature.

A Study of Information Systems Project Management and the ODOT Experiences

M. Arora, M. Coleman, R. Gagnier, P. Ghavami, M. Guntrum, B. Stratton

EMP-9663

TERM PROJECT

A STUDY OF INFORMATION SYSTEMS PROJECT MANAGEMENT AND THE ODOT EXPERIENCE

EMGT 545/645 (Spring 1996)

Submitted: June 5, 1996

TEAM 3:

Monica Arora
Micha Coleman
Rob Gagnier
Peter Ghavami
Mike Guntrum
Bud Stratton

1.0 EXECUTIVE SUMMARY 4

2.0 INTRODUCTION 6

2.1 Project Purpose 6

2.2 Project Methodology: 6
2.2.1 The Literature Search: 6
2.2.2 Analysis of the Problem: 7

3.0 LITERATURE SURVEY 7

3.1. Introduction 7

3.2 Conventional Project Management Life Cycle 8
3.2.1 Generic Systems Development Phases 8
3.2.2 Nicholas Model for Systems Engineering 10
3.2.2.1 Identification of Need: 11
3.2.2.2 System Concept 11
3.2.2.3 System Definition and Preliminary Design 12
3.2.2.4 Detailed Design and System Development 12
3.2.2.5 System Construction and/or Production 13
3.2.2.6 System Operation and Support (Execution) 13
3.2.2.7 System Evaluation 13
3.2.3 Top Causes of Project Failures 14
3.2.3.1 Poor Planning 15
3.2.3.2 Poor Communications 15
3.2.3.3 Inadequate Resources 15

3.3 Computer Systems/Information Technology Project Management Cycle 15
3.2.1 Unique characteristics of IS Project Management 15
3.3.2 Different Life Cycle Representations 16
3.3.3 The causes of project failures 19

3.4. Large Scale Computer Systems Projects. 21
3.4.1 Saturn 21
3.4.2 California DMV 22

4. COMPUTER SYSTEMS PROJECT MANAGEMENT MODEL 23

4.1 Model development 24

4.2 Model discussion by phase 26
4.2.1 Concept Phase 26
4.2.2 Definition Phase 28
4.2.3 Acquisition Phase 31
4.2.4 Operation Phase 33

5. ANALYSIS OF ODOT PROJECT MANAGEMENT 34

5.1 Description of the ODOT Project 34

5.2 ODOT Independent Data Collection 38
5.3.1 Model Comparison 39
5.3.1.1 The Concept Phase. 39
5.3.1.2 The Definition Phase. 41
5.3.1.3 The Acquisition Phase. 44
5.3.1.4 The Operation Phase. 46
5.3.2 Project Pitfalls 46
5.3.4 Quality Management 49
5.3.5 Successful actions 50

5.4 Prescription for successful ODOT Project Management 55

5.4 ODOT PROJECT MANAGEMENT 57
5.4.1 Poor Planing 58
5.4.1.1 Lack of project focus 58
5.4.1.2 Poor Organizational Structure. 58
5.4.1.3 Inappropriate Tools. 58
5.4.2 Inadequate Resources 59
5.4.2.1 Poor choice of project manager(s) 59
5.4.2.2 Lack of management Support. 59
5.4.2.3 Failure to involve the User 59
5.4.2.4 Information Systems personnel not involved. 60

6.0 FUTURE STUDIES 60

6.1 Applicability of the Model to other types of Projects 60

6.2 Role of Information Systems Technology in the Government. 60

6.3 DMV Projects around the nation. 60

6.4 Turnaround Models. 61

6.5 ODOT DMV. 61

6.6 Artificial Intelligence approach to project management. 61

BIBLIOGRAPHY 62

1.0 EXECUTIVE SUMMARY

Large information systems projects are difficult to manage and prone to failure. This is due to the size, complexity, long development and implementation time, coverage of a large geographic region, and other complicating factors. This paper looks at the application of project management to these types of projects. Through the literature survey the classical methodology for the project management and the design and implementation of information systems projects were reviewed. A model was developed that indicated the failure causing oversights that frequently occur during the development of an information system project. This model formed the basis for comparing the Oregon Department of Transportation (ODOT) Information Systems Reengineering Project with the methods for successful computer systems management cited in the literature. Analysis of the ODOT project revealed that many of the classical failure mechanisms of information system projects were also present in the ODOT project.

Our review of literature and survey of project managers formed the outline for comparing the Oregon Department of Transportation (ODOT) Information Systems Reengineering Project with the methods for successful computer systems management cited in the literature. The analysis of the ODOT project showed many of the classical failure mechanisms in project management. Some of the biggest mistakes were:

* Tri-managers-no one responsible for the project outcome
* Lack of technical and project management skills
* No IS architecture
* No project plan
* Prime contractor's lack of experience
* Deliverables not defined
* Lack of fiscal control
* QA analysis and reports ignored

Due to these and other problems the project failed to meet it's schedule, cost and performance requirements. The field study provided ample lessons for managing large, mega projects to our team. Most definitely the skill and experience of the project manager seem to be an indicator of a large project's success or failure.

2.0 INTRODUCTION

2.1 Project Purpose

The purpose of this project is to investigate the factors that lead to successful project management of information systems. Key success factors will be identified. The events and experiences of Oregon Department of Transportation (ODOT) in developing and implementing an updated information system will be contrasted with the key success factors. Potential danger signs and "detours" from a successful project management road map will be identified and discussed.

2.2 Project Methodology:

2.2.1 The Literature Search:

The literature search consisted of two segments. The first segment addressed Information Systems Project Management in general and the second segment addressed the planning and execution of a highly publicized Oregon Department of Transportation (ODOT) information systems project.

A comprehensive literature search was conducted to identify articles discussing and defining approaches and techniques leading to successful project management of Information System programs. Team members reviewed and discussed the results of the literature search during team meetings. Developmental challenges and approaches that distinguish Information System project management from other types of project management were identified and summarized..

An example of a troubled information systems project was then reviewed. Information on the ODOT Information System was gathered form reports, questionnaires and interviews with key individuals currently involved with the project..

2.2.2 Analysis of the Problem:

The general literature was reviewed to identify "Key events" that seemed to lead to successful Information System Project Management. This information was used to produce a generic model for successful Information System project management. . Key factors leading to the ODOT project difficulties were identified and discussed. The generic model was then used as a benchmark to evaluate the effectiveness of planning and execution of the ODOT project. Observations and conclusions are then offered on the adequacy of the model, the ODOT project and topics for further research.

3.0 LITERATURE SURVEY

3.1. Introduction

A survey of literature was performed to understand the differences between conventional project management life cycles and information technology project life cycles. Several examples of information technology project management studies were cited and analyzed as to their reasons for success or failure. Of particular interest and focus, was the Oregon Department of Transportation and Oregon Department of Motor Vehicles recent computer system implementation project failure.

Portals, ABI Inform and other on-line data bases were used to search for literature that contained the following key words: project management and implementation, information systems, information technology, business process reengineering, strategic management, and project planning. Over 3500 articles each were found on the subjects of information technology and implementation; however, this was reduced to approximately 200 articles when these key words were cross referenced.

3.2 Conventional Project Management Life Cycle

As the use of technology increases in our everyday lives customers are expecting more from the products they purchase and use. This is true in all levels of products from consumer products such as electronics and home computers to buildings to large computer systems. Nearly every thing we use is becoming more complicated. In order to design and manage these complex systems the project manager must use system approaches.

The purpose of a systems type of approach is to make sure that the overall purpose of the project and how this project interacts with surrounding systems is not lost in dealing with the details of the system components. Systems thinking is needed when dealing with complex projects so that when the project is completed the resulting system fulfills the customers expectations.

3.2.1 Generic Systems Development Phases

From lecture notes, a generic model of a system life cycle can be defined by the following:

- Conceptual phase
- Definition phase
- Production phase
- Operational phase
- Divestment phase

There are many sources in literature that discuss project life cycles and use various terms to describe each phase. Table 3.1 shows a listing of six sources with their interpretation and definition of project development phases.

SOURCES	SYSTEM DEVELOPMENT PHASES					
John Nicholas	Conception Phase	Definition Phase		Acquisition Phase	Operation Phase	
Cleland and Kocoglu	Conceptual Phase	Definition Phase		Production Phase	Operational Phase	Divestment Phase
DOD 5000.1	Concept Exploration and Definition	Prototyping and Risk Reduction		Engineering & Manufacturing Development	Production and Deployment	Operations an Support
Hdbk of IE	Initiation Phase	Development			Handover to Production	
Jenkins	System Concept	Definition and Preliminary Design	Detailed Design and System Devlopment	Construction/ Production	Operation & Support	Phase out

Table 3.1 Sample System Development Phases

Even though the same basic process are followed in the life cycle, the titles provided to the different phases vary by source. This divergence of titles is caused by the emphasis that is being placed on certain events in the life cycle. Referring to Table 3.1, the phases presented by Nicholas and by Cleland and Kocoglu are the most generic. These terms can be applied to most developments. However, referring to the recently redefined phases of Defense Departments primary acquisition guidance document, DOD 5000.1, the major emphasis being placed on prototyping and risk reduction become evident.

The simplest life cycle is found in the Handbook of Industrial Engineering. This life cycle has three stages and is defined more from the perspective of a plant engineer. The Initiation phase involves mostly planning functions. The Development phase involves the design of the product and the Handover to Production phase is providing these designs to a manufacturing element to be produced. This concept of life cycle does not emphasize the period when the product is in use or how the product will be phased out of operation.

3.2.2 Nicholas Model for Systems Engineering

Projects logically transition from one phase to another. Some phases require more detail and may overlap and interact with other phases. The purpose of this section is to look at systems engineering in a general non-project specific sense as described by the Nicholas model. The basic stages of system engineering and outlines for each phase will be discussed. Figure 3.2 shows the stages and how they interrelate.

