

CONSTRUCTION INDUSTRY INSTITUTE®

AN ANALYSIS OF LESSONS LEARNED PROGRAMS
IN THE CONSTRUCTION INDUSTRY

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Research Report 230-11

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IN THE CONSTRUCTION INDUSTRY

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A Report to
Construction Industry Institute
The University of Texas at Austin

Under the Guidance of
CII Research Team 230
Effective Management Practices and Technologies for Lessons Learned Programs

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Executive Summary

Effectiveness in the construction industry depends to a large extent on organizations' ability to store and transmit knowledge and experience. Lessons learned programs are used to capture and disseminate knowledge to add value and continuously improve an organization.

This study analyzes lessons learned programs in the construction industry by conducting multiple surveys and interview sessions. Its major findings were as follows:

1. Lessons learned programs are widely used by many construction organizations.
2. Organizations must understand the key characteristics of a lessons learned program, which include leadership, lesson collection, lesson analysis, lesson implementation, resources, maintenance and improvement, and culture.
3. They must also recognize some special considerations that include legal issues, challenges with metrics, cultural and global concerns, and implementation hurdles in order to implement an effective lessons learned program.
4. Both human and IT resources are critical to lessons learned program success.

Guidance for all of these areas are provided in this report based on an extensive research effort involving more than 100 individuals from 70 organizations.

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Chapter 1. Introduction

1.1 PROBLEM STATEMENT

Construction is a project-based industry in which success is highly dependent on employing the right combination of knowledge and experience. Knowledge gained from involvement in various projects helps project teams deliver high-quality products that meet customers' needs.

When an organization's knowledge and experience are not disseminated throughout the firm, recurring problems surface and employees are forced to reinvent solutions (Harrison, 2003). Similarly, past successes that should be repeated are often overlooked when knowledge is not properly documented and shared within an organization. Construction organizations must find a way to allow individuals to share project knowledge throughout the organization to ensure that past successes are repeated and that negative experiences are avoided. Furthermore, organizational processes must support knowledge transfer between project team members in order for an organization to remain competitive (Kotnour, 2000).

Knowledge management is extremely pertinent to the construction industry since the workforce is aging and high turnover rates are prevalent. If organizations do not take steps to manage knowledge, years of accumulated wisdom will disappear once longtime employees retire or change jobs. Effort must be made to combat these trends and ensure that expertise stays within the organization and is managed successfully. Lessons learned programs are a critical component of knowledge management because they can help organizations achieve these goals and remain successful in the marketplace.

1.2 MOTIVATION AND PURPOSE

Many organizations today have come to recognize the value of a lessons learned programs and its relationship to knowledge management. However, construction organizations are still searching for the best way to incorporate lessons learned into business practices. For this reason, the Construction Industry Institute (CII) has been involved in the development of lessons learned programs for construction organizations. In 1998, CII Research Team 123: Modeling Lessons Learned, outlined the lessons learned process in the construction industry.

Because practices and procedures for lessons learned programs are constantly evolving, and given recent technological advances, new methods to collect, analyze, and implement lessons learned have become necessary. Legal implications of lessons learned programs have also emerged, creating new challenges for both owner and contractor organizations. Therefore, there was a need to update the previous CII work on lessons learned to incorporate new technological advances and identify management best practices. Research Team 230, Effective Management Practices and Technologies for Lessons Learned Programs, was chartered in 2005 to oversee and guide this research.

Lessons learned programs in the construction industry are more important today than ever before because a large portion of the workforce is approaching retirement. Organizations can use lessons to communicate information from these individuals to less knowledgeable employees. In addition, globalization also increases the need for lessons learned programs. The challenges posed by performing work in jurisdictions with varying cultures and languages increases the need for lessons learned to reduce risks.

1.3 HYPOTHESIS

The hypothesis for this research is as follows: Effective implementation of a lessons learned program will provide significant benefits to construction organizations,

and specific requirements and process steps are necessary to implement a successful lessons learned program.

1.4 RESEARCH OBJECTIVES

The purpose of this research effort is to provide definitive recommendations, guidelines, and tools for the development and use of lessons learned programs. The five primary objectives of this research are:

1. To identify effective practices for gathering and transferring lessons learned.
2. To characterize the lessons learned collection, analysis, and implementation processes.
3. To identify and discuss characteristics of successful and unsuccessful lessons learned programs, including any implementation barriers.
4. To identify current information technology tools that can be used to facilitate the lessons learned process
5. To identify and discuss any perceived legal liabilities associated with lessons learned programs.

These objectives were met by deploying and analyzing surveys and case study data from both inside and outside the CII-member organizations.

1.5 SCOPE

This research employed extensive background reviews and surveys with CII-member organizations. Follow-up interviews and long surveys with selected CII-member organizations were also used. Case study interviews were also conducted with CII and non-CII organizations outside the construction domain. Organizations of different types and sizes were considered. Although the findings of this study are probably applicable to

organizations outside of CII, the focus remains on CII-member organizations and are indicative of their processes and procedures.

1.6 LIMITATIONS AND ASSUMPTIONS

The researchers assume that the organizations participating as sample populations in surveys and case studies are a fair representation of the CII membership. However, since only CII member organizations were surveyed, the researchers are not able to project their findings onto the entire construction industry (although two case studies were conducted with organizations outside of CII membership). The information presented here was gathered from surveys and interviews and directly reflected the individuals who participated. Additionally, the sample for this study was made up of organizations that had volunteered for the study rather than a random sample from a known population.

1.7 ORGANIZATION OF RESEARCH REPORT

Following this introduction, Chapter 2 presents a description of the research methodology. Chapter 3 provides background information about lessons learned programs. After that, data collection from surveys, questionnaires, and case study interviews are discussed in Chapters 4, 5, 6, and 7. Chapter 8 then addresses the lessons learned process. Chapter 9 introduces the maturity model and provides detailed characteristics of mature lessons learned programs. Chapter 10 provides a jump start guide and Chapter 11 discusses information technologies and special considerations associated with lessons learned. Lastly, Chapter 12 offers conclusions and recommendations.

Chapter 2. Research Methodology

The goal of this research was to verify whether lessons learned are an effective method of representing and communicating project knowledge. Therefore, effective lessons learned practices and information management resources must be identified and investigated. The research methodology described in this section and illustrated in Figure 1 was employed to define and test the research hypothesis.

