Assessment and Improvement of Construction Closeout at Michigan State University

MSU Center for Construction Project Performance Assessment and Improvement

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Executive Summary

This report outlines a recent research project undertaken by School of Planning Design and Construction (SPDC) faculty and students which examined construction closeout processes at Michigan State University (MSU). Funding for the research was provided by MSU’s Office of the Vice President for Finance and Operations, to create a Center for Project Performance Improvement and to undertake annual research in construction project management relevant to Michigan State University. For academic year 2006-2007 two projects were undertaken “Assessment and Improvement of Construction Closeout at Michigan State University” and “Vendor Performance Assessment Methods”. This report addresses the “Closeout” project.

Construction project closeout frequently is a lengthy and problem plagued phase of a construction project. Closeout refers to the completion of all construction contract requirements following substantial completion, including punchlist items, delivering documentation such as operations and maintenance manuals, as-build drawings, contractor’s verification forms, resolution of change orders and claims, final inspections, final payment and owner’s internal resolution of all accounts and reporting.

While a number of organizations have recognized difficulties with this phase of a project, limited research has been conducted. Consequently, the overall goals of the construction closeout research were to comprehensively survey the relevant literature on closeout, develop benchmarking, and identify effective strategies and recommendations for improving closeout. The researchers believe implementation of the recommendations can reduce delays, administrative time, problems, and costs associated with this phase of a project.

The primary research activities for this study consisted of: 1) review of existing research and literature, 2) development and administration of an interview/questionnaire process of MSU administrators and staff involved with construction projects on campus, 3) process mapping of existing MSU closeout processes, 4) interviews of outside contractors, subcontractors, architects and engineers who provide construction and design services to MSU, 5) interviews of four peer Division One research universities 6) development and administration of a collaborative work session at the national conference of Construction Owners Association of America (COAA), 6) analysis of projects from the MSU FAMIS database (Capital Planning and Administration) 7) analysis of all project data and 8) development of recommendations and strategies. In all over 100 experienced construction industry participants were interviewed or participated in the study, which provided valuable insight to this research.

Statistical analysis of 39 recent MSU construction projects showed that the time to closeout projects from substantial completion to final payment averaged 284 days and the time from final payment to MSU Internal project closeout was 247 days for a average total closeout time of 531 days. The researchers also statistically correlated closeout time to construction duration from project start to substantial completion, and found that closeout duration is largely independent of construction duration.

In order to determine if MSU processing times were long compared to other organizations, the researchers searched for but found no published studies addressing average industry closeout times. Consequently, an interview approach was used and the researchers correlated the analysis of MSU project closeout processing times with interview data collected from interviews of contractors, architects, engineers and other Division One Research Universities, as well as from a collaborative work session at the Spring 2007 national conference of the Construction Owners Association of America. From the interview data the researchers conclude that closeout times vary widely from project to project within all organizations and are based on specific project circumstances. The researchers concluded that MSU typical closeout times while seemingly lengthy, are comparable or slightly longer to closeout times for similar projects within similar organizations with multiple projects and facilities.
Interview and workshop data was collected to determine causes of slow closeout, factors which influence closeout time such as project scale, construction duration, project delivery method, commissioning etc. and effective strategies used to shorten closeout. The interview data was coupled with the database analysis to form recommendations for streamlining closeout processes. Twenty three recommendations are presented which emphasize, organizational commitment, standardizing processes, reducing layers of approval, more effective incorporation of self perform work and use of project management software to track and manage documentation.
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SECTION 1.0 INTRODUCTION

1.1 Introduction and Project Overview

This report outlines a recent research project undertaken by School of Planning, Design and Construction (SPDC) faculty and students, which examined construction closeout processes at Michigan State University (MSU). Funding for the research was provided by the MSU Office of the Vice President for Finance and Operations to create a Center for Construction Project Performance, Assessment and Improvement (C2P2AI) and to undertake annual research in construction project management relevant to Michigan State University (MSU). For academic year 2006-2007 two projects were undertaken “Construction Closeout” and “Vendor Performance Assessment Methods”. This report addresses the “Construction Closeout’ project.

The overall goals of the construction closeout research were to comprehensively survey the literature on closeout, benchmark other organizations, identify effective strategies and recommendations for improving university construction project closeout procedures. The researchers believe that Implementation of these recommendations can reduce delays, administrative time, problems, and costs associated with this phase of a construction project.

1.2 The Project Closeout Process and the Research Challenge

Construction project closeout refers to completion of a construction contract and includes a number of administrative, contractual and technical activities such as: completion of punch list items, furnishing “as built” documents and operations and maintenance information, final inspections, corrections, resolution of claims and change orders, submission of contractor’s verification forms, final acceptance of the work, final payment applications, payment by the owner, commencement of the warranty period, as well as an owner’s internal administrative processes.

Within the contracting community, closeout is often defined to be the period from when the owner can occupy the structure for its intended beneficial use, referred to as “substantial completion”, to the point when the contractor receives final payment. Owners may have a different perspective and extend this definition to include their internal administrative and final project accounting processes. Formally, contract closeout is the process by which contracts are verified complete and administratively processed for official closure. Generally, closeout is completed when all administrative actions have been finalized, all disputes settled, and final payment has been made (Busansky 2003). The mechanics of the closeout process and the individuals involved vary depending on the type and complexity of the project. In many instances, however, the end of the contract cycle is plagued by slowdowns resulting from various sources leading to a lengthy, detailed and time-consuming phase.

The literature, as well as anecdotal accounts from industry professionals indicates that the problem of contract closeout is prevalent and has serious consequences. Closeout delays can cost administrative time for owners, dissatisfaction from building users, tension between project parties and cash flow problems for smaller contractors and subcontractors.

There is no overarching reason found in the literature for poor contract closeout performance. The literature suggests that inefficient closeout processes result from a combination of factors and sources (e.g. poor design, slow contractor response to requests, and owner’s lack of attention). Pinto et al (1998) describe the typical project closeout scenario as anything but smooth because team members are focusing on the next job and not the job at hand, problems (“bugs”) exist that need to be worked out, resources are running out, and, finally, near the end of the job, the need to produce documentation becomes critical.
A recent study by Busansky (2003) investigated contract closeout on federally funded projects and identified several closeout problem sources which include: process friction, inadequate information technology, long-life contracts, personnel skill level, contract financial issues, management concerns, perceptions, timeliness, problem process steps, existing backlogs, inadequate manpower, and records and file documentation. Busansky (2003) considered these problems to be “pathologies” that should be addressed.

The literature on the topic of construction project closeout is sparse and mainly descriptive or anecdotal. In fact, few prior serious attempts have been made to uncover commonalities and derive a sound theoretical framework that can be of assistance in guiding practitioners to successfully handle the challenges of concluding construction projects. The majority of the literature on the subject is limited to recommendations on additional contractual language to incorporate and administrative procedures for managing punch lists. Alternative project delivery systems, such as design-build and construction management, as well as commissioning services are advanced as potential remedies to the problematic phase of project closeout (Molenaar and Songer 1998). In addition, organizational forms such as partnering (Chan et al. 2004), value engineering (Eldin and Hikle 2003), and information technology support have all been suggested, developed, and pursued with modest outcomes (Ballard and Koskela 1998).

In spite of these suggested “state-of-the-art” remedies and approaches, the project closeout problem continue to persist; “projects take too long, cost too much, fail to meet quality expectations, and still present serious safety risks (Lichtig 2005).” The issue with these remedies is that they are treated as mutually exclusive methods, and, hence, are separately applied yielding competing and contradictory fixes and eventually becoming a barrier for progress (Ballard and Howell 2003). Moreover, these remedies merely mitigate the negative effects of the problems rather than addressing the problems’ root causes.

1.3 Project Rationale: Presenting an Industry Perspective

Closeout is a concern to project managers across diverse industries and organizations. For example, in a 1993 customer survey, the Defense Contract Management Command (DCMC) identified the contract closeout process to be “one of the most important services to be provided and one with which customers are least satisfied.” Dinsmore (1993) points out that even though contracts do not usually delineate a closeout phase, it is indeed a distinct phase requiring its own management. Pinto (1998) concluded, “the importance of the project closeout phase is often overlooked.” The Department of Energy (DOE 2003) describes project closeout as “frequently under funded, understaffed, and (understandably) not well planned or performed.” The significance of effective construction closeout has been articulated by the City of Seattle (2005) as “an important part of the City’s capital development process because it ensures fulfillment of contractual and legal obligations before releasing final payment to the contractor, and it facilitates commissioning the built infrastructure.”

In the current era of tight budgets and scarce funding, the efficient and effective conclusion of project closeout is undoubtedly in the best interest of all project stakeholders. The importance of timely contract closeout goes beyond time and cost considerations. Pinto (1998) contends that good closeouts are necessary for “aesthetic,” administrative, and customer-relations reasons. Aesthetics in relation to closeout means that the project terminates in a pleasing manner and that loose ends are tied-up. Psychologically, stakeholders perceive that the project was in control until the end. An environment of efficient organizational operations exists administratively when good closeout practices are in place. Finally, customer relations are improved for the reason that “…good closeouts maximize customer satisfaction and increase customer confidence that the project has been implemented with care. Messy
closeouts can cause customers to question the competence of the project team and may lead to delays in customer acceptance of the deliverable.” (Pinto 1998).
SECTION 2.0 RESEARCH PROCESS

2.1 Research Process Overview

The primary research activities for this study consisted of: 1) review of existing research and literature, 2) development and administration of an interview/questionnaire process of MSU administrators and staff involved with construction projects on campus, 3) process mapping of existing MSU closeout processes, 4) interviews of outside contractors, subcontractors, architects and engineers who provide construction and design services to MSU, 5) interviews of four other peer Division One universities, 5) development and administration of a collaborative work session at the national conference of Construction Owners Association of America (COAA), 6) analysis of projects from the MSU FAMIS database (Capital Planning and Administration) 7) analysis of all project data and 8) development of recommendations and strategies. Figure 2.1 below depicts the research methodology.

![Diagram](image-url)

**Figure 2.1 Closeout Research Methodology**

Much of the project data comes from construction industry participants through interviews and a collaborative work session. Approximately, 100 university and industry professionals provided input through interviews or participation in the work session. The interview process consisted of interviews designed to gather information about closeout perspectives and management practices of MSU and other organizations. Researchers conducted open-ended interviews of twenty one MSU personnel, twelve
outside contractor, subcontractor, architectural and engineering companies, and construction administrators from four Division One Universities including Pennsylvania State University, University of Texas at Austin, University of Nevada Las Vegas and the University of Florida. Data from the interviews and work session was paraphrased, tabulated and analyzed using content analysis in order to assess general themes expressed by the interviewees.