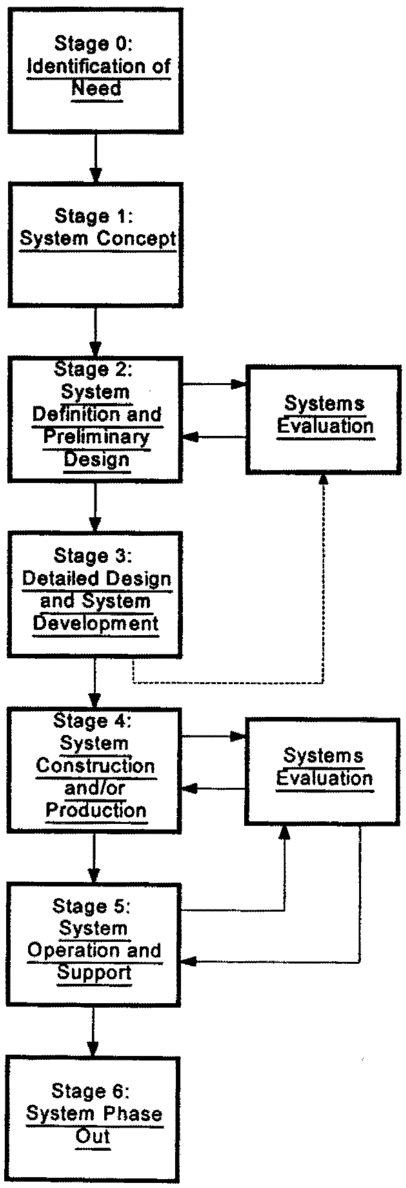

Figure 3.2, System Engineering Phases (Nicholas)

3.2.2.1 Identification of Need:

In the first stage, the customer first realizes that something is not working correctly or that something new might be needed. While the need is felt, the customer is unsure of what is exactly needed, or what should be done to fulfill this need.

A clear description of the problem and an estimate of the value of the desired system is needed before any work can begin. This process begins by asking some basic questions [44]:

1. How did the problem or need arise?
2. Who believes it to be a problem or feels the need?
3. Why is a solution important? How much money (or time, etc.) will it save? What is the value of the system?
4. Is it the right problem or need anyway, or is it a manifestation of some other problem? Would greater benefits accrue if other problems or needs were addressed instead?
5. Does it seem that there would be a reasonable return on effort if resources were applied to this system or would this effort be better applies by tackling another problem or need?

3.2.2.2 System Concept

In the conceptual phase, the emphasis is on breadth and not depth. The purpose of the system concept phase is to develop an exact set of concepts, requirements, and criteria. To this end a feasibility study is performed. The feasibility study defines the system more precisely and attempts to develop goals for hardware, software, support, and other elements of the system. Technical, economic and environmental impacts to the organization are assessed during this phase and alternative solutions should be established. Users and roles are clearly identified. Gap analysis and feasibility studies are conducted to aid in the project's conceptualization. Many projects end with the conceptual phase. However, those which are approved by the organization move onto the definition phase. The end result is a set of design requirements, criteria for the overall system, a preliminary design for the functional configuration, and physical characteristics of the system.

3.2.2.3 System Definition and Preliminary Design

At this stage the system requirements, criteria, and concepts developed in the previous phase are grouped and translated into functions. These function describe a specific process or action required to meet a specific goal. From these functions functional flow charts and block diagrams are developed. These show system design requirements and how these requirements interface with each other. In the latter part of this phase a system analysis is performed on each block in the flow diagram. This analysis determines the technical requirements of the function and tries to arrive at a solution that is reliable and effective. The support system is then analyzed in a similar manner to determine what is the most feasible, reliable, and economic means for supporting the operating system and minimizing downtime. Several satisfactory designs might be identified for each function. Mathematical or other models may be used to analyze the alternative designs. Once all of the alternatives have been analyzed the final system concept can be constructed and examined. From this final system a list of specifications is developed for the system design. The customer then reviews the system and makes recommendations. Due to the expense of a detailed design permission from the customer is usually required before proceeding to the next phase.

3.2.2.4 Detailed Design and System Development

In the detailed design the subsystems are further described in greater detail. For example, the types of mechanical devices used to fulfill the functions are selected in this stage. The end result is a document with the detailed descriptions of all the elements in the system that shows the specifications, analysis results, study results, detailed drawings, materials, parts, etc. From this document the system can go into the development stage. Prototype subsystems are constructed and tested. These prototype systems can then be integrated to see how they work together as a larger subsystem. This process can continue until a complete system prototype is developed and tested to ensure the design meets specifications and the customers expectations. From the results of the testing the final production design is developed. Concurrent with the prototype testing production facilities and support must be designed and coordinated. This might include the design of new production facilities, selection of materials and equipment, preparations for production control, personnel hiring and training, and data collection and processing

3.2.2.5 System Construction and/or Production

Once the design is frozen system production begins. The system may be mass produced in multiple quantities, customized and produced in limited quantities, or built and installed as a single item.

3.2.2.6 System Operation and Support (Execution)

Once the system is delivered the customer operates it until it becomes obsolete or no longer functions. The support system is utilized to assist in maintenance, upgrades, and finally support in phasing out of the system.

3.2.2.7 System Evaluation

System evaluation is done throughout the entire engineering process. In stages 1 and 2 the system is evaluated through the conceptual and mathematical models used to describe the system and select design alternatives. During stage 3 prototypes are constructed and evaluated to see how well they function together as systems and subsystems. Then all of these prototypes are evaluated together to test the total system. In the operational phase the system is evaluated within the operating environment for its ability to satisfy the original requirements.

3.2.3 Top Causes of Project Failures

Most projects are considered to be a success if they are completed on time, within the established budget, and meet the performance criteria established for the project. Since the concept of meeting the performance criteria is some what abstract and frequently very qualitative, the most common gages for project success quantitative measures of time and cost. Was it completed on time? Did it stay within budget?

A comprehensive study[60) identified the major causes of project failure to fall into five major categories:

1. Poor Planning [40%)
   - 1.1. Unrealistic Project Plan
   - 1.2. Poor Project definition
   - 1.3. Insufficient Front End Planning
   - 1.4. Inability to track Progress
2. Poor Communication [24%)
   - 2.1. Communication difficulties
   - 2.2. Responsibilities unclear
   - 2.3. No commitment to plans
   - 2.4. Cultural differences
3. Inadequate Resources [21%)
   - 3.1. Unqualified Project Personnel
   - 3.2. Insufficient funds or personnel
   - 3.3. Inadequate support from others
4. Changing expectations and scope [12%)
5. Poor Organizational Structure [3%)

Approximately 85 % of the failures were due to the first three categories of Poor Planning, Poor Communications and Inadequate Resources.

3.2.3.1 Poor Planning

Poor planning accounts for 40% of all project failures. The literature cited several cases where projects failed due to poor planning and related ailments, such as underestimating the project scope, inability to track projects, and insufficient front-end planning. Instead of preparing in advance, management reacts to things as they occur. [1][45]

3.2.3.2 Poor Communications

Poor communication is another reason for project failure that is often cited. This is especially true in high-tech industries due to the shortened project life span. With complex projects informal (verbal) and formal (written) communications are essential for the project to be successful.

3.2.3.3 Inadequate Resources

Inadequate resources accounted for 21% of project failures. Resources requirements are not anticipated and scheduled. An attempt is made to remedy the problem only after it has occurred.

3.3 Computer Systems/Information Technology Project Management Cycle

3.2.1 Unique characteristics of IS Project Management

IS projects share many of the same common causes of failures as other types of projects. However, IS project management has many unique qualities compared with conventional project management. The output of IS projects is far less tangible and more difficult to conceptualize than for product or construction type projects. This makes IS projects difficult to estimate cost, schedule, and performance criteria.

There are many rules given in literature for project managers to follow to ensure the success of their projects. In one text, 18 rules for good project management were given. [46] However, the author goes on to add a final rule: "Don't engrave the rules on stone tablets. One of the best ways to get into trouble is by following a single formula for success." This holds true since a basic definition of a project is that it is unique and somewhat unfamiliar.

Even though precise success formulas are difficult to find for projects, each project must go through a logical sequence of phases. The next section discusses these phases and the IS project management process.

3.3.2 Different Life Cycle Representations

Examples of various life cycle phases applied to IS projects are shown in table 3.2. The more general and simplified development phase description is the Price Waterhouse definition. Four phases were listed with this definition: analysis stage, design stage, construction stage, and implementation stage. The Handbook of IS Management, defines the development phases in more detail: [47]

SOURCES	SOFTWARE SYSTEM DEVELOPMENT PHASES						
Price Waterhouse	Analysis Stage	Design Stage	Construction Stage	Implementation Stage			
Intel System Develop Std	Proj Initiation	Tech Archit Def	Bus Process Def	Application Def	Appl Engr	Distr Deploy	
Grady Booch	Conceptualization	Analysis	Design	Evolution	Maintenance		
Meredith & Mantel	Definition	Analysis	Design	Programming	System Test	Acceptance	Operation
IS Mgmt Handbook	Vision and Business Objectives	Business Arch.	IT Arch.	Design and Engineering	Building and Implementation	Benefits Audit	
	1. Understand Business Strategies 2. Develop "As Is" & "to be" process flows 3. Define target Audience & culture/skills/commo 4. Develop Project Plan 5. Establish development shcedule	1. Define Technical Architecture 2. Define Business Requirements Specs 3. Develop Logical Data Model 4. Define system controls and risks 5. Refine Schedule and plans	1. Complete Design Specs 2. Complete development and unit test 3. Conduct data cleanup 4. Conduct integration and stress testing 5. Develop training materials 6. Develop and user test final prototypes 7. Test Design 8. Update Schedule and plans	1. Develop technical docs 2. Provide user Training and materials 3. Implement tested system 4. Monitor operation 5. Support and modify			

Table 3.2 SOURCES COMPUTER/SOFTWARE SYSTEM DEVELOPMENT PHASES

Handbook of IS Management:

PHASE	ACTIVITY
1	Vision and business objectives
2	Business architecture
3	The IT architecture
4	Design and engineering
5	Building and implementation
6	Benefits audit

Phase 1: Vision and Business Objectives. The corporation's high-level business visions and strategic objectives are documented in this first phase. A rough project plan is defined which includes the statement of objectives, scope, and goals. This initial phase should also include a list of the end users and precise, quantifiable performance targets.

Phase 2: Business Architecture. Business strategies are identified and defined. This phase maps out the existing business processes along with the future process requirements. An improvement action plan is developed with key steps to achieve the new business architecture.

Phase 3: The IT Architecture. The technical architecture designed is based on the business requirements. A first step before formulating a new architecture is to baseline the existing architecture. From this baseline, a blueprint is created to guide the technology strategies, and the schedules and plans are refined.
Risk assessment is another important deliverable during this phase.