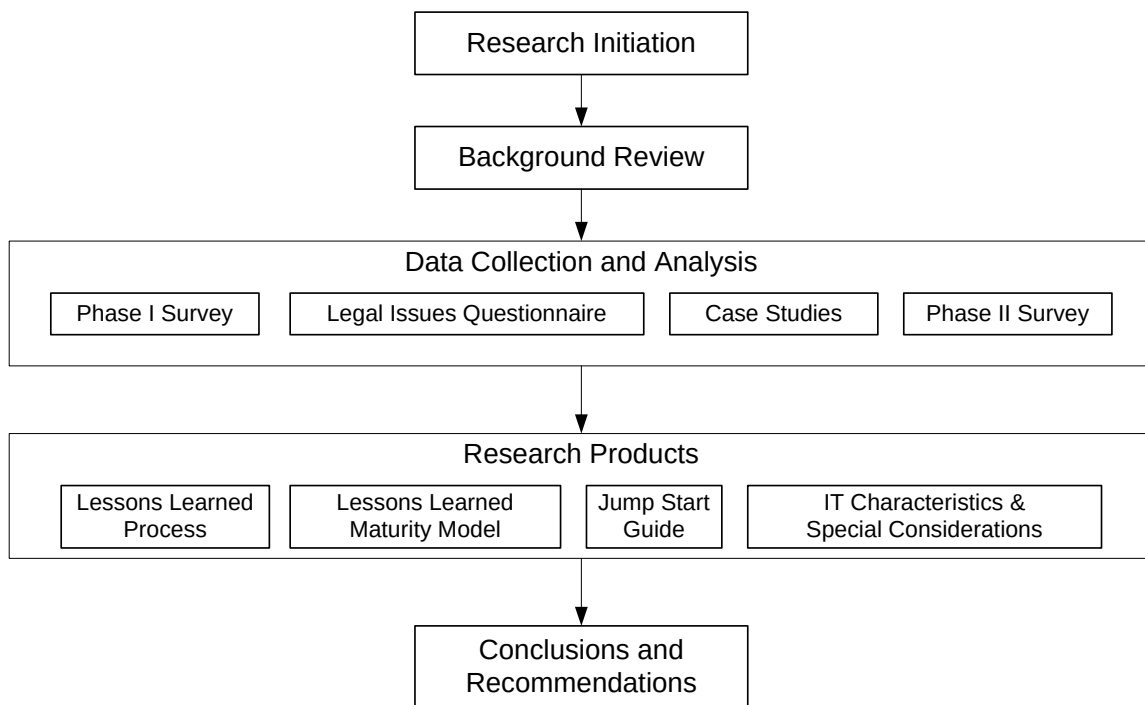


Figure 1: Research Methodology

This research was initiated by the Construction Industry Institute (CII), a consortium of more than 100 leading owner, engineering-contractor, and supplier organizations from both the public and private sectors. On its website, CII states that its mission is “to enhance business effectiveness and sustainability of the capital facility life

cycle in the construction industry through research, related initiatives, and industry alliances.”

In 1996, CII formed Research Team 123 to model the lessons learned process. Since RT123 completed its work in 1998, the advancement of learning organizations and technology as well as the evolution of the business environment created new alternatives for collection, analysis and implement lessons learned. In order to implement a comprehensive lessons learned program today there must be a focus on tools, people, and work processes. In 2005, CII Research Team 230 (RT230) was formed to update the work done by Research Team 123 and identify the current best approaches used to collect, analyze, and implement lessons learned. The authors of this report were key researchers for CII RT230. Other members of the research team provided valuable input at every step of this research. The names of these participants are listed in Appendix A.

After RT230 was formed, a detailed literature and background review was conducted in order to identify new developments in lessons learned programs since the publication of CII Research Report 123-11 in 1998. Extensive library and internet searches were performed to find data relating to lessons learned. Information from these sources were analyzed and incorporated into the research as applicable.

After receiving input from the research team, the Phase I Survey was drafted and distributed to all CII member organizations. The CII members that participated in this research effort are listed in Appendix B. This short survey was used to collect preliminary information on lessons learned practices, barriers, and tools utilized by member organizations. The long survey prepared by RT123 in the previous CII research project was used as a basis for the development of the Phase I Survey and was revised with the help of the research team. A copy of the Phase I Survey form is given in Appendix C. The results of the Phase I Survey allowed the researchers to begin to

identify effective practices, implementation barriers, current information technology tools, and other special considerations for lessons learned.

Once the results from the Phase I Survey were analyzed, it became evident that legal issues have a significant impact on lessons learned. Because of this, the researchers conducted a legal issues questionnaire, which was distributed to organizations participating in RT230. This questionnaire gave the team a better understanding of the legal issues threatening the use of lessons learned. The legal questionnaire was developed by the researchers with input from the research team. A copy of the legal issues questionnaire is given in Appendix D.

Results from the Phase I Survey and the legal issues questionnaire prompted the research team to investigate methods to determine the maturity levels of lessons learned programs in the industry. In order to do this, the researchers distributed a Phase II Survey to all CII organizations with an active lessons learned program. The Phase II Survey was developed by the researchers with extensive input from the research team and is given in Appendix E. This survey provided in-depth data about organizational lessons learned practices and procedures. The Phase II Survey results also helped the research team to identify organizations to contact for the subsequent case study interviews.

The case study interviews were conducted for further analysis of lessons learned best management practices. A structured interview guide was used for the assessment and is given in Appendix G. The guide was developed by the researchers with input from the research team. The sample for case studies was primarily chosen based on an assessment of already surveyed participants' lessons learned programs, and an attempt was also made to collect data from owners and contractors as well as organizations outside of CII.

These data collection efforts allowed the research team to identify the most effective management practices and technologies for lessons learned and provided the

basis for various research products. The research team used this information to update the lessons learned process models generated by RT123 and to create a lessons learned maturity model matrix, self-assessment questionnaire, a program jump start guide, and an updated Transactional Work Flow Diagram. Information technology (IT) characteristics and other special considerations were also identified and analyzed.

At the end of this research effort, the team was able to reach conclusions and provide recommendations for the construction industry regarding lessons learned programs. This multiple data collection approach provided rich insight into lessons learned programs within the CII membership.

Chapter 3. Background Information

Today's economy is driven by information and the value of an organization has become increasingly dependent on knowledge assets rather than tangible ones (Anumba 2005). The global character of the economy also forces organizations to transmit information over both physical and cultural barriers every day; organizations now focus their efforts on managing knowledge as a "strategic resource" that must be transferred around the world 24 hours a day, 7 days a week (Carnes 2002). Knowledge plays a crucial role in organizations and is the generator of innovation and competitive advantage.

Since knowledge has become a priceless commodity, knowledge management is required for organizational success. Although information management became a focus of organizational leaders in the 1990s, the concept is far from new (Hansen 1999). For centuries, knowledge has been passed down in crafts from masters to apprentices and in family businesses from generation to generation. Today, knowledge management is used to find ways to gather knowledge from individuals and communicate it to others within an organization.

3.1 DEFINITION OF KNOWLEDGE MANAGEMENT

In order to fully understand knowledge management, one must first grasp the idea of "knowledge." Knowledge typically exists in both the explicit sense and the tacit sense. Explicit knowledge can be codified and documented with ease, allowing members of the organization to store and search for this type of information. Tacit knowledge, conversely, is generated from personal knowledge and is embedded in individual experiences (Collision 2004). It is not possible to document the many facets of this knowledge; tacit information must be shared in face-to-face interaction and storytelling.

These two very different types of knowledge create the need for both capturing information through formal documentation and for allowing individuals to connect with one another in a more informal manner. Knowledge management is a mechanism for accomplishing both of these goals.

In general terms, knowledge management represents a broad concept, and is thought of as an organized process for identifying, analyzing, and using knowledge to achieve organizational objectives. It is more than simply moving or transferring files and data from one employee or project to another. Knowledge management actually allows others to build upon an employee's or project's experience in a way that strengthens not only the individuals and projects, but the organization as a whole. Knowledge management is also a method for ensuring years of accumulated wisdom does not leave an organization once an employee moves or retires.

Knowledge management systems consist of many components such as work processes, training, mentoring programs, and so on. The implementation of lessons learned programs is a crucial component of knowledge management systems in construction organizations, as shown in Figure 2.