2.2 Project Oversight Committee

An Oversight Committee comprised of MSU administrators from the Physical Plant, Engineering and Architectural Services (EAS, Campus Planning and Administration (CPA), and Construction Maintenance and Interior Design (CMID) was created at the inception of the research project. The Oversight Committee met to define the scope of the project and to make recommendations on appropriate MSU staff positions, industry firms which provide services for MSU including architects, contractors, construction managers, subcontractors and other universities which could be included in the interview process.

2.3 Literature Review

Literature review conducted for the project focused on 1) prior closeout research 2) relevant industry articles 3) existing practices and checklists 4) other university practices and 5) benchmarking. Relatively little prior academic research was found to have been conducted on construction contract closeout. However, a significant amount of information on existing processes and activities used by a variety of organizations such as the American Institute of Architects (AIA) and Associated General Contractors (AGC), was available, but there was little evaluation of these published processes evident in the literature. Additionally, closeout processes of peer universities including all Big Ten Universities, as well as, five other universities were examined through review of web based process information.

2.4 MSU Administrators and Staff Interview Process

In order to gain an understanding of existing MSU closeout processes and opportunities for improvement, researchers reviewed available MSU published resources consisting of construction standards, typical project manuals, front end documents consisting of General Conditions, Supplementary Conditions, and CSI Division One General Requirements posted at (http://www.eas.msu.edu/home.cfm). From this information it was decided to conduct an interview process of staff and administrators who had roles in closeout of MSU construction processes. The oversight committee along with the research team identified staff classifications appropriate for interviews. Subjects were selected by the research team and their identities were kept confidential from the Oversight Committee. The research team developed an interview questionnaire format and had the research protocol, questions, interview consent form and the application for the human subjects research reviewed by the MSU Institutional Review Board (http://www.humanresearch.msu.edu/) prior to conducting the interviews.

The interview process included 30 questions relating to project closeout processes and 35 relating to vendor performance improvement. The vendor performance questions are reported separately and are not a part of this closeout study. Categories of questions relating to closeout included demographic questions, duties, organizational structure, procurement and contracting practices, existing closeout processes, project closeout investigations and possible strategies for improvement.

Paraphrased responses were recorded during the interview, entered into an Excell® spreadsheet and then aggregated with those of the other interviewees. Content analysis of the aggregated responses was conducted to identify the general themes.
The interviews were conducted in Spring 2007 and in all twenty one MSU staff and administrators who are involved in the MSU closeout process were interviewed. The results of the interviews are addressed in Section 3.0 of the report and were used, together with the literature review and other data collection instruments, to map MSU processes and to prepare recommendations.

2.5 Process Mapping of Existing MSU Processes

MSU’s exiting closeout processes were mapped using data collected during the MSU Interviews, along with a standardized MSU closeout checklist and available MSU published resources consisting of construction standards, typical project manuals, front end documents, General Conditions, Supplementary Conditions, and CSI Division One General Requirements posted at (http://www.eas.msu.edu/home.cfm). The process map was confirmed with Engineering and Architectural Services (EAS) personnel as being an accurate depiction of the existing “formal” projects closeout process and is addressed below.

2.6 Contractor, Subcontractor, Architect and Engineer Interviews

Contractors, construction managers, subcontractors, architects and engineers who provide services for MSU were interviewed to obtain benchmarking information and to gain feedback on MSU’s closeout processes, as well as to learn about effective strategies used by other organizations. Researchers selected and contacted firms for interviews from suggested lists developed by the oversight committee and the researchers. Final interviewee selections were decided by the researchers and were not disclosed to the oversight committee.

Interviews were conducted in early summer 2007. Twenty six individuals from fifteen contracting, construction management, subcontracting, architectural and engineering firms were interviewed.

As with the MSU interviews, paraphrased responses recorded during the interviews by the researchers were entered into aggregate spreadsheets which were then analyzed using content analysis to identify general themes.

2.7 Other University Interviews

During summer of 2007, the researchers conducted open-ended interviews of four Division One Universities, including: Pennsylvania State University, University of Texas at Austin, University of Nevada Las Vegas and the University of Florida. Additionally, representatives of the University of Texas (UT) systems were interviewed. The research team traveled to the universities and generally spent one day with staff. Consent procedures, human subject review processes and interview methods and content analysis methods were again similar to those used for the MSU and contractor interviews. The purposes of the university interviews were to learn about how closeout was being managed in other comparable institutions, in order to develop a benchmarking perspective and to identify effective strategies.

2.8 Construction Owners Association of America (COAA) Collaborative Work Session

As part of the Spring Owners Leadership Conference (May 9-11, 2007), organized by the Construction Owners Association of America, the MSU research team presented a 3-hour workshop titled: “Project Closeout Workshop: Barriers and Opportunities.”

39 attendees of the conference participated in the workshop. The main aim of the work session was to bring together owners and other stakeholders in a collaborative discussion to identify constraints that hamper the closeout process and to brainstorm solutions to these problems.
An online survey was created to find the most prevalent trouble spots and possible remedies, based on the input of various project participants at [http://www.questionpro.com/akira/TakeSurvey?id=658186](http://www.questionpro.com/akira/TakeSurvey?id=658186). An email announcement was sent to all COAA members highlighting the main focus of the workshop and encouraging members to complete the online survey. The survey was open to all COAA members.

The workshop utilized a PowerPoint presentation to provide an overview of the research and literature, create a working definition of the research and to help explore problems and strategies for minimizing time and impact of closeout. After the initial presentation attendees were divided into workgroups to address four key questions which included:

- What are the critical factors that affect the project closeout process?
- Rate the relative impact that these factors affect the likelihood of project delays (high influence, moderate influence, low influence)?
- What upstream actions, during the programming, design and construction phases, might be taken to reduce the impact of the identified factors on the project closeout process?
- Building on our knowledge of effective contractual systems and team processes, what integrated approach can be developed that leads to better project closeout and more successful construction projects?

Work groups reported their responses and group ranking exercises were used to classify the relative impacts of factors most prominent in impacting delays.

### 2.9 Analysis of project Histories from the MSU FAMIS

Information contained in the MSU Campus Planning and Administration (CPA) FAMIS database was used by the researchers to profile MSU projects and evaluate timeframes for closeout. The research team received summary reports in spreadsheet format from CPA for 48 recent MSU projects. The researchers examined the summary reports for compliance with the scheduled date of substantial completion, length of time from contractor’s substantial completion to final completion (contractor’s receipt of final payment) and from final payment to internal MSU closure of the project. Additionally, the researchers developed short narrative descriptions of closeout performance of each of the 48 projects in the database. Some projects had incomplete data so the researchers used 36 projects with complete data for the analysis.

To analyze the data the research team sorted the data by project durations and created new spreadsheets for analysis to compute average durations and standard deviations. Results were correlated with the MSU process map, the literature review, the interview data and the COAA workshop survey and group responses to develop recommendations and identify opportunities for improvements.

### 2.10 Data Analysis, Synthesis and Recommendations

Data collected through the study is presented in Section 3.0 of this report. The researchers considered all the data along with the literature in order to identify general themes, uncover problems and strategies relevant both to MSU and other organizations and to establish a benchmarking perspective. Finally, from all the data and analysis the researchers identified recommendations and best practices strategies for consideration by MSU. These recommendations and strategies are presented in Section 4.0 of this report.
2.11 Research Team and Student Involvement

The research was conducted by SPDC faculty and students at Michigan State University. Five graduate students and one undergraduate student worked on the project. Students were involved in development of the research methodology, data collection instruments, interview database, interview process, the COAA Collaborative Work Session in New Orleans, Louisiana, case study analysis and final recommendations. Important objectives of the research team in involving students were: to foster a research mind set in students, to develop and enhance research skills and to increase student understanding of closeout and construction management processes.

The research team met weekly for the project and developed a project Website in the MSU Angel system in order to post documents and provide access to all information for members of the project team and oversight committee. Additionally, periodic update meetings were held with the oversight committee and one member regularly attended the weekly research team project meetings. Figures 2.2 and 2.3 below show snapshot views of the project website.

Figure 2.2 Closeout Project Website          Figure 2.3 Closeout Project Website

A special highlight, of student involvement in the project, was that undergraduate research assistant Steven Lung worked with the research faculty and PhD candidate Don Schafer who oversaw the student team, to apply for an undergraduate student research award from the College of Agriculture and Natural (CANR) Undergraduate Research Program. The undergraduate researcher received a $1500 dollar award from CANR for work on the project. Mr. Lung’s research work was presented at the University Undergraduate Research Forum in April 2007.
SECTION 3.0 FINDINGS

3.1 Introduction

Many construction industry participants identify slow “closeout” as an important industry problem. But despite its importance, little prior research has been conducted to address its improvement. This study reviewed available research literature and industry articles, examined closeout processes used by a number of universities, gathered input from owners, contractors, subcontractors and engineers, and reviewed construction projects at Michigan State University as a detailed case study to uncover any inefficiencies with closeout and identify strategies for process improvement. While the primary intended beneficiary of the research is MSU, the researchers strongly believe the lessons learned are applicable to other university and large organizations. Concerns over closeout have been expressed by a number of organizations. It is hoped that this research can help improve this project ending process for a variety of owner and construction contracting organizations.

3.2 Michigan State University Background

Construction project types at Michigan State University are similar to those of other Division One Research Institutions and consist of a variety of new construction, renovation and infrastructure projects. Typical projects can range from small laboratory, classroom or utility modifications to major new construction projects. Recent example are its $92,000,000 Biophysical Sciences Building and $60,000,000 Stadium addition. According to the Facilities and Infrastructure Report 2007, prepared from CPA FAMIS reports, construction annual payments for the period 2002-2006 ranged from $60 million to $90 million.

University-wide there are over 600 buildings containing over 22.5 million gross square feet with a replacement value of over $2.1 billion. In the past 20 years, the number of on-campus buildings at MSU has increased from approximately 450 to a little more than 550 buildings with a total square feet increasing from 17 million in 1987 to 22.5 million in 2007.

Under the state of Michigan’s Constitution, MSU is ultimately supervised and directed by the elected Board of Trustees. The Trustees appoint the President who oversees all administrative, academic, operational, and financial aspects of the university. All academic affairs are under the direction of the Provost and Vice President for Academic Affairs. The Vice President for Finance and Operations directs a variety of campus divisions, which manage the campus infrastructure and facilities.

Because of the size of the university, campus buildings are impacted by a variety of administrative units. Offices most closely involved with construction projects and their management are the Office of the Vice President of Finance and Operations (VPFO), Campus Planning and Administration (CPA), Physical Plant, Engineering and Architectural Services (EAS) and Construction Maintenance and Interior Design (CMID) (a division of Housing and Food Services (HFS)).