Phase 4: Design and Engineering. The business and IT requirements are translated into guidelines and specifications. This phase includes requirements definition, software evaluation and selection, conceptual design, and detailed design as its key deliverables.

Phase 5: Building and Implementation. This phase includes the coding, testing, documentation, piloting, training, installation, and maintenance. Final prototypes are developed and tested by the user groups.

Phase 6: Benefits Audit. Performance measurements of ongoing activities occur during this phase. Benefits evaluation, system evaluation, and an identification of lessons learned from the project are documented to share the learning across other projects.

3.3.3 The causes of project failures

"According to a recent report from The Standish Group International Inc., nearly 1/3 of all information systems projects fail and more than half come in over budget." [48] The reason behind this failure rate, is the difficulty in estimating large information system projects. Before starting a large IS project, the cost estimate is most likely within a plus or minus 50 percent accuracy rate. "When the code has been written and tested, we should be able to estimate within plus or minus 10 percent for the implementation." [46]

One recent survey "found that 80 percent of IS projects exceed budget and schedule because of system changes after requirements are frozen." [49]
The recommended preventive methods to avoid these "requirements creep" were:

1. Joint user/developer application design
2. Prototyping
3. Through requirements definition
4. Project management/monitoring tools

Another survey, conducted by KMPG consulting group, analyzed 120 UK organizations which were managing IT development projects. [50] The survey noted poor project management and the introduction of technology without the necessary skills as the major reasons for failure.

Top reasons for failure cited in the KMPG survey include:

1. Failure to fully specify project goals
2. Poor planning and estimating
3. Inadequate project management methods
4. New technology implementation
5. Hardware and software supplier performance

"KMPG researcher Andy Cole believes that most projects were poorly conceived from the start and that technology is advancing faster than the skills of the developers."

Implementation problems causing project failures were also cited and categorized: [51]

- Management support problems
- Technological competence problems
- Process delineation problems
- Project planning problems
- Change-management problems
- Project management problems

"An organization involved in developing and implementing a large-scale IT project typically faces risks that threaten the successful completion of the project." [52] The ability of a project manager to identify and to manage risks determines the success of the project. Risks associated with large-scale IT projects can be categorized as follows: [52]

- Financial risk
- Technical risk
- Project risk
- Functionality risk
- Political risk

The number one functional capability for IS project managers to be successful is their ability to assess risk. A project manager can use a four step method called Project Risk Assessment Method (PRAM): [53]

1. Identify the risk.
2. Assess the impact of the risk on the project.
3. Decide how to mitigate the negative consequences or maximize the positive benefits.
4. Develop a risk profile.

The PRAM method provides a simple way to identify and clearly state project risks to users in order to establish action plans to reduce the risks involved and improve the chances for a successful project.

3.4. Large Scale Computer Systems Projects.

Experiences from other Large Scale public and private projects Information Systems Management projects vary in scope and intensity in today's corporations. In our research we found many examples of Information Systems projects that did or did not meet the project objectives. These projects were long and short term projects that spanned the public and private sectors of industry. The following are two examples of relevant Information Systems Management projects:

3.4.1 Saturn

Saturn is an example of a large scale Information Systems Management project in the public sector of industry. In this project, Saturn met its objectives at the conclusion of the development life cycle. The project was the development of an information system specifically designed for Saturn dealerships. This system has successfully been implemented and is currently in operation.

SIS, Saturn Information Systems, was developed by the Saturn Automobile Cooperation (GM) as a means to enhance Saturn's ability to service consumers. "GM's management set its objectives at being at the leading edge in three areas: manufacturing, marketing, and IS."[12] EDS (Electronic Data Systems), a GM subsidiary, developed an IS system designed to integrate services for management, production, and the dealerships of Saturn. This system includes several subsystems that link the dealerships directly to the production facilities. The result has been an increase in communication between manufacturing and dealers with information relating to parts shortages, redesigns etc.

SIS allows Saturn to "improve service and give the company a competitive edge." An SIS tracking systems, microprocessor embedded in the chassis, allows Saturn to track a specific automobile throughout the life of the car. This gave Saturn the opportunity to easily notify owners during a recall in 1991 for a seat recliner mechanism. Saturn is committed to purchase only from vendors that adopt the information system developed by EDS. "This Strategy saves the company millions of dollars annually" [13]

3.4.2 California DMV

The state of California experienced an issue with Information Systems Management very similar to that of the Oregon Department of Transportation. The California DMV spent "$50 million on a doomed computer project at the Department of Motor Vehicles by violating contracting laws, repeatedly ignoring signs of trouble in the system and bypassing state cost controlled safeguards." [10] The redesign began in 1987, when the DMV began development of a Information System that combined "the state's driver and vehicle registration databases." [10] At project onset the previous Governor Deukmejian and the DMV director A.A. Pierce, current State lottery director were in full support of the project. A change in administration and the outcome of an audit revealed questionable administration ethics, as well as poor project planning which led to project failure.

Initial warning signs of the impending failure began to show up by 1990; however, the signs were ignored and the project moved forward through 1992. There was "ample evidence of serious trouble as early as 1990, when only $14.8 million had been spent on the project."[10] These signs were known to the Office of Information Technology and funding was continued. The solution was an increase in monetary commitment in attempts to steer away from failure. Rules and regulating were ignored in hopes of achieving the system redesign. The administrators were so driven to resign that they "falsified $46K in invoices to pay project consultants." [10] as well as awarded four contracts without competitive bids. These contracts were awarded to corporations such as the Tandem Cooperation, though they did not pass key elements in the DMV objectives. This behavior resulted in "an additional $34.6 million being spent on a project that ultimately failed." [11]

The project was abandoned in 1994 by Frank Zolin, current DMV director, and the Governor Pete Wilson Administration, current governor . When Zolin took over the project, $34 million had already been spent. Initially attempts to salvage the project were made by the administration. These attempts resulted in additional tax payer money begin spent on the project. Eventually an audit was conducted that showed that the data system that was being developed would not meet the needs of the California DMV. (There had been no work plan or model developed for this project.) This led to uncovering of unethical behavior, and poor communication and planning between all level of management. The key areas that were faulted were the Governor and his administration (current and past), the DMV Administration, and the Office of Information Technology.

“there are two choices here for what happened...either there were conflicts of interest or gross incompetence, either of which are the grounds for termination.” [11]

Experiences from other Large Scale public and private projects Information Systems Management projects vary in scope and intensity in today's corporations. In our research we found many definitions of Information Systems projects that did or did not meet the project objectives. These projects were long and short term projects that spanned the public and private sectors. Of the encountered projects the experiences of the California DMV and Saturn are examples of relevant experiences:

4. COMPUTER SYSTEMS PROJECT MANAGEMENT MODEL

4.1 Model development

The intent of this section is to develop a set of guidelines--that if followed would provide a high degree of assurance that a computer systems project will be a success.

The approach is rather straight forward:

a. Survey the literature to determine the main causes of computer system/information system project failures,
b. Identify the actions that can be taken to prevent these failures and
c. Compile a list of these actions for each phase of the life cycle.

Before addressing the steps to be taken to help assure success, it is worthwhile to establish what is meant by success. Generally, a project will be judged as a success if it meets the following criteria (8]

a. Was completed within the established budget
b. Was completed on or before the scheduled completion time
c. Met most or all of the users' expectations

Much of the criteria for success is in reality a setting and managing of customer expectations--expectations as to how firm are the budget and schedule estimates and what and how the functional capabilities will be satisfied by the system. Hamilton points out the complexity of this task by stating "In virtually no other industry (speaking of computer systems projects) is there such a disparity between what is presented during the sales process and what is actually....delivered"[10].

Why this disparity? What are these causes of failures? The literature survey revealed many documents which addressed certain causes of computer system project failures. However, there is no universally accepted causes of these failures. Computer Weekly, identified in a study of 120 organizations that the prevalent causes of failures [28]:

a. Failure to fully specify project goals,

b. Bad planning,

c. Problems introducing new technology and

d. Inadequate project management methods.

Bailetti, Callahan and DiPeityo identified effective coordination as one of the most important factors which differentiate successful from unsuccessful project [1]. Hamilton states that selecting the project team is the single most important step in making projects successful [10]. Umbaugh thought that formation of a management steering team was essential for project success [31].

Vandersluis seems to summarize these causes by concluding in his article that the vast majority of failed project management efforts are the result of poor planning on the part of the project managers [42].

Project managers do not set out to fail. They do not set out to not to communicate, set false expectations or to not establish and execute a comprehensive plan. What are the steps they should follow to help assure success? Our attempt to answer this question is contained in the next section. The numerous and differing causes and suggestions for improving the process were collected from the literature and mapped into each phase of the life cycle. For the life cycle, we selected the model presented by Nicholas [41] (the primary text for the EGMT 645 Class):

a. Conception Phase

b. Definition Phase

c. Acquisition Phase

d. Operation Phase

4.2 Model discussion by phase

4.2.1 Concept Phase

The Concept Phase is characterized by an emphasis on the breadth of the project to include defining the environment and objectives, alternatives, resource requirements and overall feasibility. Expected conflicts include establishing priorities among other competing new and ongoing projects. This resolution often results in an established manpower and budget limitations. Hamilton cautions about setting hard manpower and budget requirements too soon. He states: "It is virtually impossible to define planning and budgeting numbers early in the project life cycle [10].

The compilation of the tasks recommended for the Concept Phase are portrayed in Table 4.1. First on the list is the identification true system users. It is important to recognize and engage this group in the planning and development. Often managers or other intermediaries are mistaken for the true user.

Hoplin notes the importance of early consideration of external considerations such as competition, customers, government regulations, etc. to make sure that appropriate alternatives are developed [12].

The tasks associated with analysis of alternatives and feasibility's are consistent with standard concept phase activities [41][37][43][38].

Fine (8] stresses the importance of keeping expectations under control throughout the project. Fine stresses that the project manager must keep in mind that the perception of failure can be as bad as actual failure. At this time in the life cycle, estimates of cost, schedule and performance are all subject to change--and some "performance requirements" may turn out to be unattainable.

Finally, Williams [33] supports the early establishment of change management procedures. He notes the need to have an established procedure to determine the desirability of proposed changes as well as a means to determine and agreeing to the related changes in cost and schedule. This procedure, will then be used throughout the remaining life cycle.