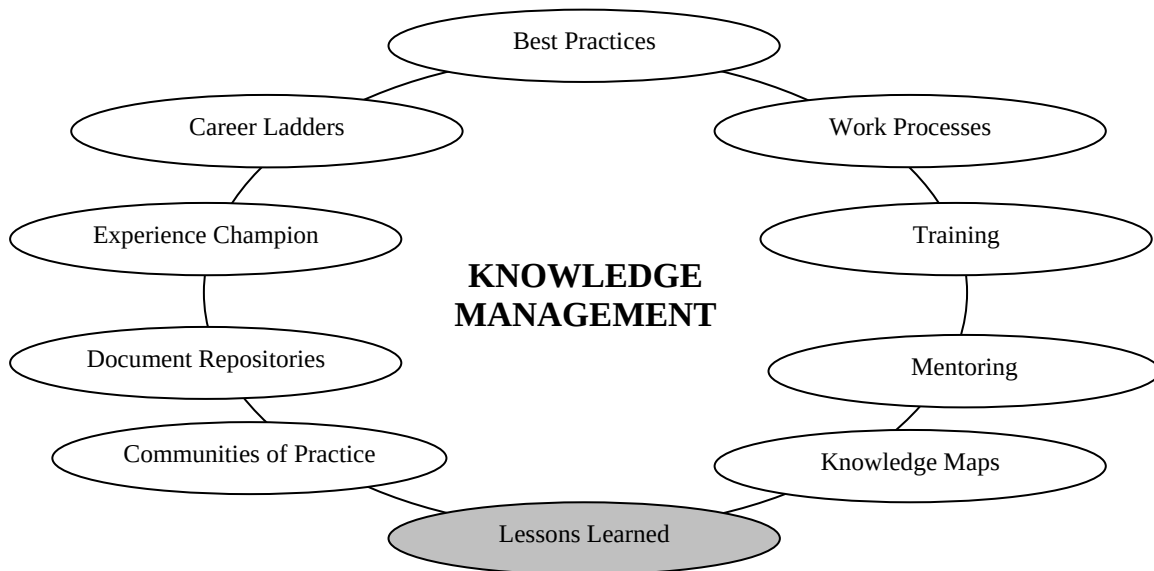


Figure 2: Knowledge Management and Lessons Learned

In order for an individual to benefit from knowledge management and gain information and insight from an experience, he or she must consider the activity that occurred and extract a lesson learned (Collision 2004).

3.2 DEFINITION OF LESSONS LEARNED

Lessons learned facilitate the collection and implementation of knowledge gained on past projects to enhance learning. The specific definition of a lesson learned varies. The U.S. Army defines lessons learned as “validated knowledge and experience derived from observations and historical study of military training, exercises, and combat operations” (United States Army 2006). Lessons learned can also be defined as “a good work practice or innovative approach that is captured and shared to promote repeat application, or an adverse work practice or experience that is captured and shared to avoid recurrence” (Harrison 2003). In 1998, CII Research Team 123 defined lessons learned as “knowledge gained from experience, successful or otherwise, for the purpose

of improving future performance” (CII 1998). After evaluating the many definitions found in the literature, CII Research Team 230 chose to adopt CII RT123’s definition and clarify its meaning by providing specific examples of what could constitute a “lesson learned.” The definition developed for a lesson learned is the following:

Knowledge gained from experience, successful or otherwise, for the purpose of improving future performance. Examples include:

- o A lesson learned that is incorporated into a work process*
- o A tip to enhance future performance*
- o A solution to a problem or a preventative action*
- o A lesson that is incorporated into a policy or a guideline*
- o An adverse situation to avoid*

Some organizations believe that lessons learned must be incorporated into work processes while others believe that a lesson is anything that will improve organizational performance. Therefore, it is important to customize the definition of lessons learned to fit the needs of each organization. No matter the specific definition used, lessons learned are always used to help an organization achieve its business needs and goals (Weber 2001).

A lesson learned program consists of the people, processes, and tools that support the collection, analysis, and implementation of validated lessons learned in organizations. The ultimate goal of such a program is to add value to the organization by promoting the communication of information. The use of a lessons learned program helps to implement knowledge management within the organization by collecting and disseminating information and experiences. People, processes, and technologies are crucial to the implementation of an effective lessons learned program (Collision 2004). People are the source of organizational knowledge, and their support and involvement in the program

generate results. Processes and practices within the organization must be generated to allow for easy knowledge collection and sharing. Furthermore, technologies must facilitate knowledge transfer between individuals. Emphasis on any one of these areas will cause the program to shift off-balance; therefore, organizations must strive to focus on all three areas equally.

Lessons learned programs can be classified further as formal or informal. Formal lessons learned programs employ a standard, documented work process for lessons learned. They also are consistent across an organization and are well-resourced. Informal programs, on the other hand, are more inconsistent and ad-hoc. These programs may even be a grassroots effort with no official action taking place.

There are multiple facets to a lessons learned program that must be used effectively in order to make the effort a success. The characteristics will be explored in detail in subsequent sections of this report.

3.3 THE LESSONS LEARNED PROCESS

CII Research Team 123 found that the lessons learned process includes three key steps: collection, analysis, and implementation. These actions are shown in Figure 3.

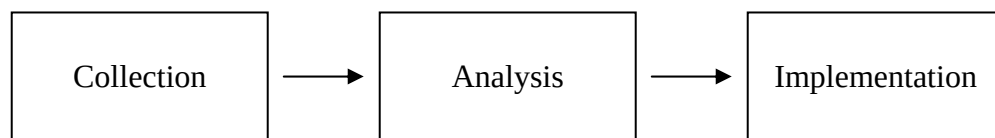


Figure 3: The Three Main Steps of the Lessons Learned Process

Collection is the gathering of knowledge and experiences from individuals in the organization. Individuals may submit lessons by electronic means or by communicating ideas in formalized workshops. Collection can occur at various stages of project execution by different members of the organization, including project managers and

project teams. After lessons are collected, they must be analyzed and validated before they are disseminated through the organization. Analysis can be conducted in a team setting or by an individual. This crucial portion of the lessons learned process guarantees that the information shared throughout the organization is correct and easily interpreted. Lastly, the lesson is implemented. This step is extremely important since lessons can only help an organization if they are put into action (Collision 2004). Implementation can take many forms, ranging from publication of lessons in an electronic database to the changing of practices and procedures to reflect lessons learned.

In addition to this high-level process flow, CII Research Team 123 also addressed the transactional lessons learned work process in Research Report 123-11. This analysis will be given later in this report.

3.4 IMPORTANCE AND POTENTIAL BENEFITS OF LESSONS LEARNED PROGRAMS

The use of a lessons learned program helps to disseminate knowledge. When information is not communicated throughout an entire organization, the same problems continue to resurface and solutions have to be reinvented (Harrison 2003). However, a lessons learned program can help to bridge the communication gap, allowing employees to use previous solutions and focus on new problems. A lessons learned program also communicates essential information that can help to solve critical problems. Transferring knowledge through lessons learned can help project teams increase efficiency, which is extremely important in the current fast-paced construction industry environment (Disterer 2002). Furthermore, competencies and skills acquired by members of project teams should remain within the organization, even if an employee moves or retires. Documenting and implementing lessons can help communicate knowledge throughout an entire organization and eliminate the need to rely on one individual. Lessons learned allow construction organizations to document project experiences so that each

organization as a whole can learn from one person's actions (Kotnour 2000). The lessons learned process can also play a key role in the continuous improvement of an organization. By using the program, employees learn from one another and ultimately improve business practices. Organizations that use lessons learned show their commitment to continuous improvement to serve their clients better. Some organizations have even used lessons learned programs to differentiate themselves from the competition and win work (Carrillo 2005).