Several departments can procure campus construction services, and include MSU Physical Plant, Engineering and Architectural Services (EAS), Housing and Food Services Construction Maintenance & Interior Design (CMID) and the Athletic Department. Additionally, the Office of Land Management can procure construction services for off campus facilities. CMID can procure services directly for small projects or through EAS on larger projects. The scope of this research is limited to projects which are administered through EAS.
Within the MSU system services are procured as Major, (defined as exceeding $1,000,000 and requiring MSU Board of Trustees approval), Formal, Construction Manager or Purchase Order projects. This research focuses on the formal process, as administered by EAS.

On many MSU projects, portions of a project’s construction may be self-performed by MSU staff from a variety of offices which include Building Services, Grounds, Maintenance Services, Skilled Trades and Telecommunications. These self-perform portions are typically in the later stages of the project or occur after the construction contractor’s contract is complete. Administratively, self-perform work extends the time period for closeout, sometimes well after the outside contractor has received final payment.

CPA tracks information on projects which is furnished by EAS project personnel. This information is tracked in an MSU database using FAMIS software. All capital projects are tracked with this software.

3.3 MSU Process Mapping Approach

The research team collected information and data from a variety of sources in order to gain an overall perspective on closeout processes at MSU.

Published information on MSU and its closeout practices including the MSU “Front End Documents”, Construction Standards, Supplementary Conditions and CSI Division 1 General Requirements at the EAS website (http://www.eas.msu.edu/home.cfm), were reviewed. Project data available from Campus Planning and Administration was analyzed for process flow time. Interviews were conducted of MSU staff and administrators who administer campus construction projects, as well as, outside contractors, subcontractors, architects, engineers who do business with MSU in order to gain the perspectives of involved parties. Information collected was organized in order to develop a process map which characterizes the MSU closeout process and to seek opportunities for improvement. Figure 3.1 shows snapshot of the EAS website and Figure 3.2 shows an excerpt of the closeout portion of the “General Requirements.”
From the data, a process map representing current MSU processes was developed and is shown in Figure 3.3. The process map covers closeout activities from substantial to final completion. The date of substantial completion is contractually defined as the point when the work is sufficiently complete and the project can be occupied for beneficial use. Final completion indicates the date of final payment to the contractor. Substantial completion triggers a number of activities and signifies an important contractual milestone. Achieving substantial completion usually provides for owner occupancy, commencement of warranties and preparation of punch lists. Figure 3.4 shows the MSU Final Payment Submittal Close Out Form.

It is important to note that although the activities appear to occur in a linear sequence, communication occurs continuously back and forth between the contractor and the project representative to receive and verify all the documents required for the project.

Subsequent to the contractor’s activities in the closeout process and receipt of final payment, MSU conducts a variety of “post contractor” processes before the university closes the project internally. These activities may include self-performing some construction work such as landscaping, installing signs or data and telecommunications work, as well as final project accounting. These “post contractor” closeout activities do not involve the contractor, but instead are MSU internal processes and make up a significant portion of the owner’s overall closeout process from substantial completion to closing out of all internal accounts and funds.
Fig 3.3 Closeout Process Map of MSU
# Figure 3.4 MSU “Final Payment/ Closeout” checklist

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<tr>
<td>Air Balance Report</td>
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<tr>
<td>Vibration Tests</td>
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<tr>
<td>Asbestos Monitoring Tests</td>
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<tr>
<td>Asbestos Removal Certificate</td>
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<tr>
<td>Asbestos Disposal Waste Certificate</td>
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<tr>
<td>Performance Tests</td>
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<td>Water System Balance</td>
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<td>Landfill Disposal Certificates</td>
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<td>Concrete Testing Reports</td>
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<td>Soil Testing Reports</td>
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<td>PCB Testing</td>
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<td>Keys</td>
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<tr>
<td>Shop Drawings</td>
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<tr>
<td>Substantial Completion Notice to Shops</td>
<td></td>
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<tr>
<td>As-Built Drawings- (if already submitted, include copy of transmittal): Drawing No.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation and Maintenance Manuals (if already submitted, include copy of transmittal):</td>
<td></td>
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<td></td>
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<tr>
<td>Life Cycle Data Base Updates</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Project Reps: submit your complete project files with final payment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Designer: submit your complete project files with final payment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Designer/Construction Rep ..... All Shop/Telecom Work Orders are Complete and can be closed _____ Yes
One set of Operation & Maintenance Manual delivered to the Building _____ Yes
Other Services are Complete/Charged to Project

CENTRAL CONTROL SIGN-OFF (when applicable): DATE:

APPROVED FOR FINAL PAYMENT:
1. Project Representative/Date
2. Design Representative/Date

APPROVED FOR CLOSE OUT:
3. Records Manager/Date
4. Final Payment/Date
3.4 MSU Projects Overview from FAMIS Database

Information contained in the CPA FAMIS database was used by the researchers to profile MSU projects and evaluate timeframes for closeout. CPA communicates with EAS to obtain information on projects for the database.

The research team received summary reports in spreadsheet format from CPA for 48 recent MSU projects. The researchers examined the summary reports for compliance with the scheduled date of substantial completion, length of time from contractor’s substantial completion to final completion (contractor’s receipt of final payment) and from final payment to internal MSU closure of the project. Additionally, the researchers developed short narrative descriptions of closeout performance of each of the 48 projects in the database. Some projects had incomplete data so the researchers used 36 projects with complete data for the analysis. A sample summary report is included as Figure 3.5 below. To analyze the data the research team sorted the data by project durations and created new spreadsheets for analysis. A sample research spreadsheet is shown in Figure 3.6 below.

Fig 3.5 Summary Project Report
From the FAMIS data it was determined that during fiscal year 2005-2006, 38% of projects were completed early and prior to their scheduled substantial completion date, 19% were on time, 31% were late between 1-60 days and 13% of the projects were delayed by more than 90 days. Generally, the research team concluded that MSU contractors are doing a good job of getting projects to substantial completion in a timely manner. However, the period from substantial completion to final completion was frequently extended so that final completion dates are longer than planned. Relative to scheduled final completion date, approximately 25% of the projects were on time, 56% were 90 to 365 days late and 19% were more than a year late. (Michigan State University, (2007) “Facilities and Infrastructure Report 2007” Vice President for Finance and Operations).

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Fig 3.6 Partial View of the research spreadsheet

<table>
<thead>
<tr>
<th>CP_NUMBER</th>
<th>DESCRIPTION</th>
<th>ACTUAL DURATION</th>
<th>ACTUAL DURATION (DAYS)</th>
<th>PERIOD BETWEEN SUBSTANTIAL COMPLETION TO FINAL PAYMENT DATE</th>
<th>PERIOD BETWEEN FINAL PAYMENT DATE TO END OF CLOSEOUT</th>
<th>PERIOD BETWEEN SUBSTANTIAL COMPLETION AND END OF CLOSEOUT</th>
<th>States of substantial completion</th>
<th>States of final completion</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1006</td>
<td>ENGINEERING BUILDING - CONVERT ROOM Z15D FROM CLASSROOM TO LABS</td>
<td>155</td>
<td>30</td>
<td>185</td>
<td>410</td>
<td>620</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>1003</td>
<td>CENTER FOR INTEGRATED PLANT SYSTEMS: POLYGREENHOUSE 2004</td>
<td>155</td>
<td>-4</td>
<td>428</td>
<td>192</td>
<td>621</td>
<td>C</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>1004</td>
<td>CHERRY LANE APARTMENTS: DATA ACCESS SERVICE</td>
<td>154</td>
<td>15</td>
<td>85</td>
<td>459</td>
<td>527</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>1005</td>
<td>CHERRY LANE APARTMENTS: ALTERATIONS AND RELOCATION OF HEATING EQUIPMENT IN 919 RT</td>
<td>107</td>
<td>20</td>
<td>133</td>
<td>166</td>
<td>299</td>
<td>L</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>1006</td>
<td>NATURAL RESOURCES</td>
<td></td>
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<td></td>
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</tbody>
</table>

The project ended 30 days late on substantial completion but took more than a year to end closedout than actually planned. The closedout delay could be indicative of slow administration process or long owner self-performed work.

The project was substantially complete 4 days earlier than planned but took 306 days after the final closeout. Final payment took 438 days which could be indicative of long list of punchlist items or added scope of work.

The project ended 18 days late on substantial completion but took 304 more days to end closedout than actually planned. The administrative closedout took 469 days which could be indicative of slow administration process or long owner self-performed work.

The project was 20 days late on substantial completion but finished 34 days earlier than planned date of closedout. Does not indicate any problem.
In order to define and represent processing times the following equation was developed by the researchers and is used throughout the report:

\[ T_1 + T_2 = T_{\text{Total}} \]  

**Equation 3.1**

Where:

- \( T_1 \) = time from substantial completion to final payment
- \( T_2 \) = time from final payment to owner’s closing of all accounts
- \( T_{\text{Total}} \) = total time from substantial completion to owner’s closing of all accounts

\( T_1 \) can be rewritten as:

\[ T_1 = \max \{C_1, O_1\} + OC_1 \]  

**Equation 3.2**

\( T_2 \) can be rewritten as:

\[ T_2 = \max \{O_{2\text{SP}}, O_{2A}\} \]  

**Equation 3.3**

Where:

- \( C_1 \) = Contractor’s closeout activities
- \( O_1 \) = Owner’s \( T_1 \) processing activities
- \( OC_1 \) = Contractor’s and Owner’s joint processing activities
- \( O_{2\text{SP}} \) = Owner’s self perform work
- \( O_{2A} \) = Owner’s \( T_2 \) processing and accounting

**Expanded form of the equation therefore is:**

\[ T_1 = \max \{C_1, O_1\} + OC_1 + T_2 = \max \{O_{2\text{SP}}, O_{2A}\} = T_{\text{Total}} \]  

**Equation 3.4**

\[ I_{\text{SC-FP}} = \max \{C_1, O_1\} + OC_1 \]  

\[ \frac{1}{T_{1\text{planned}}} \]  

\[ I_{\text{SC-FP}} < 1 \text{ Project ahead of planned target} \]  

\[ I_{\text{SC-FP}} > 1 \text{ Project behind planned target} \]  

**Equation 3.5**

\[ I_{\text{FP-PCO}} = \max \{O_{2\text{SP}}, O_{2A}\} \]  

\[ \frac{1}{T_{2\text{planned}}} \]  

\[ I_{\text{FP-PCO}} < 1 \text{ Project ahead of planned target} \]  

\[ I_{\text{FP-PCO}} > 1 \text{ Project behind planned target} \]  

**Equation 3.6**

Where:

- \( I_{\text{SC-FP}} \) = Index measure of actual to planned \( T_1 \) performance
- \( I_{\text{FP-PCO}} \) = Index measure of actual to planned \( T_2 \) performance

**Examples of key activities are:**
C₁ = Contractor’s closeout activity examples:

- Completion of punch list items
- Furnishing Operations and Maintenance manuals
- Furnishing As-Built documents
- Furnishing required product lists
- Furnishing verifications (wage statements, warranties etc.)
- Furnishing remaining change order documentation
- Furnishing final application for payment

O₁ = Owner’s T₁ processing activity examples:

- Review and acceptance of completed punch list items
- Review and acceptance of Operations and Maintenance
- Review and acceptance of As-Built documents
- Review and acceptance of product lists
- Review and acceptance of verifications (wage statements, waivers, warranties etc.)
- Review of final application for payment
- Reconciliation of accounts
- Release of retainage
- Final payment
- Start self perform work where applicable
- Internal administrative processes

OC₁ = Contractor’s and Owner’s joint processing activity examples:

- Negotiation and reconciliation of change orders
- Define and agree on scope related change orders necessary to accommodate un-met end user requirements identified at closeout or during T₁ period

O₂SP = Owner’s self perform work examples:

- Landscaping
- Data and communication systems

O₂A = Owner’s T₂ processing and accounting examples:

- Final reconciliation of accounts
- Owner’s administrative processes
- Owner’s reporting to funding agency
- Owner’s archiving of project records

Using statistical analysis to calculate means, standard deviations and box plots the entire database showed that the time to closeout projects (T₁ + T₂ = T_Total) averaged 531 days from substantial completion to MSU internal closeout. The time from substantial completion to final payment (T₁) averaged 284 days and the average time from final payment to MSU Internal project closeout (T₂) was 247 days.

When considering construction duration the results were not much different from above. Projects with less than six months construction duration (short duration projects) took on average 491 days (T₁ + T₂ =
\( T_{\text{Total}} \) from substantial completion to MSU internal closeout. For those projects with construction durations from six months to one year (mid-term duration projects) an average of 511 days \((T_1 + T_2 = T_{\text{Total}})\) was calculated. Finally for projects with construction durations of more than one year (long duration projects), average closeout time was 596 days \((T_1 + T_2 = T_{\text{Total}})\). The researchers had anticipated that long construction durations (which implied more construction complexity) would have much longer closeout durations than short projects, but the variance was not as great as expected. To further substantiate the analysis a two sample t-test (standard statistical procedure for hypothesis testing for small data samples) was conducted with a hypothesis that 'true average mean of closeout duration' was similar irrespective of the length of the construction duration of the project. Three tests were conducted for the following three cases to compare the average closeout durations of projects across the three different categories:

a) Short duration projects and Mid-term duration projects
b) Mid-term duration projects and Long duration projects
c) Short duration projects and Long duration projects

The results for the test case (a) indicated that there was no correlation between closeout durations and construction duration of projects falling under those two categories. The analysis was supported by a p-value of 0.790 (for any rejection) which implies that the researchers were only 21% sure that there is a correlation between the \( T_1 \) and \( T_2 \) durations, which is insufficient to establish a correlation. The results for the test cases (b) and (c) indicated that there was a slight correlation between the closeout durations and construction durations of projects when they fall in the long duration category. The analysis resulted in p-values of 0.424 and 0.301, respectively, for the two cases. This implied that the researchers could be 58% and 70% sure, respectively, that there is a correlation between the closeout and construction durations of the projects. In other words, the closeout durations increased with the complexity of the projects.

None of the above three tests could establish a significant correlation or dependency of closeout durations on construction durations, which was initially anticipated by the researchers through observation of the raw data. Time from substantial completion to contractor’s receipt of payment, \( T_1 \), varied on average from 255 days for projects less than six months construction duration, 255 days for projects with six months to one year duration and 348 days for projects with construction duration greater than one year. MSU internal processes from contractor’s final payment to MSU internal closeout, \( T_2 \), also were fairly constant for projects with less than six months duration taking 236 days \( T_2 \), projects with six months to one year construction duration taking 256 days, and projects with construction duration more than one year taking on average 249 days.

In addition to average times, a considerable number of projects have very long closeout times \((T_1 + T_2 = T_{\text{Total}})\). All 12 projects with construction durations less than six months took more time to closeout than for the actual construction work, with six of twelve projects taking three times the length of construction for closeout process (over 600 days). For projects with construction durations between six months and one year nearly one half had total closeout durations which were twice as long as the actual construction process. And lastly for longer duration projects, four of twelve projects took over two years for total closeout with one elevator project taking 1084 days to closeout.

Average durations from substantial completion to final payment time \( T_1 \), from final payment to MSU internal closeout time \( T_2 \), and total time from substantial completion to MSU internal closeout \((T_1 + T_2 = T_{\text{Total}})\) seem lengthy to the researchers. The relative independence from project duration and corresponding presumed project complexity implies that flow of information and internal processes may be influencing factors in bringing projects to closure. Figures 3.6, 3.7, 3.8 and 3.9 depict times \( T_1, T_2 \) and \( T_{\text{Total}} \) closeout times for projects based on construction durations.
Fig 3.7 Graph Showing Closeout durations less than 6 month projects

Fig 3.8 Graph showing Closeout durations for projects of construction duration from 6 months to 1 year
Fig 3.9 Graph Showing Closeout Durations for projects of construction duration of more than 1 year

Fig 3.10 Graphs showing closeout durations for all projects
There are many parties involved with closeout of a project. The contactor and subcontractor must complete their work, assemble documentation and properly submit it. MSU must receive the documentation, review it, approve it and process it. If there is MSU “self perform” work included in the project, that work must be performed. Claims and change order items must be resolved and finally, all project accounting must be finalized. Anyone of these parties or processes can cause a disruption in timely closeout.

The researchers were surprised to see closeout durations were only loosely related to construction duration, implying that information flow and internal processes may be heavily influencing overall closeout time. Therefore, the researchers examined MSU processes as well as contractor’s processes to look for opportunities for improvement.

Lastly, the real impact of these extended closeout times is difficult to quantify. Surely, ongoing administrative time and energy is spent processing this information for an extended period. But it is more difficult to tell if these processes impact overall project contract costs and relationships. The interviews of contractors revealed that MSU is a good owner with closeout processes and durations not that atypical of other large owners. However a number of external parties indicated in the interviews that there is an “MSU” factor incorporated into their pricing and they had a number of practical recommendations for improving its processes.

3.5 Benchmarking

It is difficult to know whether these closeout times are excessive when compared to other comparable public organizations, because the researchers believe that no research or quantitative construction industry benchmarking on closeout has been published. In order to provide some benchmarking insight into closeout, the researchers in this study collected benchmarking information from interviews of contractors, architects, engineers and other Division One Research Universities, as well as from a collaborative work session at the Spring 2007 national conference of the COAA. Few organizations have maintained quantitative data on this phase of the project, so what is reported is perception and were validated independently by the researchers, but in aggregate they do provide some insight. Some organizations particularly those which are ISO certified were found to maintain and aggregate quantitative project data and interview responses from these organizations was particularly helpful in putting MSU projects in context.

3.5.1 Benchmarking- COAA On-line Survey

The web based online survey of COAA Conference attendees had 36 responses. The majority (31/36) of the respondents were owners, with three A/E firms and two Constructors responding. The respondents indicated involvement with the following type of buildings: 19% Universities; 15% Office Buildings; 14% Dormitories; 12% Sport Complexes; and 12% Hospitals. Among them, the respondents had an annual construction budget ranging from less than 25 million dollars to greater than 1 billion. With few exceptions, respondents used more than one delivery method, but design-bid-build was used most frequently (40%) followed by CM-at-Risk (25%) and design-build (17%).

About 77% of the respondents indicated that their organizations have a formalized project closeout process. The respondents varied on their judgment of the effectiveness of their adopted project closeout process, with 50% indicating that it is only somewhat effective. In general, 79% (27/34) of the respondents indicated their dissatisfaction with the time it takes to closeout projects in their organizations.

None of the respondents were aware of any published average time for the project closeout process. Aggregated responses indicated average $T_1$ closeout times varied with project length. When respondents were asked to give an estimate of typical length of project closeout for projects lasting 2-months, 6-
months, and 12- months respectively 85% of respondents indicated that for a 2-month to 6-month project, the typical time to close was 5 months or less. When 12-month projects were considered, only 60% of the respondents indicated that the typical time to close was 5 months or less. Figure 3.11 below shows the aggregate COAA survey responses.

The survey also revealed that 65% of the respondents set internal goals or procedures to facilitate speedy project closeout times which range from 30 to 360 days after substantial completion. Figure 3.12 below shows the range of responses for closeout $T_1$ time goals.
3.5.2 Benchmarking- Contractor, Subcontractor, Architect and Engineer Interviews

Interviews of 15 external contracting, construction management, subcontracting, architectural and engineering firms which do business with MSU were conducted for the study. In all 26 individuals participated from the 15 firms. The questions were presented in an open ended format. Paraphrased responses were entered into a spreadsheet and content analysis was used to draw out general indicators and themes. The broad themes are reported below.

None of the respondents were aware of any published data on industry average closeout times. Three questions in the interviews targeted typical closeout times. The first sought typical closeout times ($T_1$ time from substantial completion to contractor’s final payment) for their projects, the second asked about their targets/goals for their portion of the closeout process ($C_1$ contractor’s closeout activity), and the third asked about typical length to receive payment after final submission of contractor’s final submission and final application for payment.

Contractors, subcontractors, architects and engineers generally indicated that the time for closeout varies with the owner, with usual closeout times ranging from 30 to 60 days. Some projects may take as many as 270 days to two years ($T_1$). Contractors and subcontractors were in agreement that receipt of final payment after final submission by the contractor was approximately 30 to 60 days. See Figure 3.13 below for a snapshot of contractor’s response to typical $T_1$ closeout times.

Contractors and subcontractors set internal goals for their portion of the closeout process, $C_1$ (Contractor’s closeout activity) of the $T_1$ Time at 30 to 60 days but may range from 45 to 270 days for larger projects.

When taken together, goals for contractors ($C_1$ Contractor’s closeout activity) added to the typical payment time from owners of 30-60 days sets an overall target for $T_1$ Time (from substantial completion to contractor’s final payment) of 60-120 days. These interviewees were not asked about $T_2$ (time from final payment to owner’s closing of all accounts) or $T_{Total}$ (total time from substantial completion to owner’s closing of all accounts.) See Figure 3.14 for a snapshot of Interview Responses for $C_1$ (Contractor’s closeout activity) time goals.