CONCEPT PHASE • Emphasis on breadth, not depth • Conflicts: Priorities, Manpower and Budget		COMPLETED
1.	Clearly identify the users and their roles	
2.	User's environment understood to include competition, customers and government regulations	
3.	User's objectives understood--expected results--Acceptance criteria established (minimum capabilities for the system to be considered a success)	
4.	Alternative solutions identified with attendant: 4.1. resources 4.2. organization 4.3. technologies 4.4. strategy 4.5. time required (often understated)	
5.	Assess technical feasibility	
6.	Assess economic feasibility	
7.	Assess environmental feasibility	
8.	Determine affected individuals and organizations	
9.	Conduct feasibility study	
10.	Establish that potential solutions are consistent with goals and resources	
11.	Establish a real need exists and funding is available	
12.	Establish that the project has sufficient priority-present and future	
13.	Establish that the project has particular value--i.e. enhancing reputation, raising profits.	
14.	Set Expectations--Important to recognize that changes will occur	
15.	Establish procedure for identifying the desirability of	

changes and agreeing to attendant changes is cost and schedule	

TABLE 4.1 EMPHASIS STEPS ON THE PROJECT ROAD MAP--CONCEPT PHASE

4.2.2 Definition Phase

The Definition Phase has two major objectives: the determining of the final and detailed system requirements and the preparation of a detailed project plan. The emphasis changes to a focus on depth of detail for the solution. Major sources of conflict to be expected during this phase are:

a. Schedule--can the schedule be expedited. Beware of setting unattainable expectations
b. Personality Clashes--between team members representing different functions and coming from different organizations.
c. Turf Disputes--between the project manager and functional managers
d. Lack of support-- from the senior management and from functional managers.

Table 4.2 provides a list of the steps, if followed, will preclude most of the problems identified during the Definition phase. The first portion of the table address refining and improving requirements definition. Poor requirements definition was the most frequently cited reason for failure cited in the article " Managing Information Technology in Turbulent Times" [43].

However, most of the current literature we found concentrated on portions of inadequate planning. Williams [33] states that a detailed plan, based on a proper work breakdown structure, is an absolute must for managing a project. Tennant [30) states that the value of a work plan as being two fold: one, to force the project manager to think about problems and barriers that will develop--permitting one to come up with mitigating strategies, and two, serving as a strong communication device between the participants, customers and upper management of the project.

Even in this stage, prudence is suggested in setting dates and budget requirements. Hamilton [10] found that large scale projects are frequently undertaken with totally unrealistic timetables set against artificial deadlines. Williams [33] cautions that in very complex systems, it is not possible to determine development costs and time schedule accurately without a significant amount of analysis and design being completed. Once again raising Find's (8] caution to keep expectations under control.

As part of the planning process, a common mistake, particularly by inexperienced project managers, is to neglect or thoroughly underestimate the amount of risk associated with a project [33]. Clemons, Thatcher and Row [3] found project to frequently fail because of neglecting the following forms of risk:

a. Financial risk--the potential for cost escalation and to what degree
b. Technical risk--does technology exist and can it be adopted to meet requirements.
c. Project risk--do many of the skill requirements of the project fall outside of the traditional strength of the project team
d. Functionality risk--is the project delivering what the customer wants and needs
e. Political risk--is the organization committed to the project.

Emphasizing risk and uncertainty, Hamilton [10] encourages planning for the contingencies--noting that problems, delays and impacts on cost and schedule are inevitable.

The last item listed on Table 4.2 deals with trying to save a doomed project. The fact that a project is doomed frequently becomes known early in the project [13]. It is important to continually and objectively review the projects prospective for successful completion and avoid a phenomena known as "escalating commitment to a failing course of action". [13].

DEFINITION PHASE-- • Analysis of the solution--focus on depth • Conflicts: Schedule, Personality Clashes, Turf Disputes, Lack of support	COMPLETED
1. Identify Resource Requirements	
2. Identify system performance requirements	
3. Identify major subsystems/components	
4. Identify support systems	
5. Identify system interfaces	
6. Determine project cost requirements	
7. Determine project schedule requirements	
8. Assemble comprehensive plan to include 8.1. Activities 8.2. Schedules 8.3. Costs 8.4. Required resources 8.5. Performance requirements 8.6. Work packages (WBS), don't forget: 8.6.1. Training and training materials 8.6.2. System and user documentation 8.6.3. Integration strategy for new system 8.6.4. Comprehensive testing and peer reviews 8.6.5. Customer support and problem correction procedures 8.7. Risks, uncertainty and Contingency (**Usually underestimated**): 8.7.1. Project will not generate required return 8.7.2. Technologies necessary to implement don't exist 8.7.3. New Technologies may not be easily integrated into process 8.7.4. Project is outside developers traditional strength (missing essential skills) 8.7.5. Changing or misunderstood functional requirements 8.7.6. Organizational resistance to change to great 8.8. Change control 8.9. Work plan reviews 8.9.1. Establish schedules for reviews 8.9.1.1.Progress reviews 8.9.1.2.Peer software reviews 8.9.1.3.Customer/affected worker reviews 8.9.1.4.Status presentations to senior	

management 8.9.2. Establish and monitor danger thresholds	
9. Obtain management "buy in" of the Plan	
10. Assess technical feasibility	
11. Assess economic feasibility	
12. Assess environmental feasibility	
13. Develop functional requirements	
14. Develop systems requirements: 14.1. Compatibility 14.2. Commonality 14.3. Cost Effectiveness 14.4. Reliability 14.5. Maintainability 14.6. Testability	
15. Functional requirements reviewed by user	
16. System requirements reviewed by user	
17. Reassess project prospects for success--avoid escalating commitment to a failing course of action	

TABLE 4.2 EMPHASIS STEPS ON THE PROJECT ROAD MAP--DEFINITION PHASE

4.2.3 Acquisition Phase

The Acquisition Phase of the project focuses on design and construction of the system. The conflicts of the Definition Phase remain. However, in addition, the necessity for continual communication between the developers, the customers/users, upper management and the supporting functional staff elements is critical.

Omitted or slighted tasks to be considered during the Acquisition Phase are listed in Table 4.3.

The task list begins with the updating of the project plan. Although this is an ongoing task, it is called out to remind folks that the plan is not just a document--but rather the project roadmap. Vandersluis [42] states that the most important thing of all is to have a plan to start with and to get the potential users to sign on for the plan before it is implemented. Getting everyone working as a team toward a common objective gives a project it best chance of success.

PM management and control are also critical during this phase. Keil, Mixon, Saarinen and Tuunaninen [13] point out that IT projects are notoriously difficult to control. This is because of the intangible nature of software makes it difficult to determine project status and to obtain accurate estimates regarding time of completion. Control is necessary of the project team as well as the project manager's desire to show progress. Williams [33] cautions the project manager to avoid the temptation to appear to make progress by starting a new phase of the project before the previous one is complete.

The project manager is encouraged to develop a comprehensive implementation strategy Tenants of that strategy should include:

a. Prior to implementation, develop a model and try a pilot to permit user feedback .
b. Avoid doing the biggest application first (8].
c. Select for initial fielding the portion of the project with the highest potential for success--and field that to the most capable user group.
d. Develop integrating strategy--35% of all system implementation costs are conversions or interfaces with legacy systems[10]
e. Consider phased implementation of the system capabilities.
f. Consider phased implementation to the user base.
g. Be cautious of new technology--45 % of a 1995 survey reported that new technology was the cause of projects going out of control [28].

ACQUISITION PHASE • Design and Construction • Conflicts: Manpower, Lack of support, communications		COMPLETED
1.	Update Project Plan	
2.	Design logical elements	
3.	Design physical elements	
4.	Evaluate alternatives through models and mock ups	

5.	Avoid implementation of several new technologies	
6.	PM oversees and controls resources	
7.	Develop training and train user	
8.	Establish technical support	
9.	Develop test plans to: 9.1. Conduct integration tests 9.2. Conduct unit tests 9.3. Conduct user tests	
10.	Determine activities for converting from old to new system Bring functional change into organization in layers	
11.	Determine sequencing and scheduling of implementation activities Avoid trying to bring entire organization on line at same time	
12.	Determine acceptance criteria for the new system	
13.	Determine approach to phase out old system and reassign personnel	
14.	Develop user training plan to include: 14.1. User manuals 14.2. User training 14.3. User servicing 14.4. Training materials 14.5. Training schedules 14.6. Teachers and locations	
15.	Reassess project prospects for success--avoid escalating commitment to a failing course of action	

TABLE 4.3 EMPHASIS STEPS ON THE PROJECT ROAD MAP--ACQUISITION PHASE

4.2.4 Operation Phase

The Operation Phase of the project focuses on support and update of the system. Unlike many projects, computer/information systems frequently take on an extended life with enhancements and revisions. The conflicts of the Acquisition Phase remain. However, in addition, the necessity for continual communication shifts toward more and better communication with the true users. They will identify the system bugs and user enhancements. Tasks that are frequently omitted or slighted tasks during this phase are listed in Table 4.3.

OPERATION PHASE • Support and update • Conflicts: Manpower, budget, communications	COMPLETED
1. Conduct Post installation review	
2. Establish procedures for follow on training	
3. Develop procedure to identify and resolve system "bugs"	
4. Develop procedure to identify, estimate, prioritize and budget for enhancements	

TABLE 4.4 EMPHASIS STEPS ON THE PROJECT ROAD MAP--OPERATION PHASE

Walsh [32] identified key events to assure failure of an information systems project. These events included:

a. Don't manage expectations
b. Don't fully test new technologies before attempting to use
c. Don't provide adequate technical support to end users
d. Don't provide a feasible plan to migrate from the old to the new system.

The preceding tables have attempted to capture these overlooked and slighted tasks and provide focus to help prevent the prevalence of information system project overruns and failures.

5. ANALYSIS OF ODOT PROJECT MANAGEMENT

5.1 Description of the ODOT Project

The Oregon Department of Transportation (ODOT) saw an opportunity to set precedence in the country by developing and managing a more efficient and cost effective Information System. This system would reduce the staff by 230, and dramatically reduce operational costs. The DMV is creating a single log-on for users that transparently moves them through multiple systems and application sign-ons. [55]

"One of the planned systems in the Oregon Department of Motor Vehicles' re-engineering project will include a new document imaging system intended to bring the DMV out of the dark ages of the paper filled office." [54]

The impetus for the new Information System was the end of AT&T Pardyne (previous Operating system contractor) support within the next five years. (This was announced in 1988.) In 1993, the project was estimated to cost $48 Million over 6 years and the projected savings was $7.5 Million per year. The heart of the DMV's reengineering project is a new computer system which includes both hardware and a series of 11 software packages, numbers 0.0 through 10.0. Each package, or release, performs a different function. The first of these, Release 0.0, was completed in 1994 and the second, Release 1.0, was implemented in the spring of 1995. The implementation of Release 1.0 resulted in an increased awareness of the issues with the project's development. Release 1.0 was intended to consolidate customer data into a single record.