Though data on the benefits of a lessons learned program are difficult to come by, past research suggests that the lack of hard numbers does not inhibit organizations from implementing a program. In general, the consensus is that lessons learned programs are intrinsically valuable. Notably, in 1998, the US Army Corps of Engineers hired a consultant to conduct a three year economic analysis of the Design Review Checking System (DrChecks) and Corporate Lessons Learned (CLL). The US Army Corps of Engineers developed the Design Quality Lessons Learned (DQLL) system, which serves as a subject matter repository. DrChecks is a component of the system that works seamlessly with CLL, collecting lessons during the design and construction phases of projects. DQLL is one of the most successful lessons learned systems to date with consistently high reported usage by the US Army Corps of Engineers and some affiliates (Gerber 2004). In the economic analysis, a prototype of the software was studied in three districts (Seattle, Huntington, and Baltimore) to monitor the input and use of the lessons in the system and the economic benefits of lessons learned and costs to start up and maintain a program. Though 25,000 comments were logged during this time, 29 were locally-approved as lessons learned. The consulting firm calculated that the savings associated with the reuse of the 29 identified lessons was \$672,000 annually and each lesson learned reduced the developing district's construction cost by 0.02% per year or

\$23,000 per lesson. Throughout the US Army Corps of Engineers, the potential savings was reported to be \$53M for the 29 lessons over a span of seven years. The non-recurring cost per initial prototype user was \$5800 and the recurring cost per user annually was reportedly \$29,000, but for every \$1 invested by the US Army Corps of Engineers, a savings of \$120 could be anticipated (East 2002).

3.5 EXAMPLES OF EXISTING LESSONS LEARNED PROGRAMS

Although many construction organizations understand the usefulness of lessons learned, the concept is not pervasive throughout the industry; only a few firms have been able to systematically identify and transfer meaningful knowledge from current projects to future projects (Disterer 2002). Many more organizations outside of the construction arena have successfully implemented lessons learned programs. Information about many of these programs is documented on the internet and in publications. For example, the U.S. Department of Energy (DOE) has an award-winning documented lessons learned program (Carnes 2002). The program was developed by a process improvement team in 1994, and documentation describing the system is widely accessible to employees and the general public. Approximately 200 DOE employees participate in the Society of Effective Lessons Learned Sharing, a volunteer community of practice that provides feedback and guidance for the lessons learned program. This society also actively promotes lessons learned at all DOE sites. In addition, the DOE lessons learned program also employs a database website for lesson submission and implementation (United States Department of Energy 2006).

Military organizations are required to both record and refer to lessons learned. The United States Air Force, Army, Navy, Marines Corps, and Coast Guard all employ lessons learned to help support operations (United States Department of Defense 2006). All of these organizations view lessons learned as a necessity for the safety of their troops

and the success of their missions. More information about the Center for Army Lessons Learned (CALL) is provided in the case study portion of this report.

The European Union and Environmental agencies, such as the Environmental Protection Agency (EPA) have also implemented lesson learned database systems to gather information in order to “prevent major accidents and mitigate their consequences” (Balasubramanian 2002). For example, the Accidental Release Information Program database was developed to determine the cause of chemical releases and determine a way to prevent them from recurring. The EPA also developed the Major Accident Reporting System to collect information to use as a basis for producing lessons learned in order to prevent major accidents and mitigate their consequences.

Furthermore, the Federal Highway Administration has begun to focus on continuous quality improvement, using lessons learned as one mechanism for this program. For example, Boston’s Central Artery/Tunnel (“Big Dig”) Project’s collection of lessons has already proven useful to other projects of the same nature, including major works like Utah’s Interstate 15 Corridor Reconstruction project and Denver’s Transportation Expansion project, T-REX (Allen 2004). Additionally, mega highway projects have benefited significantly from using the internet to share information and discuss lessons learned at conferences, meetings, and site visits.

The National Aeronautics and Space Administration (NASA) uses various means to communicate lessons from past programs and projects. NASA uses an engineering network that “promotes learning and sharing among NASA engineers” (NASA 2006). This system provides employees with lessons learned and other knowledge tools in order to increase organizational effectiveness. The NASA Engineering Network is sponsored by the NASA Office of the Chief Engineer in the hope that it will enhance learning and collaboration among NASA employees. In addition to their Lessons Learned Information

System (LLIS), recently NASA has begun sharing lessons learned with the general public through its public lessons learned system, PLLS (GAO 2002).

Even professional organizations such as the Association of Soil and Foundation Engineers, the National Fire Protection Association, and the National Bureau of Standards have attempted to collect and disseminate performance and failure information to members in their specific disciplines (Kartam 1996). In the United States, the federal and state fire agencies and the National Park Service commissioned the Wildland Fire Lessons Learned Center, which serves as a learning resource center among all fire professionals. The Wildland Fire LLC was recognized in 2006 for its significant contributions in the areas of firefighter preparedness, training, and safety (Wildland Lessons Learned Center 2007). All of these organizations use lessons learned systems to share knowledge between members to improve industry practices and enhance organizational learning.

Lessons learned programs are also used outside of the United States. The Canadian Army employs lessons learned to “support Army learning processes” (Canadian Army Lessons Learned Centre 2006) and the United Nations collects lessons to determine peacekeeping best practices (United Nations Department of Peacekeeping Operations 2006). The World Bank has even used lessons learned to avoid unnecessary mistakes and achieve better results in projects funded for developing countries (World Bank 2006). Recognizing the importance of institutional knowledge, the European Space Agency has also conducted top-level summits to determine effective methodologies for implementing lessons learned in their space programs (European Space Agency 2006).

3.6 EXAMPLES OF IT TOOLS FOR LESSONS LEARNED PROGRAMS

Some organizations have developed IT tools to launch their lessons learned programs. These systems typically allow a user to input a potential lesson for review,

accept or reject the input, and update or archive old lessons. Most lessons learned systems are Microsoft Windows based and web-accessible for global access, and many lessons learned IT tools are trending towards multimedia support to enable the attachment of video clips and images to lesson submissions (Nguyen 1998). Some examples describing the IT characteristics of existing lessons learned systems follow.

DQLL is a subject matter repository developed by the US Army Corps of Engineers that collects lessons learned in two ways: through DrChecks and manual submissions. The US Army Construction Engineering Research Laboratory (CERL) developed DrChecks as a way for multiple parties to review construction design documents and share comments over the internet using a client-server architecture (Nguyen 1998). In doing so, lessons are extracted from the comments input into the system, resulting in an enhanced corporate knowledge repository. The program is also seamlessly integrated with another CERL-developed software tool, CLL (Soibelman 2003). Though DrChecks/CLL was created expressly for the review of design documents, the software has the capability to support other documents, thus extending the system's functionality beyond the construction design and execution phases and beyond the industry itself. In addition, DQLL also supports the manual submission of potential lessons at any time, such as during construction or after-action reporting. Once a lesson is captured in DQLL, the database registry can be navigated via simple queries similar to those used in popular internet search engines. To keep the lessons "fresh" within the system, a DQLL manager assigns each validated lesson to an individual to "sunset" the lesson. It is the appointed individual's responsibility to fully incorporate the approved lesson into the appropriate work processes, manuals, guides, and specifications so that the lesson may be removed from DQLL. By sunsetting the lessons, the DQLL system remains current and manageable in size (Gerber 2004).