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Questions</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB</td>
<td>Based on statistical data or from your experience, what is the usual time associated with closeout of projects?</td>
<td>No statistical data and the time for closeout varies with owner State of Michigan has liquidated damages for both substantial completion and final completion. Most owners mention both the substantial completion and final completion dates. Liquidated damages may help with the final completion since it encourages contractors to protect/expeditious closing of all accounts. Sometimes it is 60-90 days. 30-60 days. Usually its 6 months, but it varies with project. Waivers take time, if they can be done at time of O&amp;M then the process could be faster. MSU issues a lot of change orders at the end which costs a lot of time. This results in delays amending the subcontracts which in turn hold up to O&amp;M before they get the final payment. MSU does not exchange documents with their subcontractors which takes a lot of time. Issues like prevailing wage compliances are not processed timely so they hold checks at the end which squeezes us. We try to get it done in 30 days time which is achieved for 75% of the projects. Otherwise, it takes around 45-60 days from substantial completion.</td>
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</table>

Figure 3.13 Snapshot of Interview Responses for $T_1$ (Time from Substantial Completion to Contractor’s Final Payment).
3.5.3 Benchmarking –Other Universities
Project researchers conducted interviews with construction administrators and staff from other universities to benchmark and capture construction closeout process best practices. The universities were selected from among several recommended by the oversight committee that were similar to MSU in student population, dollar volume of work completed per year, and physical characteristics (i.e. larger universities with mainly residential style main campuses). Four universities were visited; Penn State University (State College campus), the University of Texas at Austin, the University of Nevada at Las Vegas, and the University of Florida (Gainesville campus). Additionally, personnel from the University of Texas System, which contracts major capital projects for the entire University of Texas system (consisting of 14 campus locations throughout the state of Texas), were interviewed.

Project closeout is an issue that is on the minds of all of the programs contacted, whether they agreed to an interview or not. Every interviewee indicated that closeout is now a priority in their organization. However, this appears to be recent phenomena attributed to shrinking capital project budgets and closer scrutiny by university fiscal auditors. All interviewees agreed that time taken to closeout a project is not acceptable. However, no interviewee knew of any published industry closeout benchmarking studies.

Some appear to monitor progress better than others. Interviewees generally set goals for timely closeout, averaging about 45 days after substantial completion, but admitted to rarely reaching these goals.

3.6 Causes of Slow Closeout

From all the research, it is clear that there are extremely diverse reasons for slow closeout. All interviewees, survey respondents and workshop attendees indicated a number of possible causes. In all, well over 100 possible causes were suggested. It is obvious that each project has its own particular set of circumstances, conditions, events and participants which influence the effectiveness and the timeliness of closeout.

The Spring 2007 COAA workshop participants collectively reported over 30 critical factors influencing closeout. These factors were pared down to the ten most influential and are indicated below followed by the number of attendees who voted for the issue:
• Unresolved construction issues (35)
• Lack of defined closeout procedures (25)
• Lack of monetary incentive (21)
• Punch list (19)
• Strength of contract agreement, quality of documents (17)
• Change in project personnel (15)
• PM (Owner limitation) in terms of knowledge, motivation and incentive (11)
• No urgency to final completion (7)
• Audit process identified at the beginning of the project (accounting, funding) (6)
• Burn-out (4)

The 39 COAA survey respondents seemed to suggest that slow closeout and other project management issues seem to be grounded in process issues where roles and methods need to change as well as the project delivery methods for capital projects.

The top organizational factors that the respondents selected as having important to very important impact on the success of the project closeout process include:

• Management Emphasis – 90%
• Internal Process Friction – 84%
• Personnel Skill Level – 78%
• Inadequate Manpower – 74%
• Management Visibility – 70%
• Existing Backlogs – 59%
• Inadequate Records – 59%
• Inadequate IT – 34%

The COAA survey respondents indicated that the dominant causes of slow project closeout include:

Owner Issues:
• Lack of resources
• Accounting office delays in processing paperwork
• Owner's Project Manager diligence, knowledge and workload
• Good working relationship between Owner's construction and maintenance staffs
• Good working relationship between Owner and User
• Tracking mechanisms during the process
• Adherence to policy in proper filing
• Journaling and management of job files
• Owner move in during punchlist repairs - greatly hinders
• intended user's understanding of the construction process

Project Management Issues:
• Change orders and complexity and size of overall job
• Burn out at end of project - very important
• The primary factor is how well the team worked together
• Early understanding of close out requirements by project team.
• Not selecting contractors on past performance basis
• Substantial completion date only in the contract

25
Contractor Issues:
- Lack of resources
- Commitment to project
- Obtaining the following from the contractor:
  - consent of surety
  - marked up as-built drawings (bid contract only)
  - record drawings (design build contract only)
  - final accounting of contract amount and DBE final accounting
  - O and M Manuals, Warranties and Training.

Contracting, construction management, subcontracting, architectural and engineering open ended interviews indicated that some of the main causes include:

- Long punch-list
- Punch lists, as-builts and design issues
- Punch list takes long time since there is almost no production and also subs put in small crew on work.
- Unclear expectations and definitions
- Partnering agreement between the client, contractor and the subcontractor
- Lack of pre-punch list to the sub-contractor is also important.
- Transfer of the documents to too many people.
- Mechanical subs cause delays by their failure to co-ordinate with the suppliers
- Scope creep
- Partial occupancy causes trouble
- Slow change order resolution
- End user/owner is not knowledgeable
- Change of crew or personnel in charge in the end
- Shift in project team focus
- Failure to coordinate and assign responsibility
- Individual GC’s project manager heavily influence success
- Lack of providing a specific list of items that subs must provide
- Owners unreasonable requirements
- Type of owner
- Too many owner administrative channels
- Too many people involved processing documents in owner’s organization
- Source of project funds
- Renovation vs new construction
- Small projects may be harder as project personnel may be assigned to several projects
- Communication
- Failure to track documents
- Choice of materials and building equipment
- Project delivery method
- Personnel involved
- Project complexity
- Retainage practices
MSU interviewees indicated the dominate causes and influencing factors as:

- Friction between Physical Plant and EAS
- Lack of motivation by all parties involved
- Long punch list items
- Poor quality of design documents
- Disputes between architects and contractors about who is responsible for errors
- Shops Division mainly because they don’t work on formal projects all the time
- Fire protection issues
- Quality of design documents
- Defective workmanship
- Accounting
- Too many signatures required at various levels
- GC not getting the documents on time
- As-built drawings provide accurate information and minimize change orders but not taken seriously by the contractors
- Design could be better if the physical plant had more time and less projects
- Realistic dates are not set
- Underground work opening up finished work
- Getting a formal plant landscape design and not just conceptual design
- Paperwork related to billing information from suppliers
- Poor procurement schedule
- Difficulty of keeping closeout a priority
- Fee rate not adjusted to the type and value of work such as renovation
- High, change orders, flawed documents, having too many unknowns, having better inspections
- Designs and wrong size equipment put in place
- Grounds
- O & M manuals
- Front end documents – not clear and concise
- End-user is not clear on the needs
- Quality of the contractor
- Quality of the A/E firm
- Commitment of involved parties
- Changing staff on project
- Change orders may have a negative impact, hard to track and constantly changing
- Bad prints, architects doing a bad job
- “Value engineering” is “value elimination”- which takes out the functionality to make it more aesthetic

Generally, from all of the responses several broad classifications can be made. Unresolved construction issues including punch list items, change orders or document quality, lack of closeout process definition and standardized procedures, organizational and personnel commitment and personnel assignments, as well as project characteristics including complexity, materials, equipment heavily influence closeout times and process effectiveness.
3.7 Effective Closeout Processes

An objective of the study was to explore effective strategies for managing closeout. Toward this end the researchers sought input for all interviewees along with survey and workshop participants regarding effective closeout processes. Interviewees, survey respondents and workshop attendees indicated a range of effective organizational traits and processes that can help.

Overall having a clear standardized process which was well communicated to all parties and which had management commitment was seen as very important. Money is seen as a prime motivator for contractors and including specific closeout activities in the contractor’s schedule of values as well as use of retainage was seen as effective. Having the right staff, with adequate knowledge and time to effectively manage closeout was seen important. Having clear document requirements and good handling practices was seen as being very important.

Listed below are the interview respondent comments on effective strategies.

**Contractors**

- Consider closeout early even at the preconstruction stage
- Use single point of contact for closeout process
- Emphasis and effectiveness of personnel impacts closeout time
- Provide training
- Quality of design and contract documents impacts closeout
- Reduce the number of people involved in the process
- Trade contractors need to assign adequate crew size
- Improve definition of requirements
- Early submittal of operations and maintenance manuals as well as as-built drawings
- Avoid move in during punchlist completion
- Clarify and differentiate punchlist, warranty and maintenance items
- Avoid partial occupancy
- Timely resolution of change orders
- Keep team focused on closeout not on new projects
- Use “pre” punchlists
- Make requirements project specific not just boilerplate
- Include closeout items on the schedule of values
- Liquidated damages can sometimes help
- Complete late punchlist items and back charge for them
- Management emphasis
- Retainage is somewhat effective
- Money motivates
- Holding retainage until closeout items are complete
- Mixed opinion on effectiveness of project delivery system on closeout
- Commissioning delays closeout because some testing and balancing is weather dependent. But there is an overall positive attitude toward commissioning
- Shorten punchlists
- Decentralize authority of project representatives
- Need single point of authority
- Self perform work slows down closeout (shops, grounds, maintenance and telecommunications)
Contractors (cont.)

- Motivated people, experienced knowledgeable people
- Clear expectations
- Fewer levels of approval
- Keep operations and maintenance manuals up to date
- Be organized

Subcontractors

- Come subcontractors view use of retainage is effective
- Money motivates
- Mixed view on project delivery method impact on closeout time
- Commissioning seen as effective but may add time
- Commissioning needs improvement in definition of process
- Partnering not seen as having much impact on closeout time
- Training of owner personnel
- Individual style of project managers-aggressive style more effective
- Single point of contact for closeout items
- Some subcontractors viewed retainage not effective

Architects and Engineers

- Architects
- Maintain retainage
- Reduce punchlist items
- Keep same project management parties involved through the closeout process
- Contract clauses generally not seen as effective although retainage clauses may help.
- Liquidated damage clauses do not help
- Make timely payments- money motivates contractors
- Varied opinions on effectiveness of project delivery methods on closeout such as general contract, construction management and design build
- Commissioning helps reduce closeout time
- Keep closeout discussion in progress meetings
- Timely submission of operations and maintenance manuals and as-built drawings
- Do not hire the low bidder

MSU Administrators

- Map and document closeout processes
- Have fewer internal approvals
- Closer communication
- Consider workload of project managers
- Owner should complete late punchlist items and back charge the contractor
- Include closeout line items on the schedule of values
- Include more financial incentive for contractor to complete closeout items through use of retainage and payment via schedule of values
- Improve design quality by allowing adequate time, thereby reducing change orders and errors
MSU Administrators (cont.)