This first phase was completed but this was not without "massive delays in service for new licenses, title transfer and other business." [57] This phase was the beginning of a series of issues that effected the DMV's ability to respond to their customers. Rather than gaining the advances in customer service that the DMV had hoped, the DMV experienced a reduction in the level of service. The implementation resulted in the re-evaluation of the Information System Reengineering effort. The implementation resulted in major issues with system reliability, training, staffing, and documentation.

"Between the time the planning started and the Legislature approved it, the heads of the DMV and the Department of Transportation changed. Holt assumed his position in 1991, along with the former transportation chief Don Forbes and DMV director Jane Cease."[55] This Information System project was well underway when Cease arrived she choose to continue the implementation as well the further restructuring of the DMV.

The management of this system was, at the beginning of the 1995-96 legislative session, led by the new DMV (Department of Motor Vehicles) director Jane Cease and the two primary contractors, DMR and IBM. The DMR Group Inc. a Canadian based design company, was the largest of several software developers contracted. DMV's strategy was to award contracts to several contract companies and the remainder of the project would be completed by the DMV (ISB) staff.

Based on DMR's experience with DMV restructuring, DMR was involved early in the project development. This involvement resulted in a high level of interaction between DMR and the DMV in the decision making process. The partnership between DMR and the DMV led to an unclear and ill-defined implementation strategy, roadmap (plan) and schedule for the IS project.

In 1992, a five year technology partnership was formed between IBM and the DMV. As a contracted vendor IBM recommended IBM equipment and provided the necessary support for this new system. OS/2 was the recommended IS architecture. IBM appears to have been the only vendor considered for this partnership.

At the beginning of 1996 the issue of the Information System project slipping implementation schedule and rising costs was brought to the Oregon Legislature. By this time it had become obvious that cost, time and specification goals would not be met and further funding was necessary to complete the project. A task force was assigned to the DMV project to re-evaluate the project's status and give recommendations of future steps.

This task force presented their findings to Governor Kitzhaber and the Oregon Legislature in the form of a report, "Reengineering Reexamined: A Review of Recent Management Practices at the Oregon Department of Transportation and its Driver and Motor Vehicle Services Branch." In this report there were a number of issues that plagued ODOT including:

Cost:

The cost was grossly underestimated. The original budget presented to the Oregon Congress was $48 million to be spent over 6 years. The final cost is now estimated at $123 Million and the project is scheduled to completed in 12 years.

Staffing:

Planned staffing resources were insufficient. Prior to the implementation of Release 1.0 a percentage of the staff was laid off. At the implementation of Release of 1.0 a large portion of this staff was rehired to meet the resource needs of the new system. This resulted in morale issues as well as an increase in cost.

Information System:

There were many system level issues for this project. There were insufficient system training, and documentation available to the staff. There were also system level issues with the product such as little system level testing which resulted in an inferior product. This was a known issue and warnings to this effect were ignored from the DMV's quality auditors.

The involvement of the ISB (Information Systems Branch) of ODOT was not taken into consideration. (The ISB is responsible for maintaining releases after implementation.) This translated in to costs and resources not being accounted for. These costs and resources are associated with installation, and maintenance of the new system.

The findings and recommendations of this task force emphasized three areas: the DMV Reengineering Project, ODOT/DMV Management, and Statewide Issues. In each of these areas a number of issues were addressed. With reference to the DMV's Reengineering project the following seven issues are presented and discussed in the report:

1. The DMV project is too big.
2. The DMV project puts efficiency before customer service.
3. Introducing changes during peak work periods hurts customer service.
4. The cost-benefit analysis is out of date.
5. Key roles and responsibilities remain unclear.
6. ODOT is not involved enough.
7. The current cost estimates contains flaws.

Based on these findings the DMV Information Systems Management team was reorganized with new staff members. The goal of these members was to address these issues as well as to gain a fundamental understanding of the project's future.

5.2 ODOT Independent Data Collection

To better provide an in depth analysis of the project management model against the ODOT-DMV project, additional data was need. The collection of this data took the original form of "surfing" the Oregon State WEB page and contacting the local paper to discuss information sources. Based on this early information contacts were made at the Department of Administrative Services and the Driver and Motor Vehicles Department. These contacts provided access to. Reengineering Reexamined "A Review of Recent Management Practices at Oregon Department of Transportation and its Driver and Motor Vehicle Services Branch dated April 1996, a report of the Governor's investigation task force. Additional information included the names of the task force members, of which several were contacted by phone to discuss the project review process.

A questionnaire based on past project team experience was modified to help provide a better understanding of the project goals and problems. This questionnaire was answered by the current DMV Turn-Around Manager and the Manager of the Information Systems Branch.

An on-site review of the project documentation including the Project Plan, Request for Proposal (RFP) and Quality Assurance documentation was accomplished. While members of the PSU project team were reviewing the DMV project documentation, concurrent interviews were conducted with the current project management team. This included the DMV Turn-Around Manager (Program Manager), ISB Director, a DMR consultant, and Project Engineers, one technical the other financial. All of whom we are grateful to for they were most helpful and open to our questions.

All information gathered during this process has been incorporated into this analysis.

5.3 Contrast to the Computer Systems Project Management Model

5.3.1 Model Comparison

As a preliminary analysis, a contrast between the generic project management model and DMV's project experience are shown below. In this analysis, the DMV project is compared and analyzed for each of the four stages of project development.

5.3.1.1 The Concept Phase.

CONCEPT PHASE • Emphasis on breadth, not depth • Conflicts: Priorities, Manpower and Budget	COMPLETED
1. Clearly identify the users and their roles	The role of users were not well defined
2. User's environment understood to include competition, customers and government regulations	Users ownership of the system was not well defined. The primary government and public policy regulations that are key to DMV business were not (and still are not) understood by DMR
3. User's objectives understood--expected	Initial project goal was clear. As the

	results--Acceptance criteria established (minimum capabilities for the system to be considered a success)	project began, the initial objective was lost amid many operational and project changes that went out of control
4.	Alternative solutions identified with attendant: 4.1. resources 4.2. organization 4.3. technologies 4.4. strategy 4.5. time required (often understated)	No alternative solutions were identified. Neither DMR or DMV identified the key success factors that impacted the project. The planners had no backup plan for resource allocation, technology and work packages.
5.	Assess technical feasibility	Technical feasibility was inadequate and not reviewed in detail by DMV
6.	Assess economic feasibility	Economic feasibility was done on wrong economic payback assumptions. The entire project scale was underestimated.
7.	Assess environmental feasibility	Long term environmental study was not done
8.	Determine affected individuals and organizations	No pilot or user focus study was done to measure the impact and reactions of individuals to the new system. Initial user involvement was inadequate.
9.	Conduct feasibility study	Feasibility study was done by DMR and it lacked detailed analysis. DMV did not seek a third party review of its RFP and its feasibility.
10.	Establish that potential solutions are consistent with goals and resources	No linkage analysis was done to show a direct link between work package benefits and the project goals. The current project manager is doing the linkage analysis.
11.	Establish a real need exists and funding is available	Funding was allocated in two Engagements to be funded by legislature in two bi-annum budget reviews. The project schedule was stretched too long over two budget cycles which doubled the risk.
12.	Establish that the project has sufficient priority-present and future	The project was quite necessary. One may argue that the project should have begun sooner, in light of the Pardyne system obsolescence.
13.	Establish that the project has particular	The project was supposed to

	value--i.e. enhancing reputation, raising profits.	improve customer satisfaction, streamline operations, automate work processes and reduce costs
14.	Set Expectations--Important to recognize that changes will occur	No performance goals were established in the initial project plan. No description of the changes or the work environment after the system were given. The end was not clearly defined.
15.	Establish procedure for identifying the desirability of changes and agreeing to attendant changes is cost and schedule	Changes were not acceptable by users across the board. Many of the changes adversely impacted employee productivity and involvement. The work process improvements which provide real cost savings were not correctly designed in this project.

5.3.1.2 The Definition Phase.

	DEFINITION PHASE-- • Analysis of the solution--focus on depth • Conflicts: Schedule, Personality Clashes, Turf Disputes, Lack of support	COMPLETED
1.	Identify Resource Requirements	Resource requirements were underestimated because project plan did not divide the project into work packages in sufficient detail.
2.	Identify system performance requirements	System performance requirements and future requirements (such as number of transactions per second, database capacity, response time) were not analyzed in detail
3.	Identify major subsystems/components	Major subsystems were identified at a very high level prior to implementation. Additional design time should have been allotted to subsystem analysis and trade-offs
4.	Identify support systems	Support system definition were inadequate. Replacement plan for

	existing computer system was flawed. No push-pull strategy was in place for terminating the old computer system.
5. Identify system interfaces	System interfaces including data and network systems were ignored. The system included mainframes, Unix systems and OS/2, thus creating two data conversions (EBCDC/ASCII) and three network protocols, etc. which created interface challenges
6. Determine project cost requirements	Project costs were underestimated because the work packages were not studied in greater detail. No third party review of the project costs estimate was done.
7. Determine project schedule requirements	Project schedules were unrealistic, incomplete and unattainable. The project consistently slipped the schedule and cost milestones.
8. Assemble comprehensive plan to include: 8.1. Activities 8.2. Schedules 8.3. Costs 8.4. Required resources 8.5. Performance requirements 8.6. Work packages (WBS), don't forget: 8.6.1. Training and training materials 8.6.2. System and user documentation 8.6.3. Integration strategy for new system 8.6.4. Comprehensive testing and peer reviews 8.6.5. Customer support and problem correction procedures 8.7. Risks, uncertainty and Contingency (**<u>Usually underestimated</u>**): 8.7.1. Project will not generate required return 8.7.2. Technologies necessary to implement don't exist	A comprehensive plan that would outline activities, schedules and costs did not exist. Work packages were not identified in sufficient detail. The former project managers did not understand the work package inter-dependencies. The deliverable work package review and acceptance process was not sufficient. DMV did not have an integration strategy in place which would indicate its key success factors and resource requirements. There were no contingency plans. There were no user review process prior to installing the new system. The training was inadequate and too early in the delivery cycle. The project could not deliver adequate return on investment as a 9-yr or 12-yr project. The project manager did not