Since 1992 NASA has also supported a Lessons Learned Information System (LLIS), a web-based database that can be accessed by all employees to share knowledge and understanding gained through experience. Upon collecting lessons in the system, they are each indexed to enable ease of browsing/searching through the lesson database. Moreover, NASA's LLIS utilizes push technology to enable users with stored profiles to automatically receive e-mail notices when lessons matching their specific interests are published. The lessons are managed by a Lessons Learned Steering Committee (LLSC), which consists of members from all divisions of NASA. Ultimate leadership of the system falls in the hand of steering committee-appointed LLIS Curator who is responsible for operations and maintenance of the system. In addition, lessons learned are also communicated through training, program reviews, and revisions to agency policies.

The Indiana Department of Transportation (INDOT) developed the Constructability Support Multimedia System (CSMS), an IT tool to capture and store lessons primarily for design professionals. CSMS was one of the first lessons learned systems to support the inclusion of multimedia files with lesson submissions. The collection process begins with videotaped interview sessions between INDOT, designers, and contractors for lesson extraction. The system consists of four windows representing hierarchical levels, which narrow down from construction area to the actual lesson learned. At the fourth and narrowest level for lessons learned, query operations may be performed to search the lessons learned within the database, and at any time, the user may browse a higher level by selecting the appropriate level window. The major benefit of CSMS is its multimedia capabilities since many lessons can be easily retrieved from non-textual sources (Nguyen 1998).

3.7 LITERATURE REVIEW CONCLUSIONS

The literature review provided insight into the importance of knowledge management in today's business environment. The link between knowledge management and lessons learned was clearly revealed by many sources, and the three main steps of the lessons learned process were described. Research Team 230 proposed a revised lessons learned definition that includes examples of instances of lessons learned.

Many sources described the importance of lessons learned and their intrinsic contributions to organizations, most have been unsuccessful at providing a quantitative mechanism for calculating the value of an entire lessons learned program. In fact, only one organization, the US Army Corps of Engineers, was identified for measuring the economic impact of their lessons learned program over a period of time.

Some examples of IT tools were identified. However, no off-the-shelf software tool has been widely accepted to support organization-wide lessons learned programs applicable to all phases of a project life cycle.

Still lessons learned programs are pervasive in multiple industries for their understood benefits. The combined results of the literature review and internet searches revealed lessons learned success stories outside of the construction industry in the United States and all over the world. The information gathered suggests that government organizations have greater success than private organizations with lessons learned programs; however, this may be attributed to the proprietary nature of private firms.

Chapter 4. Phase I Survey

The first goal of this research effort was to get an overall “snapshot” of the current state of lessons learned programs in the construction industry. The Phase I Survey form, which can be found in Appendix C, was drafted to gather this information.

4.1 PHASE I SURVEY ADMINISTRATION

In order to be consistent with the previous CII research effort, the long survey developed by RT123 was used as a basis for the Phase I Survey. This survey focuses on the general characteristics of a lessons learned program including the “how, what, when, where, and why” of the three main phases of the lessons learned process: collection, analysis, and implementation. The survey also focuses on the people, processes, and technologies associated with lessons learned. Members of the research team reviewed the survey and provided feedback to the researchers before it was circulated. After gathering input from the research team and finalizing its structure, the survey was distributed to all CII-member organizations. The survey form was first distributed at the CII Board of Advisors meeting in November 2005. The researchers also followed up with all members of CII to solicit responses via e-mail. Data collection for this phase of the project was closed in January 2006.

4.2 PHASE I ANALYSIS

Once the surveys were returned, the researchers calculated the frequencies of each question response. These survey frequencies were categorized according to whether each respondent was considered an owner or contractor organization. The frequencies were also categorized according to whether each respondent indicated that their organization has a formal or informal lessons learned program.

During Phase I of the study, some organizations returned two or more unique, completed surveys. In order to analyze these submissions, the researchers synthesized the data into one “hybrid response” that reflected the data from all surveys. These responses were made by determining which answer was indicated most often by members of the organization. For example, if two survey responses indicated the answer to a question is “A” and one response indicated the answer is “B”, the hybrid response would state that the answer is “A”. This hybrid response was then entered into the Phase I Survey frequencies.

Some respondents did not answer every question in the Phase I survey. In order to clarify the results, the researchers have included the percentages in the tables in this part of this report. Furthermore, many of these percentages do not add up to 100 percent because as instructed, many respondents checked multiple boxes on each question.

4.3 PHASE I RESULTS

A total of 68 out of 95 potential CII-member organizations responded to the Phase I Survey from November 2005 to January 2006. Thirty seven surveys came from owner organizations, and the other thirty one surveys were from contractors.

The first question of the Phase I Survey gave an indication of the overall nature of an organization’s lessons learned program. If the respondent checked formal, then the process is most likely documented and supported; however, if he or she checked informal, the lessons learned program is more ad-hoc and may even be a grassroots effort. Table 1 illustrates the responses from Question 1.

Table 1: Types of Lessons Learned Programs

	RT230 (2006)			RT123 (1998)
	All (n = 68)	Owner (n = 37)	Contractor (n = 31)	All (n = 25)
Informal	32 (47%)	17 (46%)	16 (52%)	44%
Formal	32 (47%)	16 (43%)	15 (48%)	40%
Does not exist	4 (6%)	4 (11%)	0 (0%)	16%

Only 6 percent of the organizations who responded to the survey do not have a lessons learned program, which indicates an increase in the use of lessons learned since RT123's assessment in 1998 (Table 1). Because CII Research Report 123-11 did not provide a list of the organizations that participated in their survey, it was impossible for this research effort to directly compare the sub-samples. The remaining responses to Question 1 were evenly split between formal and informal programs, which indicate that more organizations use formal programs today than did eight years ago. It is also interesting to note that every respondent who indicated they do not have a lessons learned program is from an owner organization; all contractors reported have some type of lessons learned program.

Twenty organizations explained their future plans in Question 1a by indicating whether they planned to implement a formal lessons learned. Table 2 shows these responses.

Table 2: Future Plans to Implement a Formal Lessons Learned Program

	All (n = 20)	Owner (n = 11)	Contractor (n = 9)
Yes	14 (70%)	6 (55%)	8 (89%)
No	2 (10%)	2 (18%)	0 (0%)
Do not know	4 (20%)	3 (27%)	1 (11%)

This response shows that most organizations with an informal or non-existent lessons learned program plan to implement a formalized program in the future. Only two

organizations thought it was not necessary to have a lessons learned program as part of their business processes. When asked to explain this position, one organization stated that formal programs used in the past were not perceived to add much value because databases were rarely consulted. The other organization does not want to implement a formal lessons learned program because they are a small organization that effectively shares lessons learned within specialty groups.

The second question of the Phase I Survey asked organizations to categorize their lessons learned program. Table 3 shows the results.