- Recognize closeout in staff work assignments
- Don’t move staff to new projects
- Adequate staffing
- Use project management software to track documents
- Management should emphasize closeout and be visible about it
- Minimize repetitive information requirements
- End users not knowledgeable in closeout process—provide training
- Commissioning helps by exposing problems, but sometimes lengthens the process. Bring commissioning authority in early
- Partnering does not have much impact but can help if closeout is emphasized
- Varied opinions on responsiveness of architects and contractors
- Use a rolling punchlist
- Consider use of a dedicated closeout administrator
- Staff experience impacts effectiveness
- Reduce number of people involved in the process
- Submit operations and maintenance manuals early
- Submit as-built drawings early
- Have a defined process

COAA Workshop

- Monthly reviews of pay applications, as-builts and progress photos
- Integrating commissioning into design upfront
- Prepare early handoff from construction to operations
- Percentage or dollar incentive to closeout
- Closeout milestones in documents and schedule
- Program (performance) standards identified early
- Unhurried design process with realistic design schedules
- Educating end-user early in the process
- Include closeout in schedule of values
- List/spreadsheet/matrix of all closeout documents and reviewed long before substantial completion
- Identify long lead items
- Closely define problem to be solved at the programming stage
- Identify best team/delivery method (programming)
- Specifications link payments to architect/contractor with submittals during project (design)
- Clear definition of required documents and processes (design)
- Conduct partnering with team on closeout—include in contract requirements (design)
- Clear definition of MEP coordination/commissioning (design)
- Conduct partnering with team on closeout process (construction)
- Specify/identify closeout documents as required for construction
- Weekly MEP meeting with team on closeout
- Owner, PM performance review to include closeout
- Contract language should be tight and to include specific process, responsibilities and timelines
- Allow adequate time for programming, design, contract document preparation and complete quality control
COAA Workshop (cont.)

- Plans and specifications should be tight to include specific process and equipment requirements
- Establish closeout team
- Commissioning agent involved at project conception
- Budget for incentives
- Brainstorm closeout incentives with the team
- Identify closeout activities that could start or be done before closeout such as O & M manuals and as-built drawings
- Partial Commissioning
- Fire Marshal
- Educate end-users to minimize change orders and delays
- Periodic financial audits- large scale and duration
- Strong adherence to project schedule
- Define owner processes with A/E and Contractor
- O & M manuals with submittals
- Create special division ‘closeout’ in contract
- Fresh person for closeout identified in program phase
- One punch list with all parties represented
- Hold firm on retainage
- Clearly define closeout document
- Contractual understanding by all team members
- Establish role/responsibilities
- Establish accountability
- Implement as contracted
- Periodic reviews/checks
- Contractor writes closeout plan which becomes an addendum to contract- becomes pay item
- Ask contractor and subcontractor for suggestions
- Design for closeout by involving operators/ users and starting early
- Involving design team throughout
- Quality inspections around closeout
- Integrate commissioning- focus project around commissioning with a goal for perfect commissioning
- Use of partnering down to the subcontractor and sub-consultant level throughout project life with one common goal or motivation (overall motivation is project success- on time, within budget, quality construction)
- Excellent A/E producer
- A/E with strong contract administration personnel
- CM that executes quality construction
- Constructability and maintenance review from project concept
- Performance based selection of construction team and design team
- The owner/ architect/ contractor in a co-operative, win-win team contractually bound but operating on exceptional team oriented spirit throughout the project including project closeout
- Monetary incentive to contractor, inspector and superintendent for complete documents
- With minimum restrictions, select, develop and nurture project team members and align team member goals with overall project success
3.8 MSU Process Effectiveness

In order to evaluate how MSU could improve its closeout process the researchers conducted interviews of MSU administrators and staff involved in managing MSU projects. In all 21 MSU employees were interviewed. Additionally, interviews were conducted with 15 external firms involving 26 individuals who regularly provide contracting, construction management, architectural/engineering and subcontracting services for MSU, as well as, other large owners. Several questions were designed to obtain feedback on the effectiveness of MSU’s processes, to learn about effective processes in other organizations and to seek areas of improvement for MSU.

When considering both the MSU interviews and those of the outside parties several areas of concern were voiced. In general, it was viewed that MSU is a reasonable owner and its processes were not unlike those of similar organizations. However, interviewees did see room for improvement. Administrative processes are seen to be slow and with too many layers of approval. Examples included slow processing of change orders, construction change directives, payments and paperwork. The need to have a well defined standardized process communicated to all parties is also evident and that there should be a single point of contact for a project.

Organizational factors cited by the MSU interviewees which have an influence on the success of project closeout process were workload assignments, management emphasis and visibility, staff strength, streamlined accounting measures, efficient and thorough communication within departments and the impact of self-performed work on a project.

MSU Construction Administrators and Staff interviews indicated that reconciliation of the budget with the university ledger, making sure line items are the same in both the ledgers and the system, tracking down individual expenses on work orders (WO’s) and adjusting final bills is cumbersome. The internal billing cycle for work self-performed by MSU is lengthy since it is on a time-reimbursable basis and travels through multiple campus accounting systems.

Keeping the project team focused on closing out a past project after they have started new projects is also a concern. Close out should be considered in staff assignments so they can place adequate time and emphasis on this activity.

Industry interviews of external contractors, subcontractors and architects indicated some process issues were significant in leading to slow closeout. Several of the contractors indicated that interaction with student project representatives on-site to discuss issues was not effective. Students do not have authority to make decisions and by the time the information was forwarded to decision makers, it lacked the same level of detail and resulted in a different interpretation and requiring further rounds of clarifications. Contractors clearly indicated their preference to interact with a single point of contact and not multiple offices or individuals.

Several of the contractors also indicated that project representatives have different requirements and processes. They felt that there would be benefit in standardizing processes.

Contractors indicated that where MSU self performed work interfaces with the contractor’s work, that the self performed work hinders closeout. Either self performed work could be contracted to outside contractors or contractors should be paid and allowed to leave the site as soon as their work was finished.

The paraphrased comments form the interviews regarding effectiveness of MSU processes are listed below:
**Contractors**

- MSU is consistent in its processes
- Some variations in what is required by different MSU project representatives
- Slow construction change directive (CCD) processing
- Skilled trade inspectors use the punchlist to ask for items which are really “scope changes”
- Change order processing delays closeout
- Boiler plate requirements are not project specific (requiring items not on the project etc)
- Too many layers of authority
- Self perform work by physical plant, grounds, maintenance, telecommunications takes a long time
- MSU closeout process is effective but could be streamlined and communicated better
- Front end documents are clear
- MSU standards are reasonable
- MSU loses documents
- Contract requirements for closeout are reasonable
- MSU closeout processes are fairly typical but cold be improved
- Slow payment processes

**Subcontractors**

- MSU Front end documents are considered as good
- Too many requirements are applied even though the contractors have been pre-qualified
- Slow processing of paperwork
- Payment process takes a long time
- The as-built materials and equipment serial number lists take a long time
- MSU is a reasonable owner
- Design construction standards lengthen closeout
- Requesting multiple copies
- Too many levels of hierarchy
- Too many steps in approval
- Use of student inspectors who lack knowledge and authority
- MSU Front end documents do adequately address closeout
- Similar to other large owners
- Could benefit by use of electronic submissions of Operations and Maintenance manuals, particularly for commonly used items

**Architects and Engineers**

- Similar to other organizations
- Not very effective
- Need “single point of contact”
- Reasonable owner
- Design standards are consistent
- Staffing is an issue
- Slow paperwork processing
- Seimans controls
MSU Administrators

- Lack of universal agreement among MSU parties on advantages/disadvantages of faster closeout
- Faster closeout can lead to faster turn back of project funds eliminating their possible use to remedy problems or accommodate end user scope changes
- Front end documents are considered as good
- Grounds and maintenance departments not informed early
- Too many construction change directives (CCDs)
- Slow processes lead to extended general conditions costs such as tree protection, etc.
- Lead to reduced end user customer satisfaction
- Use too much staff time
- Extends warranty period (may be a benefit)

3.9 MSU Process Improvements

A number of suggestions for improvement of MSU processes were suggested by both the internal and external interviewees.

Interviewees suggested that MSU could shorten its closeout processes by reducing its number of layers of approval, standardizing its processes, improving its document handling, reducing late scope changes, maintaining a single point of contact, faster processing of change orders, clear definition of responsibilities for contractors at the start of the project, avoid asking for duplicate information and provide training to project parties and end users in aspects of closeout.

Specific internal and external suggestions for MSU process improvement from the interviews are listed below:

Contractors

- Communicate closeout expectations upfront
- Better definition of closeout requirements
- Make requirements project specific not just boilerplate
- Detail the closeout submissions by CSI division and section
- Give both substantial completion and closeout dates in the contract
- Improve the timeliness of processing construction change directives (CCD’s)
- Improve time for approvals and processing of change orders
- Provide training for all parties
- Better communication of closeout processes to all parties
- Reduce number of people involved
- Use a single point of contact for communications and decisions
- Student inspectors seen as intermediaries who sometimes lack knowledge, experience and authority
- Follow-up with discussions and paperwork
- Notify to GC/CM MSU representative vacations
- Use labor rate sheet to improve change order approval times
- Let the construction manager manage the contingency thereby reducing the change order process times
- Stop losing submitted paperwork
- Improve document tracking
- Reduce the number of layers of approval
**Subcontractors**
- Allow for submission of O & M information electronically for common items. Don’t duplicate everything.
- Involve only one person in closeout process (don’t involve the student inspectors)
- Consider closeout earlier
- Leniency for pre-qualified contractors

**Architects and Engineers**
- Remove liquidated damages from contracts
- Better partnering between control contractor and MSU

**MSU Administrators**
- Define closeout processes
- Clearer process and defined responsibilities
- Training programs for all involved parties
- Need training in new and more complicated systems
- Need more staff
- Recognize closeout is part of workload in assigning work to Project Representatives
- Use of an information technology-project management system
- Consider campus art earlier in process
- Earlier involvement of grounds and maintenance departments
- Get commissioning authority involved earlier
- Closer integration between EAS and CPA
- Improve work order processes and documentation
- Holding retainage

3.10 **Special Issues**

The research team was particularly interested in respondent views regarding the effectiveness of several specific project requirements including the use of commissioning services, partnering agreements, impact of project delivery methods and use of specific contract clauses.