8.7.3. New Technologies may not be easily integrated into process 8.7.4. Project is outside developers traditional strength (missing essential skills) 8.7.5. Changing or misunderstood functional requirements 8.7.6. Organizational resistance to change to great 8.8. Change control 8.9. Work plan reviews 8.9.1. Establish schedules for reviews 8.9.1.1.Progress reviews 8.9.1.2.Peer software reviews 8.9.1.3.Customer/affected worker reviews 8.9.1.4.Status presentations to senior management 8.9.2. Establish and monitor danger thresholds	challenge the assumptions on the basis of risks, software development and resource allocation. The project manager did not recognize the risks inherent with a large reengineering project and did not conduct due diligence on DMR's plans, cost-benefit analysis, etc. Change control and management did not exist. A central work repository was not created and a review committee to evaluate and accept work packages was not formed. Quality was assumed to be handled by ECG. As a result no quality features were built into the system. ECG's quality assurance reports were ignored by the ODOT services division.
9. Obtain management "buy in" of the Plan	Management was supportive of the plan but did not fully understand its impact.
10. Assess technical feasibility	Some technical feasibility was conducted by DMR prior to 1993. However, a unified and comprehensive study was not done.
11. Assess economic feasibility	Economic feasibility was high level based on several assumptions that were wrong. The economic payback analysis conducted by DMR presented the best case scenario, not the worst case.
12. Assess environmental feasibility	Inadequate study
13. Develop functional requirements	Functional requirements were not well defined since DMV experienced an organization change and DMR did not continue to seek DMV's functional, middle management's participation in

	the project.
14. Develop systems requirements: 14.1. Compatibility 14.2. Commonality 14.3. Cost Effectiveness 14.4. Reliability 14.5. Maintainability 14.6. Testability	System requirements were done by IBM and mostly unquestioned by DMV. Since ISB's involvement diminished, many system issues are still unresolved. The systems planning and implementation were released to IBM on a sole-source arrangement.
15. Functional requirements reviewed by user	A user review committee was not formed to participate in this phase
16. System requirements reviewed by user	No user review of system requirements were planned.
17. Reassess project prospects for success--avoid escalating commitment to a failing course of action	No project manager is aware of cost of failure and is in process of re-plan. The project will not be canceled until July 1997, but its scope may be narrowed substantially.

5.3.1.3 The Acquisition Phase.

ACQUISITION PHASE • Design and Construction • Conflicts: Manpower, Lack of support, communications	COMPLETED
1. Design logical elements	The data inter-dependencies were not completely clear at the start of the project. Later some of the work packages had to be moved out or displaced on the schedule to address the issue.
2. Design physical elements	Physical data design was supposed to be done by DMV ISB and DMR. The DMV business still uses two data bases: the IBM and the Pardyne system.
3. Evaluate alternatives through models and mock ups	No early pilot program, mockup or simulation model were developed for this project.

4.	Avoid implementation of several new technologies	Multiple new technologies were introduced into the project by IBM and DMV.
5.	PM oversees and controls resources	The former project manager had never managed project of this magnitude.
6.	Develop training and train user	User training was inadequate
7.	Establish technical support	Technical support and skill level required for this project were not assessed and obtained by DMV
8.	Develop test plans to: 8.1. Conduct integration tests 8.2. Conduct unit tests 8.3. Conduct user tests	No integration plan existed and DMR did not assist DMV with planning an integration process.
9.	Determine activities for converting from old to new system Bring functional change into organization in layers	No detailed conversion plan existed. The roles and responsibilities for conversion were not clearly identified.
10.	Determine sequencing and scheduling of implementation activities Avoid trying to bring entire organization on line at same time	DMR did not plan on phased roll-out or of the new system. When the new system was put into service, it impacted the entire DMV's business
11.	Determine acceptance criteria for the new system	No acceptance, test and quality inspection was planned for deliverables
12.	Determine approach to phase out old system and reassign personnel	The phase out plan was insufficient. The entire database should have been moved to the new system prior to putting the new IBM system into service.
13.	Develop user training plan to include: 13.1. User manuals 13.2. User training 13.3. User servicing 13.4. Training materials 13.5. Training schedules 13.6. Teachers and locations	User training was insufficient. A super-user approach might have been more helpful. Super users who were involved with the project could be trained to provide training to other users. Documentation was incomplete, systems support and hot-line were insufficient.
14.	Reassess project prospects for success--avoid escalating commitment to a failing course of action	Project's overall success from economic and user satisfaction appear unlikely even with the new project management on board. Unless the scope of project is reduced substantially and roles are clearly defined, the project runs a high risk of failure.

5.3.1.4 The Operation Phase.

OPERATION PHASE • Support and update • Conflicts: Manpower, budget, communications	COMPLETED
1. Conduct Post installation review	Post installation review that was conducted by DMV, DMR and ISB has not been published yet.
2. Establish procedures for follow on training	Future training is necessary. The new project managers are building user confidence in the project.
3. Develop procedure to identify and resolve system "bugs"	No central and automated system for bug recording, tracking and fixes exist. Change management process has been insufficient so far.
4. Develop procedure to identify, estimate, prioritize and budget for enhancements	The previous project managers did not have a systemic approach to budget and work package change. The new management is conducting a re-plan to establish better work and budget control mechanisms.

5.3.2 Project Pitfalls

The following is a working copy of the issues, assumptions and questions that we have gathered regarding the DMV project. The following material is an attempt to discover the root causes of DMV reengineering project:

Organizational

1. DMV and ODOT have an outdated management and organizational structure. Much of the communication problems, both inter-organization and intra-organization are symptoms of bad organizational structure.

DMV is viewed as an external organization by ODOT. It is connected to ODOT by its manager who resides in ODOT and rarely visits any DMV offices. DMV operations suffer from this single umbilical cord to ODOT because of communication bottlenecks that it creates.

2. In the process of reducing management layers down to 5 levels, DMV and ODOT demoted DMV's line-level managers. The biggest savings in reducing management layers are at the upper-echelon levels not at the operational level. After the reorganization, DMV was faced by operational deficiencies which canceled any financial savings. DMV's opportunity to down-size still resides at the top.

Project Management

1. The project had inadequate planning and project management structure. At least until very recently, no one was accountable or responsible for the project. None of the three project managers had any experience managing large, multi-year projects.

2. The project plan was unrealistic from the scope and duration perspective. The initial project plan called for a 9 year project, while information system technologies become obsolete every 18-24 months.

3. The project planners completely missed on the mission and goal of the organization, being "good, and timely service" to its customers. The objectives of the project are not aligned with DMV's mission.

4. The project planners (DMR, etc.) arranged the implementation of 11 software packages such that the revenue generating software would be completed first. The face-value benefit of this plan helped justify costs as it accelerated the break-even point. In reality, it cost DMV more to implement the process as planned because of data dependencies of the early packages on the old information system.

5. The roles and responsibility of implementors were not clearly identified. It is hard to identify the information systems architect, database designer, tester, etc. No analysis of implementor's skill level vs. skills required were done.

Information Systems

1. There was a clear lack of an information systems strategy and architecture, let alone a long term vision of what DMV's information processing requirements will be in 9 years.

2. Early data flow analysis and review of the existing data base were not done or were insufficient. DMR seems to have focused on reengineering work process but missed the opportunity to reengineer DMV's information processing.

3. It is not clear how effective the tools and development programs have been. Both hardware and software tools can affect the systems developers' productivity by as much as 10X. use of better tools for the DMV project could have accelerated development and reduced costs significantly.

4. The consulting firm of DMR planned 11 software packages that are highly inter-related. The breakdown structure and design of packages appear faulty because of interdependency of data.

5.3.3 Contract Management

A critical aspect of project management for large projects is contract management. It is inevitable that large projects involve a number of contractors and subcontractors. DMV is conducting a re-plan to address the issues in this area. The new DMV project management has stopped the project to replan and then start again when the process and contractors can be controlled.

For example, contractors were supposed to provide knowledge transfer to DMV and ISB, but it did not happen. Work packages and expectations were not clearly defined up front. Contractor payments for their work and expenses were not centralized before. These payments were paid from different locations and accounting books to multiple contractors. Obviously, the lack of centralized project accounting led to loss of cost control. Payments were not always tied to a complete review process or acceptance of work delivered by a contractor.

Previously, the project accounting procedures were insufficient. They payments were made to contractors without requiring a receipt. Since DMR is an international company, some of the billings involved foreign currency. This caused additional currency exchange issues for the State. The new management team is requiring all billings in the US currency. The State is also requiring that all expenses be subject to the State of Oregon's expense reporting procedures (travel expenses, per diems, cost of moving, etc.)

5.3.4 Quality Management

The initial project planners did not take the growth of customer base into account. They did not allow for population growth in Oregon over the life of this project. Some of the cost overruns over the next 5-7 years are due to increase in staff to provide adequate service to Oregon residents. In the initial budget forecast there are no-cost items such as work load increase due to rise in population.

DMV did not conduct a thorough cost benefit analysis prior to starting this project with DMR. The current project manager is conducting a detailed cost benefit analysis that matches benefits to work packages. Those work pages that do not match up with a benefit are not on the immediate project schedule.

The new DMV project management believes that ECG (the quality assurance firm) could have played a more pivotal role in quality assurance beyond regular reporting. ECG for example, did not identify what the sources of quality problems were. In their reports, they did not specify why the project is slipping and how the information system infrastructure and schedule can be improved. Although both DMV and administrative services paid for ECG's services, the ECG reports went only to DMV and not to Administrative Services.

5.3.5 Successful actions

The new project managers are quite capable and experienced in managing large projects. Their strategy to turn around this project is to understand and assess the current situation of this massive project first. Next, they will match project work packages with benefits and select those activities that are directly providing the benefits. Using Rapid Application Development (RAD) methodology the new management can provide quick, early prototypes for users. Once they get the user input then the can proceed with full development of that program.

The impact of high risk releases on this project is understood by the new management team. They perceive low risk as a package that is readily available off the shelf. Medium risk is when software is new but some is re-usable. High risk means developing a totally new software package.