Table 3: Categories of Lessons Learned Programs

	All (n = 63)	Formal (n = 32)	Informal (n = 31)	Owner (n = 33)	Contractor (n = 30)
Organization-wide	24 (38%)	20 (63%)	4 (13%)	12 (36%)	12 (40%)
Project specific	24 (38%)	6 (19%)	18 (58%)	11 (33%)	13 (43%)
Departmental	18 (29%)	8 (25%)	10 (32%)	14 (42%)	4 (13%)
Other	9 (14%)	4 (13%)	5 (16%)	5 (15%)	4 (13%)

The responses show that most organizations have an organization-wide or project-specific lessons learned program. Most organizations that indicated they had a formal lesson learned program also have an organization-wide program (63 percent), whereas most informal programs have a project-specific program (58 percent). Furthermore, far more owner organizations employ departmental programs as opposed to contractor organizations.

4.3.1 Collection Questions

Question 3 in the Phase I Survey presented a series of sub-questions about lessons learned collection. This question asked the respondent to give an indication of what type of lessons learned their organization collects. Table 4 illustrates the outcome.

Table 4: Categories of Collected Lessons Learned

	All (n = 62)	Owner (n = 32)	Contractor (n = 30)		All (n = 62)	Owner (n = 32)	Contractor (n = 30)
Construction	47 (76%)	27 (85%)	20 (67%)	Environmental	21 (34%)	15 (47%)	6 (20%)
Engineering/design	47 (76%)	27 (85%)	20 (67%)	Financial	16 (26%)	7 (22%)	9 (30%)
Safety	42 (68%)	25 (78%)	17 (57%)	Training	13 (21%)	6 (19%)	7 (23%)
Controls	40 (65%)	23 (72%)	17 (57%)	Other	9 (15%)	6 (19%)	3 (10%)
Quality/inspection	38 (61%)	22 (69%)	16 (53%)	All	7 (11%)	2 (6%)	5 (17%)
Procurement	35 (56%)	19 (59%)	16 (53%)	Manufacturing	5 (8%)	3 (9%)	2 (7%)
Technology	29 (47%)	15 (47%)	14 (47%)	Marketing	3 (5%)	0 (0%)	3 (10%)
Human Factors	27 (44%)	16 (50%)	11 (37%)				

Seventy-six percent of all respondents indicated that they collect lessons learned relating to construction, engineering, or design. Most organizations also collect safety and controls lessons learned. There is not a large difference between the responses from owners and contractors; almost every organization collects the same type of information.

Question 4 asked how lessons learned are collected within the organization. Table 5 shows the responses.

Table 5: How Lessons Learned are Collected

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Meetings/interviews	45 (73%)	20 (63%)	25 (83%)	25 (78%)	20 (67%)
Electronically	38 (61%)	29 (91%)	9 (30%)	22 (69%)	16 (53%)
Paper forms	22 (35%)	12 (38%)	10 (33%)	13 (41%)	9 (3%)
Word of mouth	13 (21%)	4 (13%)	9 (30%)	7 (22%)	6 (20%)
Outside consultant	5 (8%)	4 (13%)	1 (3%)	4 (13%)	1 (3%)
Other	2 (3%)	0 (0%)	2 (7%)	1 (3%)	1 (3%)

Lessons are typically collected in meetings or interviews. Technology tools are also commonly used to collect lessons. Most organizations that consider their programs to be formalized use an electronic method to collect lessons, unlike informal programs that typically use meetings and interviews.

The fifth question asked who in each organization who in each organization collects lessons learned. Table 6 shows these results.

Table 6: Who Collects Lessons Learned

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Project manager	31 (50%)	13 (41%)	18 (60%)	19 (59%)	12 (40%)
Other	18 (29%)	10 (31%)	8 (27%)	9 (28%)	9 (30%)
LLP coordinator	17 (27%)	15 (47%)	2 (7%)	10 (31%)	7 (23%)
The Lessons Learned initiator	17 (27%)	10 (31%)	7 (23%)	7 (22%)	10 (33%)
Project department	16 (26%)	6 (19%)	10 (33%)	12 (38%)	4 (13%)
Lessons Learned team	9 (15%)	7 (22%)	2 (7%)	7 (22%)	2 (7%)
IT department	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Outside consultant	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Many organizations make project managers responsible for collection. A large percentage answered “other” to this question. These responses differ greatly from one another, but multiple organizations designated the “quality group” as a responsible party for lessons learned collection. Most of the organizations that use a lessons learned process coordinator to collect lessons also have a formalized process. No organization places collection responsibility on the IT department or on an outside consultant.

The sixth question was the final question relating to lesson learned collection. This question asked respondents when lessons are collected in their organization. Table 7 shows the results.

Table 7: When Lessons are Collected

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
At the end of the project	44 (71%)	19 (60%)	25 (83%)	22 (69%)	22 (73%)
At the time of its occurrence	32 (51%)	24 (75%)	8 (27%)	17 (53%)	15 (50%)
At project milestones	15 (24%)	13 (41%)	2 (7%)	9 (28%)	6 (20%)
At pre-determined periods	13 (21%)	9 (28%)	4 (13%)	6 (19%)	7 (23%)
Other	9 (15%)	4 (13%)	5 (17%)	5 (16%)	4 (13%)

Organizations typically collect lessons at the end of a project. Additionally, over half of the respondents collect lessons as they occur. The results for owners and contractors do not differ from one another on this item; however, most organizations with a formal lessons learned program collect lessons at the time of the occurrence and most informal programs collect lessons at the end of the project.

4.3.2 Analysis Questions

Question 7 began a series of questions about lessons learned analysis. This question asks the surveyed organizations how they conduct analysis procedures. Table 8 illustrates the responses.

Table 8: How Lessons are Analyzed

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
At meetings	38 (61%)	20 (63%)	18 (60%)	22 (69%)	16 (53%)
By a subject matter expert	26 (41%)	20 (63%)	6 (20%)	14 (44%)	12 (40%)
Informally	25 (40%)	4 (13%)	21 (70%)	15 (47%)	10 (33%)
Other	11 (18%)	7 (22%)	4 (13%)	5 (16%)	6 (20%)
Electronically	6 (10%)	6 (19%)	0 (0%)	2 (7%)	4 (13%)
By an outside consultant	1 (2%)	1 (3%)	0 (0%)	1 (3%)	0 (0%)

These results indicate that most analysis takes place in a team setting at meetings. Many organizations also rely on subject matter experts to analyze lessons. Almost 20 percent of the respondents indicated that they use methods not included in the options provided. Some of these other methods include using a lessons learned review team and the quality department to review lessons. Other organizations indicated that they do not have an analysis procedure in place. Owners and contractors typically carry out analysis in the same fashion, but a difference can be seen between formal and informal programs. Many formal programs use subject matter experts to analyze lessons, whereas informal programs typically conduct analysis in a meeting session. It is also interesting to note that

only 10 percent of all analysis is conducted electronically. This indicates that most organizations do not use any type of automated tool to analyze lessons.

The next question (8) asked the respondents to indicate the type of analyses conducted in their organization to validate lessons learned. These results can be found in Table 9.