**Commissioning**
Most of the respondents from all sources were very positive about the use of commissioning on projects. They saw the benefits to the owner of better designed and more effective systems and increased quality control and oversight. Some of the respondents indicated that commissioning would decrease closeout times by finding problems early. However others thought that commissioning adds to closeout time, because of the closer scrutiny and oversight finds more problems with systems as installed. Also it was correctly pointed out that commissioning of some systems is dependent on certain climate and weather conditions being met for full testing.

**Partnering**
Respondents had mixed experiences with partnering agreements. Some respondents indicated that there would be some benefit toward reducing closeout if that was emphasized in the agreement. However, most indicated that closeout was not emphasized in the partnering agreements in which they had been involved and therefore partnering had little impact on closeout.
Project Delivery
All respondents were asked about project delivery method and its impact on closeout. There was little consensus among respondents. Use of general contracts, construction management and design build were all indicated as most effective as well as least effective. The researchers feel that respondents tended to indicate their own typical method as most effective. (i.e construction managers tended to indicate construction management was most effective, and owners who used design build seemed to indicate design build was most effective and so on. Therefore, no valid conclusion could be drawn about impact of project delivery method on closeout time.

Contract Clauses
When considering all of the data, contract clauses were seen as having only limited impact on closeout times. Most respondents acknowledged that parties are motivated by money so retainage requirements were seen as effective for stimulating closeout by contractors. Requiring closeout to be itemized on a project schedule of values (SOV) was thought to be effective. Line items in the SOV for operations and maintenance manuals, as well as “as-built” drawings etc, would stimulate contractors to submit these items early, in order to capture those funds. Liquidated damage clauses were generally not seen as effective in stimulating faster closeout. Lastly, having contractually established dates for final completion (including closeout) as well as substantial completion dates were seen as beneficial in stimulating faster closeout by making it a contractual requirement.

3.10 Other University Administrators and Staff Interviews
The research team conducted interviews with construction administrators and staff from other universities to benchmark and capture construction closeout process best practices. The universities included Pennsylvania State University (State College campus), the University of Texas at Austin, the University of Nevada at Las Vegas, and the University of Florida (Gainesville campus). Additionally, personnel from the University of Texas System, which contracts major capital projects for the entire University of Texas system (consisting of 14 campus locations throughout the state of Texas), were interviewed. The individuals interviewed are employed by organizations similar to MSU’s Engineering and Architectural Services (EAS) and supporting staff. Department heads participated in three of the four university interviews. The interview questionnaire was structured to determine the closeout process at the universities and to elicit the best practices as well as problem areas of each institution in order to make comparisons with MSU processes. The 42 questions addressed the effectiveness of the existing process, closeout process times, strategies implemented, challenges encountered, organizational factors that affect closeout, and identification of areas for improvement.

The organizational charts and general structure of the universities visited were all similar to MSU, as were the average yearly construction budgets. Individual project management was also similar with one project representative or manager overseeing several projects concurrently. In one instance project representatives were assigned to different ‘zones’ on campus. In at least one instance the project representatives/managers were assigned to the project during the conceptual design phase and remained with the project through final completion. Each university maintained a mix of external and internal consultants similar to MSU. Additionally, each institution performed in-house (or ‘shops’) work on a scale equal to MSU. Most universities interviewed don’t conduct any formal post-mortem analysis of contractors or consultants with respect to closeout or other aspects of the construction process. One institution has began to use a scorecard to evaluate contractors, another is moving toward a formal lessons learned sessions for select projects. For the most part university construction administrators use an informal post hoc method of qualifying contractors for future work. The incentive for contractors to perform well is the continued presence on a pre-qualified bidders list. Some of the same incentives are present on the consultant side; however, one university administrator mentioned that A/E’s on their staff are reluctant to judge another professional’s work.
Contracting practices with respect to closeout do not vary much within the university community surveyed. Contractors are required to prepare and submit a baseline construction schedule and update it monthly. However, the updated schedule is normally not tied to approval of the pay request. Additionally, the schedule is not tied to the approved schedule of values by most institutions interviewed. At least one university rigorously reviews the baseline and updated schedules and ties it to the schedule of values. By closely monitoring and scrutinizing the schedules this organization has determined that 90% of delays are procurement related. This same organization religiously requires that closeout milestone data be included on the schedules. Items included are typically substantial completion, receipt of attic stock, punchlist, and final completion. Other interviewees stated that typically only substantial completion was included as a milestone on the project schedule.

**Existing Closeout Processes**

Project closeout is an issue that is on the minds of all of the programs contacted, whether they agreed to an interview or not. Every interviewee emphatically stated that closeout is now a priority in their organization. However, this appears to be recent phenomena attributed to shrinking capital project budgets and closer scrutiny by university fiscal auditors.

All interviewees agree that time taken to closeout a project is not acceptable. No interviewees were aware of any published closeout time averages. However, some appear to monitor progress better than others. The main method used to monitor closeout times, by those who do so, are use of FAMIS and Primavera P3 software. Project manager and other administrative time is generally not precisely tracked by organizations. Some consider closeout to be so interwoven with other administrative duties that it is not distinguishable from time spent on other tasks. Others estimated times based on memory; this guess ranged from 5-10%, depending upon the complexity of the project.

Interviewees indicated their university generally set goals for timely closeout, averaging about 45 days after substantial completion, but admitted to rarely reaching these goals. None of the institutions interviewed track the closeout time rate of contractors quantitatively, at best it is deemed acceptable or unacceptable on a scorecard. By far, the most difficult aspect of closeout is having key project personnel remain with the project past substantial completion. This appears to be a problem shared by both the owner and contractor organizations. Lack of communication among project participants was also cited as a problem to timely closeout.

After substantial completion, project members seem to move on to the next job, if not physically then mentally. If contractors move key personnel, who have intimate knowledge of the facility, to another project after substantial completion vital knowledge is lost or must be re-learned by new personnel, thus slowing the closeout time. One organization battled this problem by assigning staff to work with the PM on closeout, ensuring continuity of the project knowledge as the PM moved on to other projects.

Commissioning, as an extension of the mechanical trades was viewed as a positive contributor to speed closeout times, although closeout time might seem to be extended – commissioning ensures that the HVAC system will function properly and eliminate callbacks.

**Project Closeout Investigations**

Interviewees felt that a contract written with the closeout process in mind helps to ‘set the table’ for a speedy conclusion to the project. One respondent even went so far as to say that contract requirements drive closeout, further stating that no clause holds dominion over another. A retainage clause was cited by some as the primary vehicle to fast closeout. All participants except one felt that their front-end documents clearly defined closeout requirements. An emphasis by upper level management was seen as an organizational factor that drives closeout time the most, the more pressure exerted by university executives the swifter the completion of the project. Workload assignments (that is, too many projects
per PM or a staffing shortage) and the skill and experience level of the owner’s PM were also cited as organizational issues impacting closeout time. No clear consensus with regard to the link between contract delivery method and closeout was indicated by the interviewees. Two respondents indicated that the construction manager at risk (CMR) method had worked well for them while another respondent stated that project delivery method is not a factor. Most felt that the complexity of the project impacted closeout more than the delivery method and that closeout time wasn’t affected if the project was characterized by either new construction or renovation. Not surprisingly, the end-user of the project, as a project owner and a member of the building team, was seen as an asset when knowledgeable about the construction industry but as a hindrance to the closeout process when the lacking knowledge of the impact to the schedule and budget of late changes or additions to the contract. It was suggested that mandatory training might alleviate problems with end-users. Partnering among project participants was not seen by any respondents as an effective tool to aid closeout or any other aspect of the project.

No dominant cause of the closeout problem was identified by any of the interviewees. One thing is for certain, finishing projects out more quickly after substantial completion is on everyone’s mind as money, staffing, and other resources become scarce. Some institutions are trying innovative methods to tackle closeout. One university had a quicker closeout on a pilot project by not allowing move-in by the end-user until all punchlist items were completed. They intend to try this on other projects. Another university is trying the ‘Red Zone Program’ to combat lengthy closeout. The ‘Red Zone Program’ (the term is borrowed from American football) treats the time period before and after substantial completion as critical and places special emphasis on those activities needed to reach the goal of timely closeout. As of the date of this publication the success of this effort hasn’t been documented. Yet another institution assiduously maps each process in the construction operations, not just closeout, and painstakingly describes the interrelationships between each process. This has been moderately successful and they are working on improving the utilization of the process maps by their staff.
4.0 RECOMMENDATIONS AND CONCLUSIONS

4.1 Introduction

The researchers considered all data along with the literature in order to identify general themes, uncover problems and strategies relevant both to MSU and other organizations and to establish a benchmarking perspective. From the data and analysis the researchers identified recommendations for consideration by MSU. The recommendations and strategies listed below are expected by the researchers to have significant potential to reduce closeout times. Several recommendations are listed as “general”, these recommendations are at the organizational level and encourage organizational commitment and standardizing processes. Several recommendations are made for actions which can lead to reductions in $T_1$ (from substantial completion to final payment) and $T_2$ (from final payment to owner’s internal closeout). While the recommendations are MSU specific the researchers believe that they can have broad application to other universities and other large organizations that have ongoing building programs.

4.2 General Recommendations

1. **Develop and agree on organizational goals for closeout and establish a “corporate commitment” to meeting them at all levels.**

   Department of Navy studies on closeout indicate that management emphasis on speedy closeout from the top down is a major factor in improving closeout performance. In a nutshell, if the university desires streamlined closeout, and is willing to allocate the needed resources, then this desire should be clearly communicated to mid-level managers. The current emphasis is to “Satisfy the Customer”. An additional emphasis should now be placed on closing out projects. The VPFO office, CPA, and EAS must agree on reasonable and sustainable goals regarding closeout that are project specific.

2. **Work to standardize the closeout process as much as possible at MSU. Use checklists as part of the standardization. Every project representative should have the same organizational system. This includes all aspects of closeout (i.e. administrative and fieldwork).**

   Standards are the foundation upon which improvement is based. An integral part of standardization is process mapping. Each person knows what they need to do and at what point it needs to be done. Contractors interviewed for this study conveyed that it is sometimes difficult to plan closeout activities because MSU project representative had different notions about how to carry out the ‘nut and bolts’ of closeout. Project specific checklists will aid in clearing confusion among project stakeholders and can act as a roadmap, along with the process maps, to smoothly finishing the project.