In large projects, use of contractors is inevitable. The new management team is using these fundamental principles to guide the project management:

A) A project manager can use either a turnkey solution and expect a complete system from a prime contractor or act as the integrator and hire multiple contractors. DMV chose the latter while it did not have the know-how and the structure to be a system integrator for such a big project.

B) The project manager must conduct risk assessment of the project and of each contractor before signing a contract with a contractor.

C) The project manager must define the deliverables and process of development. In the case of DMV neither one were well defined.

D) Previously, there was no review and acceptance process of deliverables. A project manager must have a review and acceptance procedure in place for contractors' work.

E) The current engagement plan with contractors is in two engagements:

Engagement I: includes work releases 0, 1, 3	Budget: $13M
Engagement II: includes work releases 2, , 5	Budget: $14M

A replan is required to determine what are the key benefits and key deliverables. According to the new DMV project management team, methodologies are absolutely necessary, but one does not guarantee success. Any methodology could work whether it is Anderson's Foundation, Oracle's AIM or DMR's P+.

The new project manager will most likely continue working with DMR's P+ then choose and customize it in some sections to make it fit DMV's needs. P+ has a RAD component that will be used in the future phases of the project.

Based on our survey, the role of a turn-around project manager in the success of the DMV project can be summarized as follows:

A) Project management is a very specific field. A programmer or designer can not be promoted to the position of a project manager and expect to be successful.

B) DMV's project suffered from having 3 project managers. The wisdom was that if three organizations (DMV, ISB and DMR) are involved then having 3 project managers is natural and more is better. That was a grave mistake.

The I/S architecture for the DMV project was inadequate. According to the project management team, the issues with the I/S architecture are:

A) The I/S system architecture is based on OS/2. Long term IBM is moving to NT. DMV will have to move to NT. The right time is now, but DMV does not have the money to undergo the conversion effort now. It will have to happen in the future.

B) The management team has considered using future technologies such as public kiosks, the internet, etc. They hope to implement the digital photo imaging before July 1997.

C) The long wait lines are due to having two databases and two systems running concurrently. The old legacy system has the long, detailed customer information (driving record, codes, etc), while the new relational database DB/2 has the customer 's basic information (name, address, etc).

D) A major problem with implementation of this project was premature release of new software. Being under pressure, DMV released the system too early to show results for $50M already spent on this project.

The issues behind the high transition / migration cost can be explained by the following reasons:

A) There was no project plan in place before. The new management team is working on a new project plan. They were amidst of a re-plan stage when we conducted this research.

B) Previously the project managers used a scheduling system that was inadequate. The project schedule did not exist in one single schedule. Now they are using RTMS project management tool for tracking projects and resource leveling and resource planning. They are using P+ for replaning process.

C) A major concern for the continuity of this project is the next bi-annum funding period which is coming up on July 1, 1997. They may or may not get funding for Engagement II.

D) DMV needs to have a backup plan just in case the next round of funding is not approved by the legislators. So far there is no backup plan developed yet.

E) Previously there was plenty of consensus management which delayed decisions and delivered the wrong decisions. They do not want any more consensus management. It is no secret that the "Technology I/S implementors were not in-synch with the reegineering implementors". [55]

The key improvements and lessons that DMV has learned are:

A) Communication has been a problem and a major root of cost. Working together as a team is a key to success of this project.

B) The biggest hurdle and success factor is for people to work together on this project. That includes all organizations and contractors.

C) All contractors must report to one technical project manager. They did not report to one manager before. That was a major project control problem in the past.

D) A systems and business manager (reengineering focal manager) is needed for these types of projects. DMV has identified such a manager for this project.

E) After a project failure, it is necessary to build user and staff confidence in the project. DMV management team is trying to build the confidence of users and all people in this project.

F) Another issue with implementation was lack of clear roles and responsibilities for contractors and ODOT staff. The new project management team is addressing this issue in its re-plan.

G) You need a clear set of business requirements before you can proceed with reengineering. Having clear business objectives will minimize mis-alignment between reengineering and I/S implementation.

How should contractors be managed to ensure a successful project? Is there a formula of success for contract management? According to our survey of the DMV reengineering project, the answer is yes:

A) In the past contract management was not centralized on this project which caused cost overruns. The expense reporting guidelines were not negotiated and explained to DMR.

B) Role and responsibilities of IBM, DMR and DMV (ISB) were not clearly defined and understood from the beginning. This is going to change as the new management team redefines the roles and responsibilities in its re-plan.

C) The contract stated that DMV would pay only up to 75% of contractor's work payment when work was delivered to DMV, and up to 95% when the work was accepted by DMV. However, in practice, the rules of acceptance were not defined and contractors were paid before their work was totally acceptable.

D) There was no contract amendment management. Often funds were reallocated or moved from one engagement to another without modifying the work scope of that engagement.

E) Cost accounting and contract management are key to project cost control. In the past if a cost was less than budget, it was paid without much scrutiny. This adds to unnecessary overhead in a project.

5.4 Prescription for successful ODOT Project Management

The initial project goal was to improve service to citizens of Oregon. The program was intended to transform DMV in four major areas: Information Systems, Work systems, Organization and People. However, DMR and DMV gradually deviated from the initial objective and ultimately lost the purpose of their project.

DMR had worked with DMV for three years prior to release of the first RFP for this project. By that time a great deal of influence and mind share of DMV management had been won by DMR.

DMR's initial contract was for $12.68M for the first engagement. This amount has increased by at least 20% while the Engagement is less than successful.

DMR described its proposal to DMV as a low-risk alternative. It is apparent that even DMR underestimated the complexity and scope of this project from the very beginning. DMR had only secured $1M of insurance which is inadequate for a $14M project.

According to DMV's RFP requirements, DMR was obligated to report any problems or issues encountered during the project. DMR's Engagement manager, Claud Germain should have reported potential problems during the course of this project.

The DMR Engagement manager participated in DMV project steering committee meetings. However, he did not fulfill his role to warn or point out potential problems with the project.

The productivity tool and code generation package used for this project is ADE (Advanced Development Environment). ADE is a product from Intersolv.

Other sub-contractors that were engaged by DMR were Clarmont, Transys, Prodata, Computer People and Intersolv. The problem with DMR's methodology is that it is proprietary and the result of your work becomes usable fairly late in the project life cycle. The users do not get to see an early prototype to evaluate.

The new management team has the right approach with Rapid Application Development (RAD) concept. They can show some quick, interim result as pilot software to users and correct mistakes before it is too late in the development cycle. This problem was costly with DMV's old approach as DMR's need for more funding became apparent fairly late in the project (December, 95].

ISB was expected to be involved in the development and reengineering process. ISB was expected to develop data models, process models, application and test programs. DMR was expected to train ISB/DMV project staff in methods, tools and Advanced Development Environment (ADE). This training was insufficient and did not prepare the DMV project staff for using the tools. DMR did take any corrective action on this inadequacy of skill problem.

ADE is an old technology which has low productivity rate. It really is a CASE tool from the 70's modified for the 90's, which is a wrong approach.

The current project manager is faced with sub-optimal decisions. There is no optimum decision that would maximize utility for this project. There are only cost minimizing alternatives left at this point.

The IS architecture is based on OS/2 which is practically an IBM proprietary software. Even IBM is moving towards NT. DMV is not alone in facing this migration dilemma as many other loyal IBM customers have to make the costly conversion effort.

Financial accounting and management needs to beef up. Keeping financial trails and tracking reallocation of funds, hourly rates, expense reports, etc. were not satisfactory before. The new management team is making those changes.

In conclusion, the root causes of failure were:

1. lack of integration knowledge and skills at DMV
2. DMR's inadequate skill at managing a large, multi-year projects.
3. Having three unskilled project managers instead of a single, skilled project manager
4. Lack of clear and well defined implementation strategy, roadmap (plan) and schedule
5. No fiscal accounting policies and guidelines were in place

5.4 ODOT PROJECT MANAGEMENT

As discussed in section 3.1.3 (Top Causes of Project Failure) many of the causes for project failures did occurred during the ODOT DMV project. In fact, almost every thing that should not but done was in fact mis managed. Some of these major items included the following:

5.4.1 Poor Planing

5.4.1.1 Lack of project focus

The DMV project did not have any type of detailed project plan developed for the information system reengineering project. What project plan was developed was a rough outline on how the project was to proceed. The prime contractor simply rewrote the RFP and called it a project plan, void of any real project definition and goals What the acceptable deliverables are not well define even as to this date.

5.4.1.2 Poor Organizational Structure.

The project organization structure, planning and controls were incompatible with the design of the project. This allowed the prime contractor (DMR) to take over and control the project, by passing the normal project controls and reporting. More emphasis was placed on keeping all parties busy than the results. The acceptance criteria for package has yet to be define let alone what the deliverables are.

5.4.1.3 Inappropriate Tools.

Appropriate project management tools were not available or use properly. This included and project information system which did not allow for accurate tracking of the project goals and tasks. This lead to the inability of the management team to track the progress of the project. It should be noted that the current project management has replaced the project information system with a more robust tracking package.

5.4.2 Inadequate Resources

5.4.2.1 Poor choice of project manager(s)

The DMV did not have any personnel who had large project management skills or experience. this lead to the organization to appoint three project manager, each with their own area of control and responsibility. If this approach is not bad enough not one of these project managers were empowered to make the hard decisions. It was management by committee. The responsibility and accountability for the project were unclear and poorly defined.

5.4.2.2 Lack of management Support.

Early on in the project members of the department of Administrative Services stopped participating in the project. The DVM management told project personnel that they were not to bring problem to them and that project was doing fine. This was in light of the fact that the Quality Assurance vendor continually reported the project was at High Risk to fail.
Both technical and management concerns went unanswered until recently with the change in project personnel.

5.4.2.3 Failure to involve the User

The user and customers did not participate in the initial planing, definition design or implementation process. this caused a lack of agreement in the project requirements and created conflict within the project. As the project progressed to much user input were used. This causes a lot of re-work in the software packages.