Table 9: Types of Analyses Used for Validation

	All (n = 59)	Formal (n = 30)	Informal (n = 29)	Owner (n = 32)	Contractor (n = 27)
Applicability to new projects	37 (63%)	22 (73%)	15 (52%)	21 (66%)	16 (59%)
Cost/benefit (subjective analysis)	36 (61%)	21 (70%)	15 (52%)	20 (63%)	16 (59%)
Quality of data	18 (30%)	15 (50%)	3 (10%)	9 (28%)	9 (33%)
Corporate / department/ regulatory compliance	17 (29%)	11 (37%)	6 (21%)	9 (28%)	8 (29%)
Elimination of duplicate entries	16 (27%)	13 (43%)	3 (10%)	7 (22%)	9 (33%)
Legal implications	16 (27%)	10 (33%)	6 (21%)	5 (16%)	11 (41%)
Review of existing data for relevance	16 (27%)	8 (27%)	8 (28%)	11 (34%)	5 (19%)
Prioritization	12 (20%)	8 (27%)	4 (14%)	6 (19%)	6 (22%)
Other	9 (15%)	4 (13%)	5 (17%)	5 (16%)	4 (15%)

During analysis, most organizations determine a lesson's applicability to new projects and the subjective analysis cost of its implementation compared to the benefit the organization would experience. Most of the responses to this question do not differ between owner and contractors or between formal and informal programs.

The ninth question of the Phase I survey asked who in each organization analyzes lessons and deems them suitable for implementation. Table 10 displays the results.

Table 10: Parties that Conduct Analysis

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Internal team	35 (56%)	20 (63%)	15 (50%)	20 (63%)	15 (50%)
One individual (e.g.: subject matter expert)	23 (37%)	15 (47%)	8 (27%)	11 (34%)	12 (40%)
Other	18 (29%)	6 (19%)	12 (40%)	11 (34%)	7 (23%)
Outside consultant	1 (2%)	0 (0%)	1 (3%)	0 (0%)	1 (3%)

Organizations typically use an internal team to analyze lessons, while some have one individual conduct analysis. Many organizations answered “other” to this question and indicated that their analysis procedure is ad-hoc and informal. The answers from owners and contractors are very similar.

Question 10 asked when lessons learned are analyzed. The results to this question are shown in Table 11.

Table 11: When Lessons Learned are Analyzed

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
At the end of the project	26 (42%)	8 (25%)	18 (60%)	16 (50%)	10 (33%)
Continuously	19 (31%)	13 (41%)	6 (20%)	9 (28%)	10 (33%)
As they are collected	16 (26%)	10 (31%)	6 (20%)	9 (28%)	7 (23%)
Other	13 (21%)	7 (22%)	6 (20%)	8 (25%)	5 (17%)
At project milestones	8 (13%)	6 (19%)	2 (7%)	5 (16%)	3 (10%)
On a schedule (e.g.: monthly)	6 (10%)	5 (16%)	1 (3%)	3 (9%)	3 (10%)

These responses indicate a variety of approaches to the timing of analysis during the process. The answers from owner and contractor organizations are very similar for this question. However, formal organizations differ from informal organizations; formal programs typically analyze lessons continuously or as they are collected, whereas informal programs tend to conduct analysis at the end of projects. Some of the “other” responses to this question suggest that analysis is not conducted in some organizations. Some respondents indicated that analysis is done before projects begin.

4.3.3 Implementation Questions

The next question (11) began the implementation section of the Phase I Survey by asking how lessons are implemented. Table 12 shows the results.

Table 12: How Lessons are Implemented

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
At meetings	28 (45%)	12 (38%)	16 (53%)	14 (44%)	14 (47%)
As part of changes to a work process	28 (45%)	16 (50%)	12 (40%)	16 (50%)	12 (40%)
At project kickoffs	27 (44%)	14 (44%)	13 (43%)	11 (34%)	16 (53%)
Through electronic databases	26 (42%)	21 (66%)	5 (17%)	14 (44%)	12 (40%)
Through training	22 (35%)	11 (34%)	11 (37%)	12 (38%)	10 (33%)
Informally	21 (34%)	7 (22%)	14 (47%)	14 (44%)	7 (23%)
As changes to ongoing projects	14 (23%)	11 (34%)	3 (10%)	6 (19%)	8 (27%)
Other	9 (15%)	6 (19%)	3 (10%)	7 (22%)	2 (7%)
In hard-copy files	6 (10%)	3 (9%)	3 (10%)	2 (6%)	4 (13%)

Many organizations implement lessons in meetings or by changing their work processes. More owners try to incorporate lessons into work practices, and more contractors use lessons at project kick-offs. There is a striking difference between how formal and informal programs implement lessons. Sixty-six percent of all formal programs use an electronic database to implement lessons; however, only 17 percent of informal programs use this type of resource. In addition, only 22 percent of formal programs use informal methods for lesson implementation, whereas 47 percent of informal programs rely on these informal means to execute lessons.

Question 12 asked organizations to describe the parties responsible for lessons learned implementation. Table 13 shows the results.

Table 13: Parties Responsible for Lessons Learned

	All (n = 61)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Members of future projects	35 (57%)	17 (53%)	18 (60%)	18 (56%)	17 (57%)
The entire organization	35 (57%)	21 (66%)	13 (43%)	16 (50%)	19 (63%)
The contributor's project or organization	21 (34%)	9 (28%)	12 (40%)	14 (44%)	7 (23%)
Other	10 (16%)	7 (22%)	3 (10%)	6 (19%)	4 (13%)
The contributor	9 (15%)	9 (28%)	5 (17%)	4 (13%)	5 (17%)
Outside contractors	4 (7%)	2 (6%)	2 (7%)	4 (13%)	0 (0%)

Both contractors and owners rely on members of future projects and their entire respective organization to implement lessons learned. These results were also typical for organizations that have either formal or informal lessons learned programs.

The next question attempted to identify when lessons learned are implemented in a project lifecycle. A summary of the responses is shown in Table 14.

Table 14: When Lessons Learned are Implemented in the Project Lifecycle

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Project planning	35 (56%)	18 (56%)	17 (57%)	20 (63%)	15 (50%)
No set time	21 (34%)	11 (34%)	10 (33%)	11 (34%)	10 (33%)
Project execution	15 (24%)	5 (16%)	10 (33%)	6 (19%)	9 (30%)
Other	8 (13%)	6 (19%)	2 (7%)	4 (13%)	4 (13%)

More than half of the surveys indicated that lessons are typically implemented during project planning. This response was consistent in both owner and contractor organizations as well as in formal and informal lessons learned programs.

4.3.4 Lessons Learned Process Questions

Question 14 asked how employees retrieve lessons learned. Table 15 shows these answers.

Table 15: How Employees Retrieve Lessons Learned

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Electronic database	27 (44%)	18 (56%)	9 (30%)	14 (44%)	13 (43%)
Web-based system	25 (40%)	18 (56%)	7 (23%)	16 (50%)	9 (30%)
As part of descriptions of work processes	18 (29%)	8 (25%)	10 (33%)	10 (31%)	8 (27%)
At meetings	18 (29%)	2 (6%)	15 (50%)	10 (31%)	8 (27%)
Hard-copy files	10 (16%)	3 (9%)	7 (23%)	6 (19%)	4 (13%)
Other	7 (11%)	1 (3%)	6 (20%)	2 (6%)	5 (17%)

Many organizations have moved away from using hard-copy files and now conduct lessons learned retrieval using IT tools such as electronic databases and web-based systems. Lessons are also retrieved through work process descriptions and meetings. The responses are uniform between owner and contractor organizations. However, informal lessons learned programs tend to use meetings for lessons learned retrieval while formal programs use electronic databases and web-based systems.

Next, the Phase I Survey asked respondents to indicate who manages his or her organization's lessons learned program. These responses are shown in Table 16.