3. **Identify a single point of contact (POC) for addressing contractor issues regarding closeout. Project assistants (students) may research contractor questions but feedback should come directly from the POC. Ensure that the POC stays with the project from beginning to end.**

   This recommendation stemmed from interviews with contractors that regularly conduct business with MSU. Contractors experience a moderate level of frustration from receiving inaccurate information from student representatives that may lack experience, knowledge, or the authority to properly resolve issues that impact the project timeline. This closeout problem is amplified when misinformation occurs near substantial completion and extends closeout. If the POC, who possess intimate knowledge of the project, is reassigned to other projects, information vital to speedy closeout must be researched, thus further extending closeout.
4. Implement a formal post-construction closeout analysis to document lessons learned in a central database.

Insanity has been defined as doing the same thing over and over and expecting different results. The literature suggests that a formal post hoc analysis of project performance is a vital, yet often neglected step in improving project performance in general and closeout in particular. The analysis should include project stakeholders internal and external to the university. The database should highlight both best practices and areas for improvement. This continuity of institutional information will help MSU avoid repeating costly mistakes.

5. Develop an information technology strategy that supports the closeout process. This should include collaborative software programs that share project information to all stakeholders and hardware, such as PC tablets, that can be carried in the field to immediately record punch list items. Begin to move toward a paperless process, including O&M manuals.

In interviews with MSU administrators and staff a point that was frequently mentioned was the need for early inclusion and regular updating in all phases of the construction process. This helps other organizations within MSU plan work schedules and order materials and equipment vital to closeout. A sophisticated collaborative software program that supports remote wireless devices will deliver vital project information to the right people at the right time and help to eliminate double entry of information.

6. Include closeout performance as a line item on each project representatives annual evaluation reviews – reward good performance.

Improving closeout times will require a heightened level of effort on the part of the project representative. It is often difficult to incite new behaviors in individuals for any change. Monetary or other financial incentives were not seen as a viable alternative by those interviewed in this study to improve effort expended toward closeout. Including closeout performance on an annual review may serve to both stress the importance of closeout and to inspire the career-minded individual.

To Improve T1 time

7. Performing mini-CO’s during construction phase would be valuable. Obtain items like O&M’s and systems training as soon as possible (some universities require this prior to substantial completion as allowable) and streamline approval for these. Determine upfront what is really needed and when it is needed. Red-line as-built’s monthly and tie to monthly draw.

The idea of closing out phases of work as the work progresses was culled both from the literature and interviews with other university construction administrators. Performing closeout as the job progresses means less work and confusion at the end. It has the supplemental effect of providing documents such as O&M manuals to those who may need them prior to closeout. For instance, as one MSU interviewee pointed out, mechanical equipment becomes the responsibility of MSU upon occupancy of the facility. Many times O&M manuals have not been procured at that point, which may cause problems for the trades-person answering maintenance calls. Many contractors expressed an interest in working with MSU officials prior to commencing work to jointly review the submittal register to clarify what items are truly needed and eliminate those that aren’t. A submittal register tied to the schedule might also ease this concern.

8. Require closeout activities in the schedule of values.
Nothing gets contractors attention like money. By requiring significant closeout milestone activities (such as the submittal of O&M’s) to be included in the schedule, contractors would be forced to submit them at strategic times or delay the schedule amount until a later time. This could work better than retainage.

9. Keep the punch list(s) to a minimum especially near the end of substantial completion. Require contractors to self-punch. Create deficiency tracking lists (or end of phase punch lists during the construction phase) and correct problems as soon as possible — hold money for deficiencies or deduct from money already paid for this work. Punching at the end of definable features of work reduces the logjam at the end and can minimize call-backs.

The practice of taking care of deficiencies in workmanship was suggested by contractors who have a reputation for having smooth and timely closeouts. Tackling a lengthy punchlist is difficult, key personnel may have moved to the next project or forgot about past problems. Maintaining and tracking a work deficiency list is a proactive way to manage potential punchlist items. Coupling it to a dollar value gets contractors attention.

10. Ensure closeout requirements are project specific.

Contractors are concerned that the MSU standard documents contain too much ‘boilerplate’ language and are not project specific. This could be addressed at the consultant level or by pre-planning between the contractor or CM and MSU project representatives.

11. Develop metrics to act as indicators to flag projects that show a high likelihood of a prolonged closeout phase. Aggressively track these metrics — this will help to anticipate and balance the project representative workloads.

This recommendation came about as the result of what the research team didn’t find in the literature or in interviews — hard data related to the closeout phase. Data is not available on the planned $T_1$ or $T_2$, and no metrics currently exist at MSU (or elsewhere for that matter) that clearly tracks the amount of time that managers and staff spend on closeout. The lack of data makes it difficult to set improvement goals and to allocate resources. Developing meaningful lagging and leading indicators that can help to anticipate if a project is in danger of prolonged closeout would aid all project parties. Developing these indicators will be challenging.

12. Perform constructability and maintenance reviews from project concept. Bring in shops during the construction process. Contractors cited that shops come in late and ask for things in punch list that are really scope changes

This recommendation will benefit closeout by eliminating late changes that could have been anticipated in the pre-construction planning stage.

13. Process change orders more efficiently, require fewer layers of approval.

This recommendation came about in part from the previous study on change orders conducted by the MSU Construction Management Program (CMP). In the current study contractors complained that change orders were ‘batched’ and not handled individually. This frustrates contractors because they cannot bill for work completed as a change until the change order is approved. Furthermore, if the change orders accumulate near closeout more confusion is created because of the rush to complete the job. Empowering project representatives to ‘sign-off’ on change orders would help alleviate this problem.
14. Holding retainage is effective; may work even better if tied to O&M’s and as-built.

The majority of contractors and other university interviewees felt that holding retainage is an effective incentive to entice contractors to complete closeout items. However, the threat of liquidated damages was not seen as an effective method to spur timely closeout. Most contractors expected to meet MSU’s contractual substantial completion date. Contractors indicated they grow weary of holding any payments due to prolonged administrative hold-ups over seemingly minor paperwork items.

15. Engage consultants in the closeout process – stress the need for timely closeout of items such as as-builts. Consider review and updating as-builts electronically during the construction phase as changes are finalized. This will eliminate logjams at the end of construction.

Many interviewees felt that consultants were disengaged from the closeout process and didn’t understand the difficulty of “wrapping up a project”. In particular, it was felt that consultants don’t put a sense of urgency on returning documents, such as as-builts to MSU.

16. Continue commissioning efforts – Involve the commissioning agent in the design phase.

Commissioning is quickly becoming de rigueur among the university building community. Other university interviewees strongly recommended involving commissioning agents early in the mechanical design process to forestall problems. Commissioning ensures that the building’s mechanical equipment functions as designed and works correctly the first time. MSU may want to consider Total Building Commissioning in the future.

17. A brief meeting should be held before the submittal log is prepared.

Contractors who have worked on the MSU campus for many years would like better communication regarding what submittals are actually important to MSU project representatives and consultants. They feel that some of the requirements are onerous and redundant. For instance, contractors are required to submit the same material catalog cuts over the course of many projects. One suggestion was for MSU to maintain a book (or electronic file) of common materials used by MSU that the contractor could reference rather than physically submitting the same items over and over again.

18. Work with Union officials and contractors early in the contract (or at pre-award) to preempt labor disputes related to wage and fringe payments.

Discussions with MSU construction administrators indicated that this is a problem. Not resolving wage, fringe, and benefit disputes until near the end of a project prolongs closeout.

19. Hold training sessions for end-users (clients), MSU staff, contractors and subcontractors about closeout processes.

Emphasize the importance of timely closeout. Make sure parties are aware of what is expected of them. This will aid in minimizing late change orders and other end-of-project surprises. Consider maintaining a web page for closeout that indicates project status.

The theme of all of the interviews was that there is no common understanding of the construction closeout phase and that individuals are either ‘tuned’ into the importance of closeout or are unaware of the consequences of prolonged closeout. Training, or perhaps a roundtable forum, applied to the different stakeholders can help others see the importance of timely closeout and foster understanding among the various university departments.
20. Mechanical trades & landscaping seem to affect closeout the most – find ways to mitigate their impact through design or streamlined processes.

Most study participants indicated that mechanical trades (because of the complexity and of the work) heavily influence the final completion and closeout of a project. Within Michigan State University landscaping was all cited as impacting the ability of the university to closeout a project.


Michigan State University frequently self-performs the landscaping portions of a project. Frequently these activities don’t start until after substantial completion. Reductions in overall closeout time could be achieved by performing some of these landscaping activities concurrently with the outside contractors work rather than sequentially.

22. Evaluate the decision to self-perform work in house and when to privatize trade work currently completed in-house that is problematic.

Similar to recommendations 20 and 21 above, and 23 below, MSU should closely consider when to self perform work and when to assign it to the general contractor and construction manager.

23. Consider privatizing some building services.

Landscaping trades, telecommunications and some mechanical control elements appear to contribute to MSU closeout times. There may be business reasons for self-performing certain project elements, but MSU needs to recognize that slower closeout may be a consequence of self-performing some items.
4.3 Conclusions

Closeout of construction projects is an important and frequently painful step in delivering a project, and virtually all organizations interviewed expressed some dissatisfaction with this phase of a project. Consequences of slow closeout can include lost administrative time, perceptions by end-users of an inefficient operation, and increased project costs through extended general conditions or increased bids.

Through this project the researchers have attempted to understand the closeout process, by considering any previous research, establishing a benchmarking perspective, determining causes of slow closeout, identifying effective strategies and making recommendations for improving closeout within organizations. While the focus has been on university systems, and utilized a case study of Michigan State University, it is believed by the researchers that many other types of owners who have active building programs with multiple projects can benefit by employing the recommendations.

Statistical study of 36 MSU projects shows that typical closeout times for larger projects may average approximately seven months from substantial completion to final payment of the contractor. Additionally, after the contractor has been paid, the owner may spend on average an additional seven months on final accounting, documentation and self-performing work. These average times are believed to be long but are not unusual for many large public organizations. While no published closeout data was found, the researchers considered interview data from contractors, architects, other universities as well as workshop participants and survey respondents, in concluding that these average times represent a fairly typical picture of the industry.

The possible causes for this slow closeout vary from project to project. Each project has its own circumstances, project conditions and personnel which influence the time to closeout a specific project. Study participants suggested over 100 different causes. None the less, there are many strategies which can potentially help to reduce closeout times for organizations who wish to do so. In this report 23 recommendations are made for Michigan State University which can lead to shortening closeout times. General themes of these recommendations include creating a strong organizational commitment to effective closeout and communicating it at all organizational and project levels, establishing clear standardized processes and forms, considering closeout early in a project, utilizing project management software to coordinate and track documents and their status, reducing layers of approval within the organization, coupling payment to closeout documents such as operations and maintenance manuals and as-built documents to the contractor’s schedule of values, as well as, the use of retainage. Most importantly the researchers believe that, recognizing the importance of effective closeout and having a plan for its management are likely the two most important steps in improving this final phase of a project.
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