5.4.2.4 Information Systems personnel not involved.

The Information Systems Branch (ISB) did not participate in the design process but they were expected to provide long term maintenance and support once the system was turned over to DMV

6.0 FUTURE STUDIES

6.1 Applicability of the Model to other types of Projects

In our research we found a number of other areas in Information Systems Management that could be researched further. These topics span Information Systems Management, from further Governmental research to Artificial Intelligence research. The following is a list of potential areas that we thought would aid in the further development of our model and advancement of research in this area:

6.2 Role of Information Systems Technology in the Government.

What is the role of information systems in the government? Is it possible for government entities to be on the leading edge of Information Systems? There may be benefits and drawbacks to implementing such a system in a government entity.

6.3 DMV Projects around the nation.

Are the project management issues discussed specific to ODOT and the California Department of Transportation? Or is project management difficult in government entities? Is specifically IS management that is difficult? This type of research would lend itself to an understanding of the major differences between large scale projects and small scale projects as well as public vs. private industry projects.

6.4 Turnaround Models.

How is a *turnaround* project conducted? What is the lifecycle for a turnaround project? It would be interesting to gain a fundamental understanding of the variances of a turnaround project as a opposed to a traditional project that is initiation from the conception stage. Understanding this type of project would require a "post-mortem" on the previous project (planning, implementation, and financial) and then how to balance these decisions with the deliverables.

6.5 ODOT DMV.

A more in-depth study of the ODOT situation after the "turnaround model" has been implemented. Which areas were really in need of "turnaround"? This study could be conducted after the ODOT team has re-evaluated the current situation, in the Fall of 1996. There is also to conduct a research project to understand the effects of changing Information Management styles.

6.6 Artificial Intelligence approach to project management.

What are the limitations of such a system? What is the most effective means to develop such a system? How could such a system have aided the ODOT situation?

Bibliography

[1.] A.J. Bailetti, J.R. Callahan, and Pat DiPeito, "A Coordination Structure Approach to the Management of Projects", *IEEE Transactions on Engineering Management*, vol. 41, no. 4, pp. 394-402

[2.] A. Chaudhury, K. Nam, and H. R. Rao, "Management of Information Systems Outsourcing: A Bidding Perspective", *Journal of Management Information Systems*, vol. 12, no. 2, pp. 131-159, Fall 1995

[3.] E. Clemons, M. E. Thatcher, and M.C. Row, "Identifying Sources of Reengineering Failures: A Study of the Behavioral Factors Contributing to Reengineering Factors," *Journal of Management Information Systems*, vol. 12, no. 2, pp. 9-36, Fall 1995

[4.] J. Q. M. Crindell, "Using information technology to renew government services," *CMA Magazine*, vol. 69, no. 5, p45, June 1995

[5.] J.J. Donovan, *Business Re-engineering with Information Technology*, New Jersey: PTR Prentice Hall, 1994

[6.] V. Ellis, "Audit Says DMV Ignored Warning," *Los Angles Times*, Thursday, August 18, 1994, pp. A3-A24

[7.] M. E. Fayad and W. T. Tsai, "Some Lessons Learned in Transitioning to 00 Software Development," *Communications of the ACM*, vol. 38, no. 10, p. 52, October 1995

[8.] D. Fine, "Keep expectations under control: perceptions of failure can be as bad as actual flops," *InfoWorld*, vol. 16, no. 51, p 51

[9.] P. Gagne, "Improving Service through Technology," *Canadian Insurance*, pp. 18-19, January 1994

[10.] N. Hamilton, "Reducing Project Risk," *Enterprise Systems Journal*, vol. 10, no. 3, pp. 28-33

[11.] M. Hammer and J. Champy, *Reengineering the Corporation*, HarperCollins Publications, Inc., 1993

[12.] H.P. Hoplin, "Integrating Advancement Information Systems and Technology in Future Organizations," *Industrial Management and Data Systems*, vol. 94, no. 8, pp. 17-20

[13.] M. Keil, R. Mixon, T. Saarinen, and V. Tuunaninen, "Understanding Runaway Information Technology Projects: Results from an International Research Program Based on Escalation Theory," *Journal of Management Information Systems*, vol. 11, no. 3, pp. 65-85, Winter 1994-95

[14.] Y.G. Kim and G.C. Everest, "Building an IS architecture: Collective wisdom from the field," *Information Management*, vol. 26, pp. 1-11, 1994

[15.] H. G. Levine and D. Rossmoore, "Politics and the Function of Power in a Case Study of IT Implementation", *Journal of Management Information Systems*, vol. 11, no. 3, pp. 115-133, Winter 1994-95

[16.] E. Merhoff and R. Bhela, "Overwhelmed by Change? Manage It!," *Datamation*, pp. 49-54, September 15, 1995

[17.] H. A. Moster, "Project Planning: From Inspiration to Installation," *Security Management*, pp. 98-101, November 1994

[18.] P. Musich, "Oregon DMV shifts gears to implement client/server," *PC Week*, vol. 11, no. 34, pp. 57-59

[19.] T. McHugh et al., "Reengineering Reexamined: A Review of Recent Management Practices at the Oregon Department of Transportation and its Driver and Motor Vehicle Services Branch," *Oregon Department of Transportation*, April 1996

[20.] G. Oliver, "Cease resigns as DMV director," *The Oregonia*n, pp. A1-A11, March 30, 1996

[21.] G. Oliver and R. Eure, "DMV knew trouble lurked in new computer," *The Oregonian*, p. A1, February 4, 1996

[22.] G. Oliver and R. Eure, "DMV's Pledge was indeed to good to be true," *The Oregonian*, p. D1, January 28, 1996

[23.] G. Oliver and R. Eure, "Ex-Legislator Cease's savy helps her drive through DMV disaster," *The Oregonian*, p. D5, January 5, 1996

[24.] G. Oliver and R. Eure, "Kitzhaber seeks review of DMV, Parent Agency," *The Oregonian*, p. A1, February 7, 1996

[25.] E. Oz, "Information Systems Mis-Development: The Case of Star*Doc," *Journal of Systems Management*, pp. 30-34, September 1994

[26.] E. Oz, "Saturn Automobile Corporation: Integrating Information Technology Into Corporate Strategy," *Journal of Systems Management*, pp. 6-9, March 1994

[27.] B. Pittman, "Retooling: New Skills and Structures for Changing Workplace Technology," *The Journal of Systems Managment*, p. 40, September 1994

[28.] Reed Business Publishing Group, "IT projects still fail to deliver, says researcher," *Computer Weekly*, p52, March 2, 1995

[29.] T. Saarinen, A. P. J. Vepsalainen, "Procurement Strategies for Information Systems", *Journal of Management Information Systems*, vol. 11, no. 2, pp. 187-208, Fall 1994

[30.] D.V. Tennant, "Avoiding Failure in Project Managment," Unknown source.

[31.] R. E. Umbaugh, *Handbook of IS Managment*, Auerbach Publications, 1995

[32.] M. Walsh, "Most plans get failing grade," *Computing Canada*, vol. 21, no. 7, p. 37, March 29, 1995

[33.] B. R. Williams, "Why Do Software Projects Fail?", *The GEC Journal of Research*, vol. 12, no. 1, pp. 13-16, 1995

[34] "Implementation of BPR," *Journal of Management Information Systems*, vol. 12, no. 1, pp. 109-144, Summer 1995

[35] "The Rules of Project Management", *Managing Information Technology*, pp. 115-123????

[36] R. Narayan, "Implementing the Information Data Base," *Handbook of Information Systems Managment*, pp. S199-S211

[37] Meredith, Jack R. and Samuel J. Mantel, Jr. Project Management, John Wiley & Sons, Inc. 1995, pp. 196-198.

[38] Salvendy, Gavriel, Handbook of Industrial Engineering, John Wiley & Sons, Inc. 1992, pp. 1207-1219.

[39] Booch, Grady, Object Solutions, Managing the Object-Oriented Project, Addison-Wesley Publishing Co., Inc. Menlo Park, Calif., 1996, pp. 74-153

[40] Paulk, Mark C. et. al. , The Capability Maturity Model: Guidelines for Improving the Software Process, Addison-Wesley Publishing Co.,Inc. Menlo Park, Calif., 1995

[41] Nicholas, John M., Managing Business & Engineering Projects, Prentice Hall, Upper Saddle River, NJ., 1990.

[42] Vandersluis, Chris, "Project Managers Lacking Ability to Plan", Computing Canada, May 24, 1995.

[43] Louis Fried, Managing Information Technology in Turbulent Times, John Wiley & Sons, Inc., 1995.

[44] Jenkins, "The Systems Approach," in *Systems Behavior*, 2nd ed., John Beishan and Geoff Peter, eds. (London: Harper & Row for the Open University, 1976], 88.

[45] C. Cash, Elements of Successful Project Management", *Journal of Systems Management*, vol. 43, no. 9, pp. 10-13, 1992

[46] Louis Fried, Managing Information Technology in Turbulent Times, John Wiley & Sons, Inc., 1995.

[47] Richard J. Murray and Dorothy E. Trefts, "IS Technology and Business Transformation," Handbook of IS Management, pp. S3-S11, 1994.

[48] C. Inwood, "Few IS Projects come in on time, on budget," Computerworld, vol. 28, no. 50, p. 20, December 12, 1994.

[49] Anthes, Gary H. "No More Creeps!" Computerworld, pp. 107-110, May 2, 1994.

[50] Author unknown, "IT projects still fail to deliver, says research", Computer Weekly, p. 52, March 2, 1995.

[51] Grover, et al, Implementation of BPR, Journal of Management Information Systems, vol. 12, no. 1, pp. 109-144, summer 1995.

[52] E.K. Clemons, "Managing the risk of large scale systems projects," Sloan Management Review, Spring 1995.

[53] Robet Wyatt, "How to Assess Risk", Systems Management, pp. 80-83, vol. 23, no. 10, October, 1995.

[54] "Oregon DMV shift gears to implement client/server." PC Week, August 1994

[55] "Oregon DMV shift gears to implement client/server." PC Week, August 1994

[56] "DMV's pledge was indeed too good to be true", January 28, 1996

[57] "Cease resigns as DMV director", The Oregonian, March 30, 1996

[58] "Kithaber seeks review of DMV, parent agency", Feb. 7, 1996

[59] Keil, Mixon, Saarinen, and Tuunainen, "Understanding Runaway Information Technology Projects: Results from an International Research Program on
[60] Arora, Monica, et.al, "Causes of Project Failure", EGMT 620 project, PSU Engineering Management Program, Dec 1995.

[61] Escalation Theory.", Journal of Management Information Systems, Volume 11, No. 3, page 66, Winter 1994-95