Table 16: Who Manages Lessons Learned Programs

	All (n = 62)	Formal (n = 32)	Informal (n = 30)	Owner (n = 32)	Contractor (n = 30)
Other	20 (32%)	12 (38%)	8 (27%)	12 (38%)	8 (27%)
LL Program coordinator	19 (31%)	17 (53%)	2 (7%)	9 (28%)	10 (33%)
Other senior managers	19 (31%)	8 (25%)	11 (37%)	9 (28%)	10 (33%)
Project managers	13 (21%)	2 (6%)	11 (37%)	7 (22%)	6 (20%)
IT department	1 (2%)	0 (0%)	1 (3%)	1 (3%)	0 (0%)

Many of the respondents chose "other" on this question, indicating that there is not a general agreement in this area. Written responses vary widely on this question; some organizations manage lessons in their knowledge management community while others leave this responsibility for each project's control. However, it is interesting to note that

over half of the organizations that indicated they have formal lessons learned programs also use a lessons learned program coordinator to manage the system.

Question 16 asked what types of resources are used in an organization's lessons learned program. Table 17 illustrates these answers.

Table 17: Resources used in Lessons Learned Programs

	All (n = 57)	Formal (n = 31)	Informal (n = 26)	Owner (n = 29)	Contractor (n = 28)
LL archive	29 (51%)	19 (61%)	10 (38%)	17 (57%)	12 (43%)
Software	25 (44%)	21 (68%)	4 (15%)	13 (45%)	12 (43%)
LL personnel	17 (30%)	13 (42%)	4 (15%)	8 (28%)	9 (32%)
Benefit/cost analysis	15 (26%)	8 (26%)	7 (27%)	7 (24%)	8 (29%)
Training modules	15 (26%)	8 (26%)	7 (27%)	9 (31%)	6 (21%)
Other	15 (26%)	6 (19%)	9 (35%)	8 (28%)	7 (25%)

Many organizations use a lessons learned archive and some type of software resource to facilitate their lessons learned program. The responses are fairly consistent between owner and contractor organizations. However, only 15 percent of all organizations with informal programs use software compared to 68 percent of formal programs. Most formal lessons learned programs also employ lessons learned personnel, unlike informal organizations.

The next question (17) determined the prevalence of legal issues in lessons learned programs by asking organizations if they had ever identified or faced any legal problems relating to lessons learned. Table 18 shows these responses.

Table 18: Organizations that have Faced Legal Issues

	All (n = 61)	Formal (n = 32)	Informal (n = 29)	Owner (n = 31)	Contractor (n = 30)
Yes	10 (16%)	8 (25%)	2 (7%)	4 (13%)	6 (20%)
No	40 (66%)	19 (59%)	21 (72%)	24 (77%)	16 (53%)
Do not know	11 (18%)	5 (16%)	6 (21%)	3 (10%)	8 (27%)

Although most respondent organizations have not identified any legal issues, approximately 16 percent perceive this as an important subject. Most of the organizations that answered yes to this question have a formal lessons learned program in place.

Question 18 asked the organization if metrics are used to assess the lessons learned program. Results are shown in Table 19.

Table 19: Organizations that use Metrics

	All (n = 61)	Formal (n = 32)	Informal (n = 29)	Owner (n = 31)	Contractor (n = 30)
Yes	16 (26%)	13 (41%)	3 (10%)	8 (26%)	8 (27%)
No	40 (66%)	16 (50%)	24 (83%)	21 (68%)	19 (63%)
Do not know	5 (8%)	3 (9%)	2 (7%)	2 (6%)	3 (10%)

Many organizations do not use metrics to assess their program. The respondents organizations that do use metrics also typically have formalized lessons learned programs.

The next question (19) asked the organization to describe how long they have had a lessons learned program. Answers to this question varied widely, but most organizations indicated that their program has been used for no longer than five years. Many organizations have had an informal program in the past and had recently upgraded to a more formalized program within the past couple of years.

Question 20 asked the respondents to indicate the approximate annual cost to maintain their lessons learned program. Only 17 organizations answered this question and

the responses varied so widely that the answers gave little indication of the approximate annual cost.

The final question of the Phase I Survey asked each respondent to indicate the effectiveness of his or her lessons learned program in terms of value added to the organization. The results are shown in Table 20.

Table 20: The Effectiveness of Lessons Learned Programs

	All (n = 61)	Formal (n = 32)	Informal (n = 29)	Owner (n = 31)	Contractor (n = 30)
Very effective	5 (8%)	5 (16%)	0 (0%)	1 (3%)	4 (13%)
Somewhat effective	38 (62%)	20 (63%)	18 (62%)	22 (71%)	16 (53%)
Neutral	12 (20%)	6 (19%)	6 (10%)	4 (13%)	8 (27%)
Not effective	6 (10%)	0 (0%)	6 (10%)	4 (13%)	2 (7%)
Detrimental	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Most respondents classify their lessons learned program as somewhat effective. Only 8 percent believe their program is very effective, indicating that there is plenty of room for improvement in use of lessons learned across the construction industry. It is also interesting to note that every organization that deemed their program as very effective, had a formal lessons learned program in place.

4.4 SUMMARY OF FINDINGS

The Phase I Survey illustrates the general status of lessons learned programs within the membership of CII. It asked questions relating to the collection, analysis, and implementation of lessons learned in addition to more specific questions about resources, legal issues, and metrics. The Phase I Survey responses show that lessons learned programs are probably more prevalent, and more formal, today than when the previous CII research was conducted in 1998.

The survey also indicates that lesson collection is typically conducted electronically or in meetings by project managers at the end of a project or at the time of

a lesson's occurrence. Furthermore, the responses show that analysis typically takes place at meetings with an internal team of subject matter experts. Most analysis determines the lesson's applicability to new projects and its cost compared to its benefit. Analysis is usually conducted either at the end of the project or continuously depending on the organization. In addition, the survey responses indicate that implementation typically takes place at meetings and as changes to the existing work processes, or retrieving lessons from an electronic database. The entire organization and members of future project teams are responsible for implementation, which typically takes place during project planning.

The Phase I Survey also showed that employees typically retrieve lessons learned through electronic databases or web-based systems, and that there is not a general agreement on who should manage lessons learned programs. Most organizations that responded to the survey also use a lessons learned archive and software to facilitate their program. Approximately 16 percent of the surveyed organizations have faced or identified legal issues related to lessons learned programs, and 26 percent of these organizations use metrics to assess their program's performance. Most lessons learned programs are less than five years old, and there is little information available on the approximate annual cost of maintaining a program. Most of the survey respondents also classified their programs as somewhat effective in adding value to the organization.

There was a distinct difference in Phase I Survey answers between organizations with formal programs and those with informal programs. Formal programs tend to categorize their program as organization-wide, and they collect lessons learned electronically at the time they occur. These formalized programs also employ a lessons learned coordinator to collect lessons and subject matter experts to analyze lessons. More formal programs have faced legal issues and use performance metrics to assess their

program. These formalized programs are also younger and are typically rated as somewhat effective or very effective.

Results from the Phase I Survey and RT230 discussions allowed the research team to identify the following seven key characteristics that affect the success of lessons learned programs:

- o Leadership
- o Lesson Collection
- o Lesson Analysis
- o Lesson Implementation
- o Resources
- o Maintenance and Improvement
- o Culture

These attributes became the main focus of the remaining research efforts; each area is explored further in surveys and case study interviews.